Transport for NSW

M5 Motorway Westbound Traffic Upgrade

Review of Environmental Factors

August 2022

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Acknowledgement of Country

Transport for NSW acknowledges Darug and Tharawal the traditional custodians of the land on which the M5 Motorway Westbound Traffic Upgrade is proposed.

We pay our respects to their Elders past and present and celebrate the diversity of Aboriginal people 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.

Transport for NSW is committed to honouring Aboriginal peoples' cultural and spiritual connections to the land, waters and seas and their rich contribution to society.

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Transport for NSW | August 2022

Prepared by Aurecon Australasia Pty Ltd and Transport for NSW

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Approval and authorisation

Title	M5 Motorway Westbound Traffic Upgrade Review of Environmental Factors
Accepted on behalf of Transport for NSW by:	Paul Nicholls Project Manager
Signed:	
Dated:	26/08/2022

Executive summary

The proposal

Transport for NSW proposes to upgrade the M5 Motorway westbound between Moorebank Avenue, Moorebank and the Hume Highway, Casula (the proposal). The proposal would ease congestion by improving connectivity between the M5 Motorway and the Hume Highway.

Key features of the proposal include:

- A new two-lane westbound M5 Motorway exit for Hume Highway traffic, located about 1.5 kilometres east of the existing Hume Highway exit. This exit ramp would include:
    - A grade separated underpass beneath Moorebank Avenue
    - A two-lane 290 metre long bridge over the Georges River, Southern Sydney Freight Line, and the T2 Inner West & Leppington and T5 Cumberland rail lines
- Removal of the current M5 Motorway westbound Hume Highway exit
- Upgrade of the M5 Motorway intersection with Moorebank Avenue to cater for future traffic demand
- Upgrade of the Moorebank Avenue westbound entry ramp maintaining access to the M5 Motorway and Hume Highway
- A new shared path on the southern side of the new Hume Highway exit ramp from Moorebank Avenue, across the Georges River on the new bridge and connecting to the Hume Highway and Lakewood Crescent
- Installation of new drainage infrastructure including:
    - Kerb and gutters, pits and pipes
    - Installation of a new operational spill basin under the new bridge, east of the Georges River
    - Removal of the existing spill basin near Yulong Close, Moorebank
- Intelligent Transport Systems (ITS) including installation and adjustments to traffic/SCATS detection, CCTV, a web camera, an emergency breakdown telephone and stopping bay, variable message signs (VMS) and backbone conduit
- Ancillary work associated with the proposal including:
    - Relocating, adjusting or protecting existing utility services that are in conflict with the proposal
    - Installation of new street lighting and various road furniture
    - Delineation including signage, line-marking and other items to facilitate road user safety of the new infrastructure
    - Landscaping
    - Property adjustments where necessary.

Construction is expected to take about 40 months to complete, assuming no unforeseen disruptions. Construction would be staged to minimise disruptions to transport customers and the community. There would be six construction areas across the proposal, with construction stages occurring concurrently to reduce construction time.

Need for the proposal

The section of the M5 Motorway between Moorebank Avenue and the Hume Highway (the proposal area) accommodates a variety of vehicle movements with high volumes of traffic. This includes access to industrial areas located on either side of the road corridor, including the Moorebank Logistics Park (MLP) at the southern end of Moorebank Avenue.

It is expected that the M5 Motorway will serve as a major transit link connecting south west Sydney with the future Western Sydney International Airport and Western Sydney Parklands. This will generate an overall increase in heavy and light vehicles.

Growth and development in south west Sydney has resulted in more vehicles using the M5 Motorway. This has resulted in travel time delays for motorists travelling westbound on the M5 Motorway particularly in the afternoon peak period. The existing configuration of the Moorebank Avenue and Hume Highway intersections (the proposal area) is a contributing factor for this issue.

Specifically, vehicles entering the motorway westbound from Moorebank Avenue (south), need to cross lanes with traffic wishing to exit the motorway for the Hume Highway. This scenario is referred to as a weaving movement. Weaving occurs when two or more traffic streams travelling in the same direction cross paths without the aid of traffic control. A weaving issue arises, as in this case, when there is only a short distance (and time) available to traffic entering the motorway, at speed, to undertake the necessary lane changes.

The current travel time delays on the M5 Motorway would be worsened if traffic arrangements and condition remain the same.

Crash data revealed that between January 2014 and December 2018, there were 224 reported crashes within the proposal area and connecting intersections of Heathcote Road in Moorebank/Wattle Grove and the Hume Highway in Casula/Liverpool. Crashes occurred up to 50 metres from the motorway at these intersections just outside of the proposal area.

The proposal would improve safety along the M5 Motorway for motorists travelling between Moorebank Avenue and the Hume Highway. The proposal would eliminate the existing weaving issue that occurs with vehicles travelling westbound entering the M5 Motorway from Moorebank Avenue. In particular, the potential benefits associated with the development and delivery of the proposal would include:

- Elimination of the existing weaving issue
- Improvement of traffic flow along the M5 Motorway, particularly westbound
- Improvement of motorist, cyclist, and pedestrian safety.

The need for upgrades to this section of the M5 Motorway has been identified in several NSW and local government strategic plans and policies. This includes Future Transport Strategy 2056 (NSW Government, 2018). The proposal would contribute to ‘supporting a strong economy’ by improving the efficiency and safety of the M5 Motorway. It would also contribute to the ‘safety and performance’ outcome of this strategy as well as form part of the ‘safe roads’ component of the Road Safety Plan 2021 (a supporting plan of the Future Transport Strategy 2056), which is aimed at reducing fatalities on NSW roads by 30 per cent by 2021 (Transport for NSW, 2018a).

Proposal objectives

The objectives of the proposal are:

- Maximise efficiency of the higher order road network

- Provide efficient and reliable access between the Moorebank Logistics Park precinct and the State road network
- Support the M5 Motorway as the key through-traffic connection for south west Sydney
- Support the growth of and access to the Liverpool Central Business District (CBD) through provision of an efficient arterial road access network
- Provide solutions that contribute to improved road safety outcomes
- Contribute to strategic land use outcomes including active transport and development of logistics facilities
- Incorporate necessary active transport measures to contribute to the improved performance of those modes.

Options considered

Transport for NSW identified eight preliminary options, of which three were short-listed, including constructing a collector ramp with an underpass at Moorebank Avenue (Option 1B), a collector ramp with an overpass at Moorebank Avenue (Option 2B) and braided ramps east of the Georges River (Option 4B).

These options were investigated and assessed with respect to the assessment criteria which included functional, socio-economic and environmental issues.

The collector ramp with an underpass at Moorebank Avenue (Option 1B) was selected as the recommended option. This option proved to be the most economically viable, had the least constructability issues, best fit with existing and strategically planned future road infrastructure and had the least visual and noise impacts.

Statutory and planning framework

The proposal is for road and road infrastructure facilities and is to be carried out by Transport for NSW. It 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 review of environmental factors (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.

The proposal would not have significant impacts on the environment or matters of national environmental significance. Therefore, the proposal can be assessed under Division 5.1 of the EP&A Act. No further planning approval requirements would be triggered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A Biodiversity Development Assessment Report or Species Impact Statement is not required under the *Biodiversity Conservation Act 2016* (BC Act).

Transport for NSW would require consent from the NSW Minister for Environment under the BC Act prior to carrying out work on land subject to a biodiversity stewardship agreement.

Community and stakeholder consultation

Transport for NSW carried out targeted community consultation on the recommended option between December 2019 and February 2020. This included key stakeholder committee meetings, community updates, media releases, community information sessions, door knocking, print and social media advertisements, and information uploaded to the project website.

Various government agencies and stakeholders have been consulted during the development of the proposal, including:

- The Australia Government (Department of Infrastructure, Transport, Regional Development and Communications)
- South west Sydney Local Health District
- Landowners / businesses affected by property acquisition and temporary construction leases
- Liverpool City Council
- NSW Barefoot Water Ski Club
- State Member for Holsworthy, Melanie Gibbons MP
- The local community.

The key issues raised were related to the overall design, noise impacts, traffic impacts and active transport. The issues were considered in the proposal design, options and assessment and have been addressed in this REF.

Consultation with Liverpool City Council and the State Emergency Services (SES) was carried out in accordance with clauses 2.10 and 2.13 of the State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP) as the proposal would be located on flood liable land and would require excavation of council roads. At the time of public display there were no concerns raised by these stakeholders.

Environment impacts

The main environmental impacts of the proposal are:

Noise and vibration

During construction, most residential properties would be either shielded from construction activities by existing noise barriers (which would reduce the noise levels at these properties), or the construction noise levels would not be substantially noisy in comparison to existing background noise levels (eg existing road noise from the M5 Motorway).

'Highly Intrusive' daytime construction noise impacts are predicted at the nearest residential properties located south of the M5 Motorway in Casula. The highest daytime construction noise impacts are expected during the following activities:

- Site establishment – worst-case noise levels predicted to exceed the construction noise management levels by greater than 20 decibels at the nearest residential properties
- Peak construction activities during utilities work, early work and earthworks – worst-case noise levels predicted to exceed the construction noise management levels by greater than 20 decibels at the nearest residential properties

During night-time construction periods, 'Moderately intrusive' and 'Highly intrusive' noise impacts are expected during the following activities:

- Peak utility work and earthworks – worst-case noise levels predicted to exceed the construction noise management levels by greater than 20 decibels at the nearest residential properties
- Bridge construction – worst-case noise levels predicted to exceed the construction noise management levels by up to 20 decibels at the nearest residential properties

- Widening and pavement work – worst-case noise levels predicted to exceed the construction noise management levels by up to 20 decibels at the nearest residential properties

The above worst-case noise impacts represent times when noise intensive equipment is being used. There would also 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.

Noise impacts from construction traffic are expected to be minimal where construction traffic uses existing busy roads such as the M5 Motorway or Moorebank Avenue due to high existing volumes of traffic on these major roads. A number of smaller local roads would also be used to access construction areas. Although existing traffic volumes would be relatively low on these local roads, the construction traffic is predicted to comply with the 55 dBA base criteria for local roads.

The main potential source of vibration during construction would be vibratory rollers, which would be required during peak road work, pathway installation and intersection upgrades. 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 Guidelines (Roads and Maritime, 2016).

The operational noise modelling results show that no residential receivers would experience an increase in traffic noise greater than two decibels (ie the proposal would not result in an increase in traffic noise greater than two decibels). However, as existing background noise levels in the proposal area are already high (ie existing road traffic noise not associated with the proposal), 81 residential receivers would experience noise levels above adopted operational noise criteria during operation of the proposal. To address existing road traffic noise impacts, noise mitigation measures would be considered including noise walls (where feasible and reasonable) and at-property treatment for properties that still experience noise levels exceeding the adopted criteria.

Traffic and transport

The proposal would have six construction areas, allowing for a staged approach to minimise disruptions during construction. These areas would require different traffic arrangements including reduction of speed limits along the M5 Motorway and Moorebank Avenue, temporary road layout modifications and temporary partial closures to the local road network. Transport for NSW would continue to consult with key stakeholders to minimise potential traffic impacts associated construction in these areas.

During operation, the proposal is expected to result in benefits to road users including:

- Improved efficiency with shorter queues and travel times westbound along the M5 Motorway
- Increased road safety with the elimination of the weaving issue westbound on the M5 Motorway from Moorebank Avenue to the Hume Highway
- Increased safety for cyclists and pedestrians with a shared user pathway connecting Moorebank Avenue and the Hume Highway, over the Georges River
- A potential decrease in the frequency of incidents and their associated traffic delays.

Hydrology and flooding

The proposal is located on flood prone land, which has the potential to be inundated during construction. The proposed ancillary facility is located on land that is prone to flooding in the five per cent annual exceedance probability (AEP) (ie flood once every 20 years) and there is the potential for loss and/or damage of plant, equipment and construction materials. The use of a temporary barge in the Georges River during construction may also pose a risk during flooding. However, the moveable nature of this barge reduces the risk as it could be moved to a safer location prior to a forecast flood event.

Construction impacts would be temporary, as the proposed ancillary facility and other construction working areas would be removed and rehabilitated at the completion of the construction work. In addition, the layout of proposed ancillary facility would be designed to minimise the potential flood impacts, such as siting of portable buildings and large unsecured construction objects on higher ground.

During operation, there would be no significant changes in the flood behaviour of the Georges River due to the proposal. There would be increases in peak flood levels of up to 20 millimetres upstream of the proposed bridge in flood events up to and including the probable maximum flood event. No additional properties are expected to be impacted by this increase. As design develops Transport would continue to investigate the potential impacts.

Surface water and groundwater

Construction of the proposal may impact surface water and groundwater through erosion, scouring of natural waterways, sedimentation, contamination, spills and leaks. The most direct impact to surface water would be the construction of the bridge across the Georges River, which may result in disturbance of the bed and bank of the watercourses, aquatic ecosystems and key fish habitat.

There is the potential for impacts to surface water and local groundwater during enabling work and earthworks for the proposed ancillary facility, as it is located in the Helles Park former landfill. Work completed south of the M5 Motorway and west of Moorebank Avenue, around the ABB Australia site, may also have the potential to release Polychlorinated biphenyls (PCBs) present on site into the surrounding waterways through disturbed soils. Mitigation measures would be implemented during construction to contain material on site and protect surface water and groundwater quality.

Potential impacts during operation include erosion and scouring around stormwater infrastructure and bridge piers. A new spill basin is proposed to be installed under the new bridge over the eastern side of the Georges River. This would accommodate the marginal increase in pollutant load due to the increased pavement footprint. These impacts would be negligible and would be managed through the appropriate design of proposed stormwater infrastructure.

Soils and contamination

Construction would have the following potential impacts on soils and contamination:

- Soil erosion and loss of topsoil as a result of vegetation removal, earthworks and excavation. Earthmoving activities have the potential to expose loose soils and mobilise these materials
- Spills and/or mobilisation of existing contaminating materials.

The area south of the M5 Motorway and west of Moorebank Avenue, including Helles Park former landfill and the ABB Australia Pty Ltd site, were identified as areas of potential environmental concern. The overall risk of these sites in regard to human health and the environment showed that there may be risk of direct contact with contaminated soils, incidental ingestion, inhalation of dusts, vapours or gases, water runoff and direct interaction with infrastructure. Appropriate remediation of the proposed ancillary facility at Helles Park (former landfill) would be required in advance of construction work commencing.

Mitigation measures to minimise contamination risks would be implemented during construction.

During operation, impacts on soils and contamination would be minimal with potential for indirect impacts on soils as a result of run-off and drainage. There is the potential for contaminated groundwater to interact with the proposed piers. This would be further investigated and design solutions identified during detailed design.

Biodiversity

The proposal would impact a total of 8.82 hectares of native vegetation, most of which is planted native and introduced roadside vegetation. In addition, the native plant community types including the Hinterland River-Flat Forest, Cumberland Shale Plains Woodland and Cumberland River-Flat Forest would be removed.

The proposal requires clearing of 0.23 hectares of vegetation on Commonwealth Land subject to Biobanking Agreement no. 341. A self-assessment using the process presented in the *Significant Impact Guidelines 1.2* (DOE, 2013b) determined that no significant impacts would occur and that a referral under the EPBC Act is not necessary.

Assessments of significance were carried out for threatened ecological communities and threatened species likely to occur in the proposal area. Potential habitat for the Cumberland Plain Land Snail and koalas was identified, however due to the condition/suitability of vegetation and the location of the proposal, no significant impact is expected. The proposal would be carried out in accordance with Transport for NSW's Biodiversity Policy and would therefore result in no net loss of biodiversity. With appropriate safeguards, the proposal is unlikely to have a significant impact on any listed threatened species, populations or ecological communities.

Aboriginal cultural heritage

While impacts on Aboriginal cultural heritage have been avoided where possible, there are some residual impacts. The proposal is located adjacent to the Georges River, with a higher potential for Aboriginal artefacts. Several Potential Aboriginal Deposits (PAD) sites have been identified within the vicinity of the proposal and although direct impacts are not expected there is the potential for artefacts to be uncovered during construction work. An assessment of potential impacts to identified PAD sites has been carried out to minimise risks to disturbance to any Aboriginal artefacts.

The design and construction methodology for the proposal would continue to be refined to further minimise impacts to Aboriginal cultural heritage.

Landscape character and visual

General construction activities would result in temporary visual impacts on views in the vicinity. These include the movement and operation of construction vehicles and plant, the clearance of vegetation, excavations and earthworks, erection of temporary structures (such as fencing and lighting) and the establishment of ancillary construction facilities. The greatest impact would be to residential properties that overlook the construction site due to their prolonged exposure. The magnitude of impact would depend on the stage of construction and the location of the work along the alignment.

During operation the proposal is not expected to have an impact on views in the vicinity. The new bridge would be adjacent to the existing bridge with a similar design.

Other impacts

Other impacts associated with the proposal, with a relatively minor impact, include:

- Aquatic ecology: the construction of the bridge across the Georges River has the potential to impact aquatic ecosystems particularly as the Georges River is a key fish habitat. Construction impacts to the river bed and aquatic ecology have been minimised through the proposed use of a temporary floating barge in the Georges River
- Non-Aboriginal heritage with the potential direct impacts from disturbance of former earthworks (training or practice trenches) relating to military occupation. There is the potential for indirect impacts to surrounding items from vibration.
- Socio-economic impacts from property acquisition. Consultation would be ongoing with affected landowners.

Justification and conclusion

The proposal would meet the proposal objectives and need to improve the safety and reliability associated with the use of the M5 Motorway. The need for the proposal has been driven by existing safety concerns for motorway users and the poor crash history westbound on the M5 Motorway between Moorebank Avenue and Hume Highway. The proposal is also aligned with several strategic policies and government strategies, such as *Future Transport Strategy 2056* (Transport for NSW, 2018a) and *Road Safety Plan 2021 – Towards Zero* (NSW Government, 2018a).

There would be some environmental impacts from the proposal; however, they have been avoided or minimised wherever possible through design and site-specific safeguards. The proposal would not result in any significant negative long-term impacts on society, the biophysical environment or the local economy. On balance, the beneficial effects of improving safety and motorway efficiency are considered to outweigh the mostly temporary adverse impacts and risks associated with the proposal.

Overall, the proposal is justified on the basis that it best meets the proposal objectives and results in long term benefits on safety and reliability that would outweigh potential adverse construction impacts.

Display of the review of environmental factors

This REF is on display for comment for 28 calendar days. Communication and consultation activities planned to coincide with the public display of the REF include a community update, face to face as well as online community consultation and advertising in local newspapers. You can access the documents in the following ways:

Internet

The documents are available as pdf files on the Transport for NSW website at https://roads-waterways.transport.nsw.gov.au/projects/m5-motorway-westbound/index.html

Copies by request

Printed and electronic copies are available by contacting 1800 519 525 or m5moorebank@transport.nsw.gov.au noting that there may be a charge for hard copies, CD or USB.

Community information sessions

A number of community information sessions will be held to provide the community and stakeholders with an opportunity to ask the project team questions and seek further information. Community will be invited to attend one of the following sessions:

- Moorebank Logistics Park Sales Suite, Above Piccolo Me

400 Moorebank Avenue, Moorebank, 2170

Thursday 8 September – 4 pm – 6 pm

- Casula Powerhouse Arts Centre

1 Powerhouse Road, Casula, 2170
Saturday 17 September – 10 am – 1 pm

Livestream with project team

In addition to the drop in sessions, an online session via MS Teams will also be held:

Wednesday 7 September 2022 – 4 pm – 4:30 pm
The session can be joined at nswroads.work/m5wbinfosession

How can I make a submission

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

- M5 Motorway westbound traffic upgrade, PO Box 973, Parramatta NSW 2124.
- M5moorebank@transport.nsw.gov.au.

Submissions must be received by 25 September 2022. Submissions will be managed in accordance with the Transport for NSW Privacy Statement which can be found here https://home.transport.nsw.gov.au/documents/sppreview/87fb1a25-0d26-496b-8720-951b850d654e or by contacting privacy@transport.nsw.gov.au for a copy.

What happens next

Transport for NSW will collate and consider the submissions received during public display of the REF.

After this consideration, Transport for NSW will determine whether or not the proposal should proceed as proposed, or whether changes are required to be made to the proposal based on feedback received during public display of the REF. Transport for NSW will inform the community and stakeholders of its decision.

If the proposal is determined to proceed, Transport for NSW will continue to consult with the community and stakeholders prior to and during construction.

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1 Introduction

1.1 Proposal identification

Transport for NSW proposes to upgrade the M5 Motorway westbound between Moorebank Avenue, Moorebank and the Hume Highway, Casula (the proposal). The proposal would ease congestion by improving connectivity between the M5 Motorway and the Hume Highway.

Key features of the proposal include:

- A new two-lane westbound M5 Motorway exit for Hume Highway traffic, located about 1.5 kilometres east of the existing Hume Highway exit. This exit ramp would include:
  - A grade separated underpass beneath Moorebank Avenue
  - A two-lane 290 metre long bridge over the Georges River, Southern Sydney Freight Line, and the T2 Inner West & Leppington and T5 Cumberland rail lines
- Removal of the current M5 Motorway westbound Hume Highway exit
- Upgrade of the M5 Motorway intersection with Moorebank Avenue to cater for future traffic demand
- Upgrade of the Moorebank Avenue westbound entry ramp maintaining access to the M5 Motorway and Hume Highway
- A new shared path on the southern side of the new Hume Highway exit ramp from Moorebank Avenue, across the Georges River on the new bridge and connecting to the Hume Highway and Lakewood Crescent
- Installation of new drainage infrastructure including:
  - Kerb and gutters, pits and pipes
  - Installation of a new operational spill basin under the new bridge, east of the Georges River
  - Removal of the existing spill basin near Yulong Close, Moorebank
- Intelligent Transport Systems (ITS) including installation and adjustments to traffic/SCATS detection, CCTV, a web camera, an emergency breakdown telephone and stopping bay, variable message signs (VMS) and backbone conduit
- Ancillary work associated with the proposal including:
  - Relocating, adjusting or protecting existing utility services that are in conflict with the proposal
  - Installation of new street lighting and various road furniture
  - Delineation including signage, line-marking and other items to facilitate road user safety of the new infrastructure
  - Landscaping
  - Property adjustments where necessary.

Construction is expected to take about 40 months to complete, assuming no unforeseen disruptions. Construction would be staged to minimise disruptions to transport customers and the community. There would be six construction areas across the proposal, with construction stages occurring concurrently to reduce construction time.

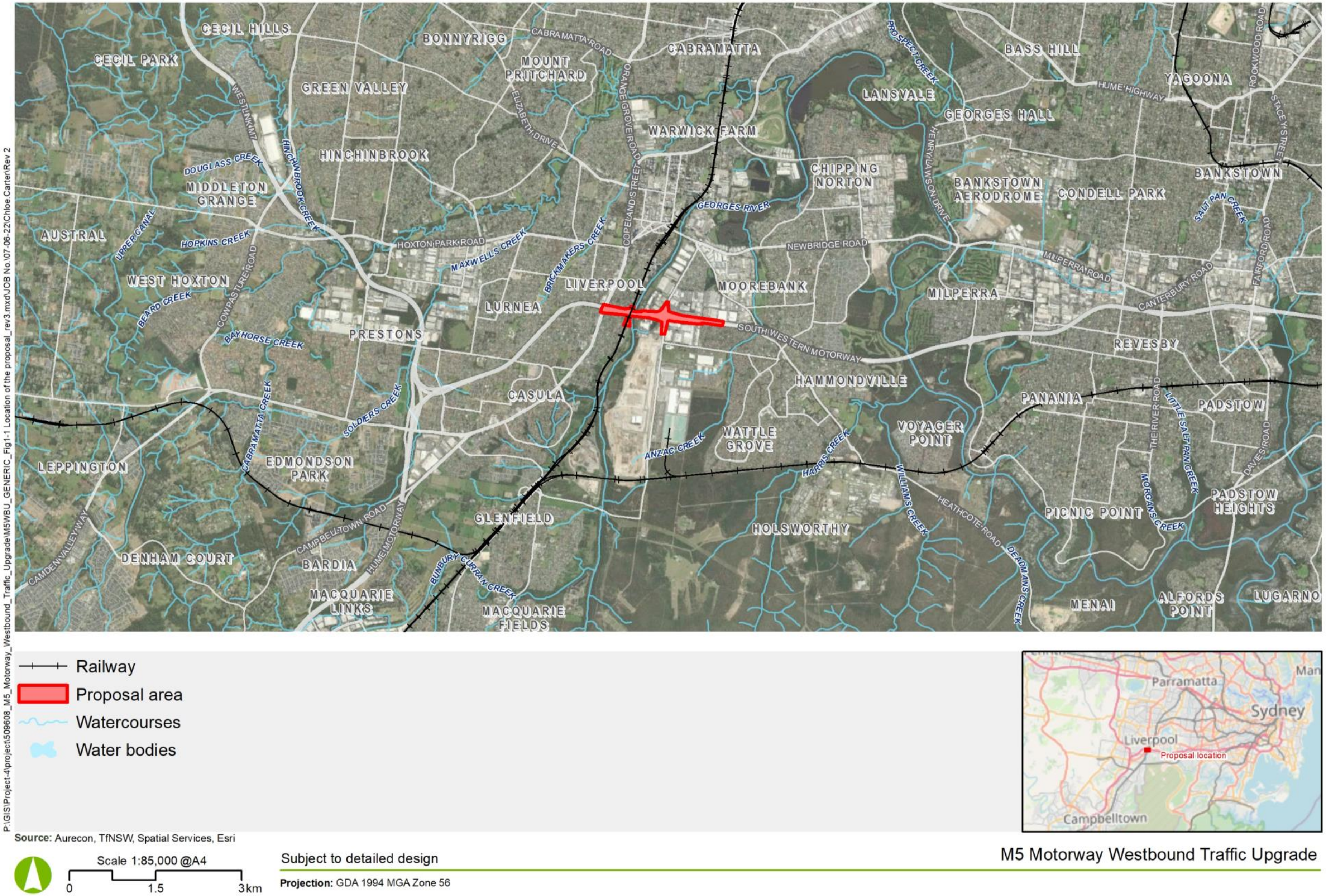


Figure 1-1 Location of the proposal

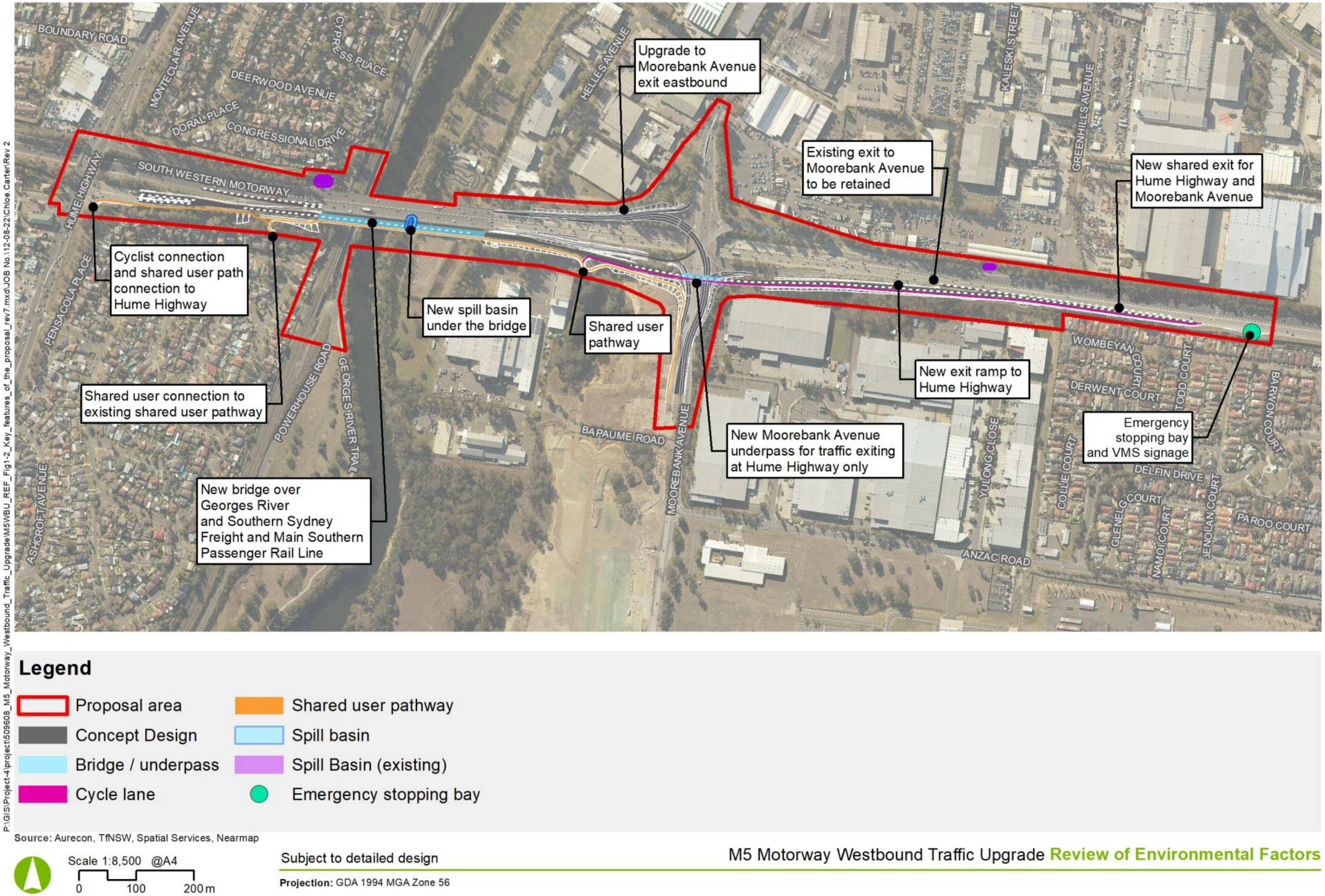


Figure 1-2 Key features of the proposal

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Aurecon Australasia Pty Ltd (Aurecon) on behalf of Transport for NSW. For the purposes of these works, Transport for NSW 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 carried out in the context of Section 171 of the Environmental Planning and Assessment Regulation 2021, the factors in Guidelines for Division 5.1 assessments (DPE, 2022), Roads and Related Facilities EIS Guideline (DUAP 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the *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 Transport for NSW 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 strategic assessment approval granted by the Federal Government under the EPBC Act in September 2015, with respect to the impacts of Transport for NSW's road activities on nationally-listed threatened species, ecological communities and migratory species.

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 if 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 Climate Change, Energy, the Environment and Waste 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

The M5 Motorway currently operates as the key through-traffic arterial connection for south west Sydney. It is used by local and regional motorists, freight carriers and businesses, and supports economic and residential growth in the Western Sydney region. The section of the M5 Motorway within the proposal area (refer to Figure 1-2) accommodates a variety of traffic movements to and from the Hume Highway and Moorebank Avenue, in addition to heavy through-traffic connections to the surrounding motorway network.

Road safety

Growth and development in the proposal area and south west Sydney has resulted in more vehicles using the M5 Motorway. This has resulted in travel time delays for motorists travelling westbound on the M5 Motorway particularly in the afternoon peak period. The existing configuration of the Moorebank Avenue and Hume Highway intersections is a contributing factor for this issue.

Specifically, vehicles entering the motorway westbound from Moorebank Avenue (south), need to cross lanes with traffic wishing to exit the motorway for the Hume Highway. This scenario is referred to as a weaving movement. Weaving occurs when two or more traffic streams travelling in the same direction cross paths without the aid of traffic control. A weaving issue arises, as in this case, when there is only a short distance (and time) available to traffic entering the motorway, at speed, to undertake the necessary lane changes.

Monitoring carried out for the proposal has indicated that there is a high volume of crossing traffic between Moorebank Avenue and the Hume Highway (up to 1,230 vehicles per hour) (Transport for NSW, 2020). A visualisation of the weaving issue at this location is shown in Figure 2-1.

In addition, crash data revealed that between January 2014 and December 2018, there were 224 reported crashes within the proposal area and connecting intersections of Heathcote Road in Moorebank/Wattle Grove and the Hume Highway in Casula/Liverpool (Transport for NSW, 2021). Crashes occurred up to 50 metres from the motorway at these intersections just outside of the proposal area (Transport for NSW, 2021). Refer to Figure 3-20 of the Traffic and transport impact assessment (Appendix D) (Aurecon, 2022) for a map of the location of these crashes.

Enabling safer freight movements

Moorebank Avenue crosses over the M5 Motorway in a north-south direction, providing access to industrial areas located on either side of the M5 Motorway. At the southern end of Moorebank Avenue is the Moorebank Logistics Park (MLP), which is being developed by Sydney Intermodal Terminal Alliance (SIMTA) to accommodate predicted increases in freight in Sydney by removing road freight between Port Botany and Western Sydney. Construction of Stage 1 of the MLP commenced in 2017, with sections of the MLP already operational, accommodating large warehouses and storage facilities (SIMTA, 2017). More information about the MLP is provided in Section 6.10.

As part of the development approval required for the Moorebank Intermodal Precinct East Stage 2 (SSD 7628), road infrastructure upgrades to support the development of the MLP are required. Development consent Condition B.13 – Road Infrastructure Upgrades states that the upgrade of the Moorebank Avenue/M5 Motorway intersection (M5MA) is required to cater for the requirements of the MLP (Department of Planning and Environment (DPE), 2018).

To manage potential cumulative traffic impacts, Transport for NSW is exploring opportunities to deliver the M5MA upgrade – at SIMTA's cost – as part of the M5 Motorway Westbound Traffic Upgrade. This would provide greater flexibility in construction staging and would minimise the duration of cumulative impacts such as noise and traffic impacts.

The planning approval documents developed for the MLP also acknowledge the existing travel time and safety issues on the M5 Motorway, between Moorebank Avenue and the Hume Highway. Travel times are expected to worsen with the anticipated growth in freight within the proposal area over time (Parsons Brinckerhoff, 2014).

The proposal would improve conditions for freight travelling between the MLP and the M5 Motorway by addressing the existing weaving issue for westbound motorists. Addressing this weaving issue would improve efficiency, reliability and safety on the M5 Motorway in the proposal area.

Traffic volumes and capacity requirements

It is expected that the M5 Motorway into the future will serve as a major transit link connecting south west Sydney with the future Western Sydney International Airport and Western Sydney Parklands (Transport for NSW, 2019).

This will generate an overall increase in heavy and light vehicles. The current travel time delays on the M5 Motorway would be worsened if traffic arrangements and condition remain the same.

As mentioned in the *M5 Motorway Westbound Traffic Upgrade – Options Evaluation Report 2019*, the MLP is estimated to generate over 6,600 additional heavy vehicle trips per day and 10,000 additional light vehicle trips per day both in and out of the facility (Transport for NSW, 2019). The Options Evaluation Report states that while substantial, this is only a small portion of traffic that is expected to be generated by the population and employment growth in south west Sydney (Transport for NSW, 2019).

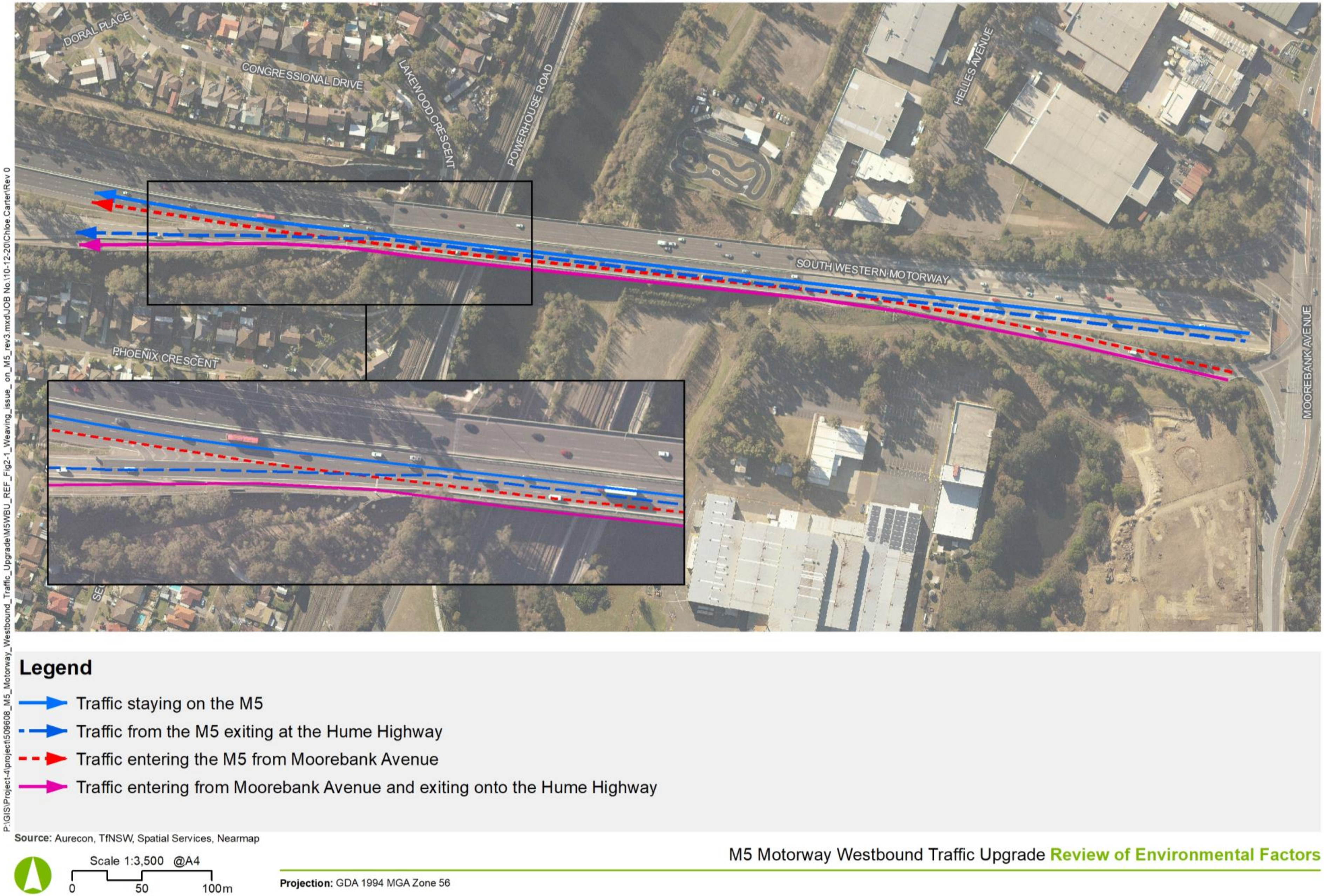


Figure 2-1 Weaving issue

2.1.1 NSW policy context

Future Transport Strategy 2056

The NSW Government's Future Transport Strategy 2056 (the Strategy) is a 40-year strategy for regional NSW and Greater Sydney. The strategy aims to achieve a world-class, safe, efficient and reliable transport system. The Strategy is supported by a range of other plans (discussed below) and outlines the direction and customer outcomes for transport planning in NSW.

The Future Transport Strategy 2056 defines transport as 'an enabler of economic and social activity, contributing to long term economic, social and environmental outcomes' (Transport for NSW, 2018a). There are six outcomes included in the Strategy, which are shown in Figure 2-2.

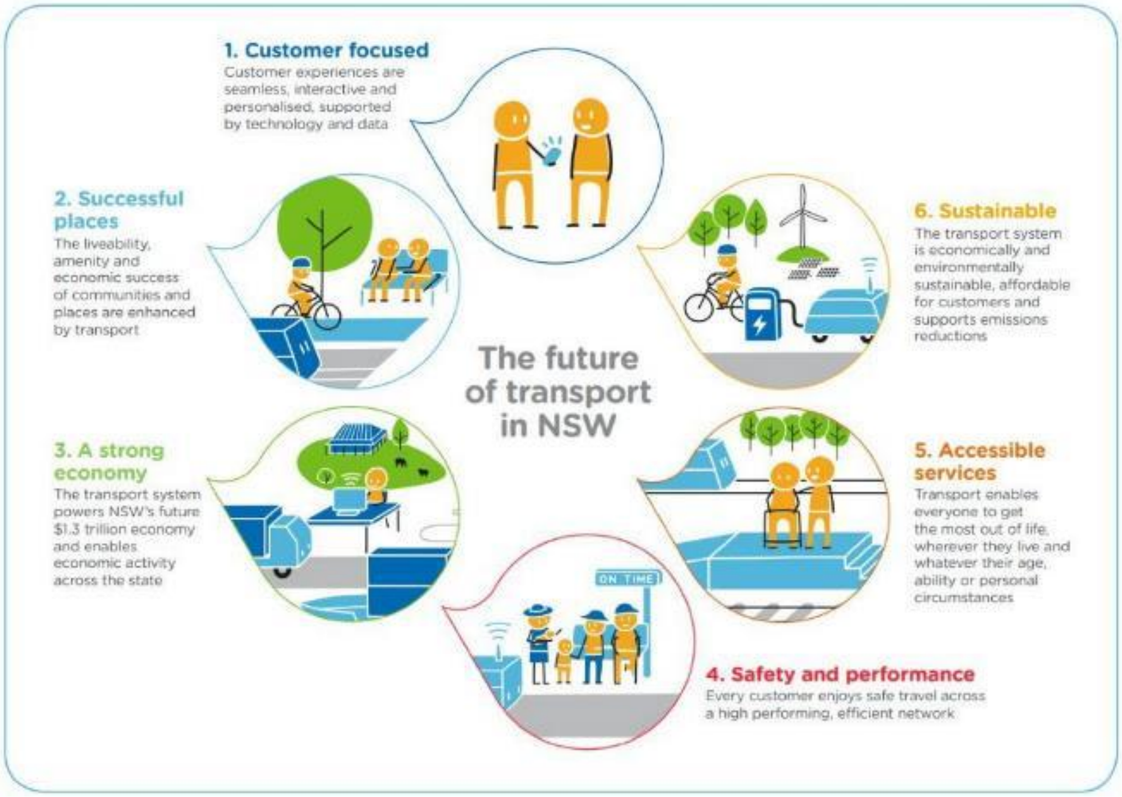


Figure 2-2 Future Transport's six state-wide outcomes *source: Future Transport Strategy (Transport for NSW, 2018))

Of the outcomes explored in the Strategy, the proposal aligns most closely with 'supporting a strong economy' and 'focusing on safety and performance'. The Strategy promotes economic and population development and growth, and the opportunities associated with having an efficient transport system. The constraints of congestion and network inefficiencies are discussed in the Strategy, with a focus on costs, growth restrictions and impacts on employment opportunities. The Strategy seeks to support the economy, with a goal to provide economically sustainable transport that gives industries and communities the certainty they need for their own planning (Transport for NSW, 2018a).

By improving the efficiency and safety of the M5 Motorway in this critical location, the proposal supports present and future transport needs, removes restrictions to employment opportunities, allows for growth in industries and creates a more sustainable transport network.

The Strategy discusses the importance of an integrated road and rail logistics network supported by intermodal terminals, dedicated and high performing pathways and major freight corridors (Transport for NSW, 2018a). The proposal facilitates the realisation of the Strategy as it would provide effective and safe access to the MLP, as well as support connections for south west Sydney.

Safety and performance is also discussed in the Strategy, with a focus on providing a high performing and efficient network that is also safe. The need for greater separation of major traffic flows to support higher performance and safety is investigated in relation to freight bypasses, installation of infrastructure such as barriers and medians and implementation of new technologies.

The proposal would improve safety along this section of the M5 Motorway and at its intersections with the Hume Highway and Moorebank Avenue. This would be achieved through the provision of dedicated turning lanes, clear directional signage, the removal of the weaving issue on the M5 Motorway between Moorebank Avenue and the Hume Highway and the inclusion of ITS. Further discussion on the weaving issue on the M5 Motorway is provided in Section 2.1 (road safety).

Greater Sydney Region Plan: A metropolis of three cities – connecting people

The Greater Sydney Commission released the updated Greater Sydney Region Plan: A Metropolis of three cities – connecting people (GSRP) in June 2018. The GSRP highlights the opportunities, challenges and vision for each of the three cities. The three cities that make up the Greater Sydney Region are defined in the GSRP as:

- The established Eastern Harbour City – building on its recognised economic strength and addressing liveability and sustainability
- The developing Central River City – investing in a wide variety of infrastructure and services and improving amenity
- The emerging Western Parkland City – establishing the framework for the development and success of an emerging new city.

The proposal is located within the Western Parkland City, within Liverpool, one of the Western Parkland City's three centres. As a place of emergence and growth, the Western Parkland City is acknowledged as a place that would require new infrastructure as well as supporting infrastructure to enable the shaping of a connected city (GSC, 2018).

The GSRP discusses the need to manage interfaces of industrial areas, trade gateways and intermodal facilities through the enhancement and development of new road and rail connections in the Western Parkland City (GSRP, 2018).

The proposal would promote the objectives of the GSRP to upgrade infrastructure to support the growth and accessibility of the Liverpool CBD. The proposal would also provide efficient and reliable access between the MLP and the road network, through provision of a new exit ramp and upgrades at Moorebank Avenue.

Western City District Plan

To achieve the vision for the GSRP, the GSC developed district plans to connect the outcomes between regional and local planning (Transport for NSW, 2018b). The Western City District Plan is a 20-year plan that focuses on the Western Parkland City, incorporating local strategies and policies. In planning for the Western Parkland City, initiatives have been identified to support land use and infrastructure planning. The Western City District Plan highlights the key planning priorities of the GSRP relevant to the Western Parkland City particularly in regard to infrastructure and collaboration, liveability and productivity.

The proposal corresponds with the key planning priorities, specifically the need for a balanced approach to freight planning. The balanced approach aims to minimise potential adverse impacts while supporting the efficient movement of freight to terminals such as the MLP (Transport for NSW, 2018b). The proposal aligns with the planning priorities identified in the plan as the upgrade of the M5 Motorway would aim to maximise efficiency and provide reliable access to the MLP whilst supporting growth.

The Western Sydney City Deal

The Western Sydney City Deal was developed by the Australian, NSW and local governments to provide a set of commitments for the Western City in Greater Sydney. The Western Sydney City Deal has six commitments:

1. Connectivity
2. Jobs for the future
3. Skills and education
4. Liveability and environment
5. Planning and housing
6. Implementation and governance.

Although the proposal is not specifically mentioned in the document, there are themes that align with the objectives of the proposal. This includes the commitment to connectivity, such as the connectivity the M5 Motorway provides as a key through-traffic connection for south west Sydney.

State Infrastructure Strategy 2018 to 2038: Building Momentum

In February 2018, Infrastructure NSW released the State Infrastructure Strategy 2018-2038: Building Momentum (SIS). The SIS provides recommendations to the NSW Government about the key infrastructure sectors across the State, identifying priorities and challenges to be considered in planning for the next 20 years (Infrastructure NSW, 2018). The strategic objective for transport recommendations in the SIS is to ‘ensure the transport system creates opportunities for people and businesses to access the services and support they need’ (Infrastructure NSW, 2018).

The proposal is specifically mentioned in the SIS, with reference to the MLP and the requirement for this development to be supported by a reliable and efficient road network. The need for an upgrade of the M5 Motorway between Moorebank Avenue and the Hume Highway is discussed, with reference to addressing the existing congestion on this section of the Motorway (Infrastructure NSW, 2018).

Recommendation 60 of the SIS refers to a collaborative investment in the development of the MLP (Infrastructure NSW, 2018). The proposal adopts the recommendations in the SIS through the proposed upgrade of the Moorebank Avenue intersection, which is specifically required to support the MLP.

NSW Freight and Ports Plan 2018 – 2038

As a supporting plan to Transport for NSW’s Future Transport Strategy 2056, the NSW Freight and Ports Plan 2018 – 2023 (FPP) provides a framework for the NSW Government and industry to make the NSW freight task more efficient and safer across the network (Transport for NSW, 2018c). The FPP highlights the significance of freight in NSW, including the contribution of freight to the economy and employment and the increase in freight related industry. As stated in the FPP, about 80 per cent of the Greater Sydney freight task is carried out by road (Transport for NSW, 2018c).

Opportunities to improve freight efficiency and the road network are also discussed. This includes management of congestion in key freight areas, with the M5 Motorway and areas around major freight terminals such as Moorebank Logistics Park (also referred to as the MLP) identified in the FPP.

The proposal would advance the FPP through the upgrade of the M5 Motorway and its connections to the Hume Highway and Moorebank Avenue. These upgrades would support the proposed MLP and existing industrial areas in Moorebank.

NSW Road Safety Plan 2021 – Towards Zero

The NSW Road Safety Plan 2021 – Towards Zero (the Road Safety Plan) establishes a commitment from the NSW Government to improve safety on NSW roads. The Plan sets out the following priority areas for action:

- 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 proposal is most closely aligned with the ‘liveable and safe urban communities’ and ‘building a safe future’ priority areas. The Road Safety Plan discusses the changing nature of urban areas, with more economic activity that brings more movement on the network. The importance of pedestrian and cyclist safety is highlighted in this priority area, with the goal to improve safety through the installation of infrastructure such as safe crossings.

The proposal would include the installation of a shared user pathway from Moorebank Avenue across the new Georges River bridge, providing an east-west connection. This would contribute to the liveability and safety within the proposal area, through safer connectivity and access for active transport users.

The Road Safety Plan focuses on harnessing opportunities to make new and upgraded roads safer through implementation of current road design standards including the latest proven safety features (Transport for NSW, 2018d). The proposal has been designed in accordance with the standards and requirements for road design and planning. The proposal would meet the objectives in the NSW Road Safety Plan 2021 through the provision of upgraded road infrastructure that adheres to current safety standards. This includes eliminating the weaving issue on the M5 Motorway between Moorebank Avenue and the Hume Highway, as well as the installation of ITS, such as CCTV, a web camera, an emergency breakdown telephone and stopping bay, VMS and backbone conduit.

Community Strategic Plan – Our Home, Liverpool 2027

In 2017, Liverpool City Council released their Community Strategic Plan – Our Home, Liverpool 2027 (the CSP). The CSP defines the vision and priorities for the community as well as the challenges and opportunities across the next 10 years (Liverpool City Council, 2017). Community consultation was carried out during the development of the plan to understand the values and priorities that are most important to residents and stakeholders in the Liverpool LGA.

The four directions that represent the priorities of the community are: Creating Connection, Leading through Collaboration, Generating Opportunity, and Strengthening and Protecting our Environment. Direction three 'Generating Opportunity' aligns closely with the objectives of the proposal as it promotes the need to meet challenges of the growing population, attract businesses for economic growth and employment and also advocate and develop the transport network to improve accessibility (Liverpool City Council, 2017).

The M5 Motorway is characterised as one of Sydney's major motorways, providing access to Liverpool. Heavy traffic volumes and travel time delays during peak periods is identified as a major challenge for the community, as well as the potential pressure that future growth and development may have on the capacity of transport networks. The MLP is referenced as a strategic site that will contribute to higher volumes of traffic in the Liverpool LGA. The CSP promotes Liverpool City Council's advocacy for upgraded infrastructure to improve the local transport network to meet increasing demand (Liverpool City Council, 2017). The proposal is consistent with the directions of the CSP and responds to the challenges identified. The proposal would maximise efficiency whilst also supporting growth and access in the Liverpool CBD.

Local Strategic Planning Statement – Connected Liverpool 2040

The Liverpool City Council Local Strategic Planning Statement – Connected Liverpool 2040 (the LSPS) was developed with a focus on connectivity, productivity, liveability and sustainability. As a framework for strategic planning, the LSPS also takes into account the directions in the CSP to align planning outcomes.

Similar to the CSP, the first priority in the LSPS relates to connectivity and mentions the commitment to advocate for critical transport improvements. The LSPS specifically mentions the requirement to undertake road network upgrades to minimise traffic impacts from the MLP (Liverpool City Council, 2020).

In addition, the LSPS also speaks to the priority of ensuring industrial and employment lands meet Liverpool's future needs. The need to consider freight movements and efficiency on the local road network to account for both industrial growth and population growth is also a key goal. Management of the freight task and interfaces between precincts, as well as the protection of key freight routes are discussed in the LSPS alongside the need to balance this with the needs of the community. The proposal aligns with the priorities in the LSPS through the provision of upgraded road transport infrastructure, including community facilities such as a shared user path, in the Liverpool LGA.

2.2 Limitations of existing infrastructure

2.2.1 Key existing infrastructure

The proposal is in the suburbs of Moorebank, Wattle Grove, Liverpool and Casula in south west Sydney. The M5 Motorway within the proposal area is a toll-free road operated by Interlink Roads. The area surrounding the M5 Motorway in this area is a mix of industrial areas (predominately in Moorebank) and residential areas in Wattle Grove, Liverpool and Casula.

The M5 Motorway generally has three to four lanes in each direction separated by a concrete median barrier and a posted speed limit of 100 kilometres per hour. The major intersections with the M5 Motorway within the proposal area are Moorebank Avenue and the Hume Highway. The posted speed limits on these intersection exits are 60 kilometres per hour.

The M5 Motorway passes over the Georges River via two bridges, with each bridge containing four traffic lanes. On the western side of the Georges River, the bridges also span over Powerhouse Road, Lakewood Crescent, and the Southern Sydney Freight and Main Southern Passenger Rail Lines.

2.2.2 Limitations of existing infrastructure

The M5 Motorway in the proposal area currently has the following limitations:

Safety

As outlined in Section 2.1 (road safety), the existing configuration of the Moorebank Avenue and Hume Highway intersections creates a potential safety risk for westbound traffic. Specifically, vehicles entering the motorway westbound from Moorebank Avenue need to cross lanes with traffic wishing to exist the motorway for the Hume Highway. This scenario is referred to as a weaving movement. A visualisation of the weaving issue at this location is shown in Figure 2-1. Further discussion on the weaving issue is provided in Section 2.1 (road safety).

Crash data revealed that between January 2014 and December 2018, there were 224 reported crashes within the proposal area and connecting intersections of Heathcote Road in Moorebank/Wattle Grove and the Hume Highway in Casula/Liverpool (Transport for NSW, 2021). Crashes occurred up to 50 metres from the motorway at these intersections just outside of the proposal area (Transport for NSW, 2021). Refer to Figure 3-20 of the Traffic and transport impact assessment (Appendix D) (Aurecon, 2022) for a map of the location of these crashes.

Capacity

As outlined in Section 2.1 (road safety), the existing weaving issue between Moorebank Avenue and Hume Highway intersections contributes to travel time delays for motorists travelling westbound on the M5 Motorway. Monitoring carried out for the proposal has indicated that there is a high volume of crossing traffic between Moorebank Avenue and the Hume Highway (up to 1,230 vehicles per hours) (Transport for NSW, 2020). This has flow on effects on the performance of the broader road network. The M5 Motorway in the proposal area is not expected to be able to accommodate future pressure on the road network as a result of the operation of the MLP and local and regional population growth. The M5 Motorway/Moorebank Avenue intersection would need to accommodate future traffic demand expected from the MLP. As discussed in Section 2.1, enabling work would be required to support the development of the MLP including the upgrade to Moorebank Avenue and the intersections along its extent.

Active transport connectivity

The M5 Motorway does not provide a continuous active transport route between Moorebank Avenue and the Hume Highway. Pedestrian access is not permitted between Moorebank Avenue and the bridge over the Georges River resulting in a missing link in the network (Figure 2-3). There is an informal narrow concrete footpath located on the southern side of the M5 Motorway (between the westbound Moorebank Avenue on ramp and the Georges River bridge); however, this footpath does not connect to the surrounding pedestrian network.

Connectivity for cyclists is limited in the proposal area with road markings, the shared user path and some signage along the extent of the proposal area. There is currently no cyclist lane for cyclists travelling from the south of Moorebank Avenue westbound onto the M5 Motorway. Cyclists are required to travel in the traffic lane on the Moorebank Avenue entry ramp to the M5 Motorway before merging into the road shoulder and eventually the shared user path over the bridge.

Cyclists travelling westbound to the Hume Highway travel within the road shoulder or the existing shared user pathway which is narrow and not clearly marked on the road. Cyclists travelling westbound that want to continue on the M5 Motorway rather than exit onto the Hume Highway are required to cross the two traffic lanes on the existing Hume Highway exit ramp into the road shoulder of the westbound traffic lanes (Figure 2-4).

Figure 2-3 End of the existing shared user pathway on the eastern side of the bridge over the Georges River (looking east)

Figure 2-4 Existing shared user pathway on the western side of the bridge over the Georges River before the cyclist crossing (looking west)

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives for the M5 Motorway westbound traffic upgrade are to:

- Maximise efficiency of the higher order road network
- Provide efficient and reliable access between the Moorebank Logistics Park precinct and the State road network
- Support the M5 Motorway as the key through-traffic connection for south west Sydney
- Support the growth of and access to the Liverpool CBD through provision of an efficient arterial road network
- Provide solutions that contribute to improved road safety outcomes
- Contribute to strategic land use outcomes including active transport and development of logistics facilities
- Incorporate necessary active transport measures to contribute to the improved performance of those modes.

The proposal aims to deliver sustainable outcomes that minimises impacts to the environment, community and stakeholders.

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 planning development in the surrounding area
- Maximise the safety and suitability of the M5 Motorway 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

Urban design objectives for the proposal include:

- To fit sensitively within the landscape and topographical setting
- To ensure connectivity and permeability for communities is enhanced
- To design built form elements that fit well in their setting and minimise disturbance to existing connectivity
- To design the roads as an experience in movement and create self-explaining road environments.

2.3.4 Sustainability objectives

Transport for NSW's Transport Sustainability Plan 2021 (Transport for NSW, 2021) outlines the agency's vision for sustainability – that every journey is people and planet positive.

To achieve this vision, Transport for NSW has identified eight focus areas, which address the most important sustainability aspects associated with Transport for NSW's activities.

Each sustainability focus area is supported by sustainability goals, which are aligned with the United Nations Sustainable Development Goals (UNSDGs) as part of best practice sustainability approaches.

Transport for NSW's sustainability focus areas and sustainability goals are listed in Table 2-1.

The proposal is being developed, and would be delivered, in accordance with Transport for NSW's Transport Sustainability Plan 2021 by aligning with the sustainability focus areas and sustainability goals listed in Table 2-1. This is discussed further in Section 6.13.

Table 2-1 Transport for NSW's sustainability focus areas and goals

Sustainability focus areas	Sustainability goals
Respond to climate change	• Net zero emissions by 2050 • Consider climate change risks in all decisions
Protect and enhance biodiversity	• No net loss of biodiversity
Improve environmental outcomes	• Develop a circular economy for transport by designing waste and pollution out and keeping products and materials in use • Reduce environmental impacts of projects and operations
Procure responsibly	• All suppliers meet the standards in the Transport Supplier Sustainability Charter • Social and environmental outcomes included in all procurement decisions • Go beyond minimum compliance targets in Aboriginal Procurement Policy
Partner with communities	• Always leave a positive legacy for communities as a result of projects • Uphold, apply and report on community engagement
Respect heritage and culture	• Aboriginal culture is integrated and preserved • Acknowledging and incorporating culture through stories, examples, and best practice
Align spend and impact	• All decisions consider value created from sustainability alongside financial analysis • Reduce whole of life costs for the transport network
Empower customers to make sustainable choices	• Use customer journeys to inform, engage and inspire more sustainable practices and demonstrate Transport's progress

2.4 Alternatives and options considered

This section summarises the options that were considered for the proposal and details the justification as to why the preferred option was chosen.

2.4.1 Methodology for selection of the preferred option

The *M5 Motorway Westbound Traffic Upgrade – Options Evaluation Report* (Transport for NSW, 2019) details the options analysis and assessment conducted to reach the preferred option (the proposal). There were eight preliminary options developed of which three options were short-listed for further development.

The options evaluation process consisted of the following key steps:

- Identify project objectives and applicable design criteria
- Identify key environmental constraints (ie analysis of preliminary environmental investigations (PEI)) to identify potential opportunities and environmental constraints that may influence the development of design options for the upgrade
- Identify a long-list of options using the recommendations of the Moorebank Intermodal Road Access (MITRA) strategy
- Evaluate long-list options against project objectives and agreed criteria during project workshops
- Develop a short-list of options to consult with major stakeholders including planning approval agencies via workshops and meetings held in March 2019. The workshops held included a risk management workshop, constructability, health and safety in design and a value management workshop with members from the design, environment and communications teams
- Selection of the preferred option and undertake any necessary refinements to shape the proposal to progress to design.

2.4.2 Identified options

Long-list options

The identified options for consideration, key features and justification for not being short-listed are summarised in Table 2-2. The nine long-listed options were evaluated based on the following criteria:

- Significant departures from geometric standards
- Unrealistic or uneconomical bridge spans
- Impact to existing structures
- Impact to critical utilities
- Impact to community and property
- Impact to adjacent road network and traffic staging impacts.

Table 2-2 Identified options

Option	Key features	Short-listed	Justification for why option was not short-listed
Base case – 'do nothing'	N/A	No	• Failed to meet proposal objectives • Does not provide necessary upgrade for the operation of the Moorebank Logistics Park • Travel time delays and congestion at off ramp to Hume Highway predicted into future
Option 1B – Collector ramp with underpass at Moorebank Avenue	• Construction of a collector ramp with underpass at Moorebank Avenue • Traffic for Hume Highway exits east of Moorebank Avenue in a two-lane shared exit • 70 metre long underpass bridge over the collector ramp south of Moorebank Avenue interchange	Yes	N/A – this option was short-listed due to its performance against the evaluation criteria
Option 2B – Collector ramp with overpass at Moorebank Avenue	• Construction of a collector ramp with overpass at Moorebank Avenue • Traffic for Hume Highway exits east of Moorebank Avenue in a two-lane shared exit • Overpass climbs at about six per cent and passes over Moorebank Avenue on a 70 metre long bridge	Yes	N/A – this option was short-listed due to its performance against the evaluation criteria

Option	Key features	Short-listed	Justification for why option was not short-listed
	south of the Moorebank Avenue interchange • A bridge pier located in the median of Moorebank Avenue		
Option 3 – Braided ramps east of the Georges River	• Construction of braided ramps east of the Georges River • Traffic for Hume Highway exits east of the Georges River and west of Moorebank Avenue • Widening of Moorebank Avenue bridge span over the M5 Motorway • New two-lane bridge over Georges River and railway connects M5 Motorway and Moorebank Avenue traffic to Hume Highway • Existing M5 Motorway westbound Hume Highway exit is closed • Existing M5 Motorway westbound Moorebank Avenue entry is closed	No	• Constructability and construction staging complexities associated with this option due to merge on the bridge structure • Potential impacts to major utilities
Option 4 – Braided ramps west of the Georges River with an overpass at the Hume Highway exit ramps	• Construction of braided ramps west of Georges River with overpass at Hume Highway exit ramp • Moorebank Avenue traffic for Hume Highway and Moorebank Avenue traffic for the M5 Motorway	No	• Design speed geometry unable to be achieved for this option and grade for entry ramp from Moorebank Avenue would be non-conforming • Vertical curves only meet 40km/h speed which would be well below the required 90km/h design speed

Option	Key features	Short-listed	Justification for why option was not short-listed
	cross the Georges River on two separate one lane bridges • Moorebank Avenue traffic for Hume Highway joins the existing exit to the Hume Highway • Moorebank Avenue traffic for the M5 Motorway westbound spans the existing Hume Highway exit with a continuation of the Georges River Bridge and then grades down to pass under the existing Hume Highway and joins the M5 Motorway with an entry ramp • Existing M5 Motorway westbound Moorebank Avenue entry is closed		
Option 4B – Braided ramps west of the Georges River with overpass at the Hume Highway exit ramp and overpass of the Hume Highway	• Construction of braided ramps west of the Georges River with overpass at Hume Highway exit ramp and overpass of Hume Highway • Moorebank Avenue traffic for Hume Highway and Moorebank Avenue traffic for the M5 Motorway cross the Georges River on two separate one lane bridges	Yes	N/A – this option was short-listed due to its performance against the evaluation criteria

Option	Key features	Short-listed	Justification for why option was not short-listed
	• Moorebank Avenue traffic for Hume Highway joins the existing exit to the Hume Highway • Moorebank Avenue traffic for the M5 Motorway westbound spans the existing Hume Highway exit with a continuation of the Georges River bridge and then spans the Hume Highway before joining the M5 Motorway with an entry ramp west of the Hume Highway • Existing M5 Motorway westbound Moorebank Avenue entry is closed		
Option 5 – Braided ramps west of the Georges River with underpass at the Hume Highway exit ramp	• Braided ramps west of the Georges River with underpass at the Hume Highway exit ramp • Moorebank Avenue traffic for Hume Highway and Moorebank Avenue traffic for the M5 Motorway cross the Georges River on two separate one lane bridges • Moorebank Avenue traffic for Hume Highway joins the existing exit to the Hume Highway • Moorebank Avenue traffic to the M5 Motorway westbound underpasses the existing Hume	No	• Non-compliant vertical and horizontal curves required; would be unable to achieve the design speed required for this option • Trucks would be unable to accelerate to achieve 100km/h entry speed to the M5 Motorway • Potential impacts to major utilities

Option	Key features	Short-listed	Justification for why option was not short-listed
	Highway exit and underpasses the Hume Highway before joining the M5 Motorway with an entry ramp west of the Hume Highway • Existing M5 Motorway westbound Moorebank Avenue entry is closed		
Option 6 – Braided ramp west of the Georges River with underpass of collector ramp	• Construction of braided ramp west of Georges River with underpass of collector ramp • M5 Motorway westbound traffic for Hume Highway exits east of the Georges River and west of Moorebank Avenue requiring widening of the Moorebank Avenue southern bridge span over the M5 Motorway • M5 Motorway westbound traffic for Hume Highway and Moorebank Avenue traffic join a new three lane bridge over Georges River and railway • Moorebank Avenue traffic to the M5 Motorway westbound underpasses the proposed Hume Highway exit and joins the M5 Motorway requiring widening of the	No	• Potential acquisition to residential properties in Casula • Non-compliant vertical and horizontal curves required; would be unable to achieve the design speed required for this option • Trucks would be unable to accelerate to achieve 100km/h entry speed to the M5 Motorway • Potential impacts to major utilities • Construction staging complexities may occur at Moorebank Avenue and the Hume Highway

Option	Key features	Short-listed	Justification for why option was not short-listed
	Hume Highway bridge span over the M5 Motorway • Existing M5 Motorway westbound Hume Highway exit is closed • Existing M5 Motorway westbound Moorebank Avenue entry is closed		
Option 7 – Exit loop at the Hume Highway	• Construction of exit loop ramp at Hume Highway • Existing M5 Motorway westbound Hume Highway exit is closed • New two lane M5 Motorway westbound Hume Highway exit is created west of the Hume Highway requiring widening of the Hume Highway bridge span over the M5 Motorway and a 40km/h design speed loop to connect the exit to the western side of the Hume Highway at a new intersection • The weave conflict is not removed but the distance between the entry and exit ramps is increased from 460 metres to 1,000 metres	No	• High impacts to community and properties due to the loop arrangement through Casula • Potential impacts to major utilities • Loss of control can occur on these types of ramp treatments which are likely with drivers overestimating a safe entry speed
Option 8 – Distributor ramp with at grade	• Construction of distributor ramp with at-grade intersection at Hume Highway	No	• Non-compliant vertical curves would be unable to achieve the design speed required for this option

Option	Key features	Short-listed	Justification for why option was not short-listed
intersection at the Hume Highway	• Moorebank Avenue traffic for Hume Highway and Moorebank Avenue traffic for the M5 Motorway cross the Georges River on a one lane bridge • Intersection of Hume Highway and westbound M5 Motorway exit ramp upgraded to allow a movement straight ahead to join the M5 Motorway westbound • New east facing entry ramp from Hume Highway to M5 Motorway westbound constructed • Existing M5 Motorway westbound Moorebank Avenue entry is closed		• Trucks would be unable to accelerate to achieve 100km/h entry speed to the M5 Motorway • Potential impacts to major utilities • Potential weaving conflicts on the exit ramp between Moorebank Avenue and the M5 Motorway

Short-listed options

After the detailed long-list evaluation, three options were deemed suitable to proceed to further assessment. These options were:

- Option 1B – Collector Ramp with underpass at Moorebank Avenue
- Option 2B – Collector Ramp with overpass at Moorebank Avenue
- Option 4B – Braided ramps west of the Georges River with overpass at the Hume Highway exit ramp and overpass of the Hume Highway.

These options are shown in Figure 2-5, Figure 2-6 and Figure 2-7.

The three short-listed options went through the following process to determine the preferred option:

- Traffic options assessment
- Development of strategic cost estimates
- Risk Management Workshop (March 2019)
- Constructability and Health and Safety in Design Workshop (March 2019)
- Value Management Workshop (March 2019).

The criteria that was used in the Value Management Workshop to determine the preferred option is provided in Table 2-3.

Table 2-3 Value Management Workshop assessment criteria

Assessment criteria	Description
Functional	• Maximises travel time efficiency and reliability of the network (including the M5 Motorway) • Minimises the complexity of constructability and allows for maximum flexibility in construction methods • Minimises safety risks during construction, operation, maintenance and demolition as well as to the general public • Minimises impact on major public utilities • Best fits with existing and future planning and local connectivity (including other Moorebank Logistics Park projects, public transport, railway, pedestrians and cyclists)
Socio-economic	• Minimises direct impacts to properties (ie acquisition and access impacts) including to lots, houses, businesses, community facilities and Commonwealth land • Minimises direct and indirect impact on businesses during construction • Minimises social impacts (ie community impacts, roads users, etc) associated with traffic disruption during construction • Minimises access impacts to river users during construction (ie access to and from the river)

Assessment criteria	Description
Environmental	• Minimises impact on biodiversity (ie vegetation communities, areas of ecological value, threatened fauna and flora species, fishing grounds and sensitive environmental areas, etc) • Minimises potential disturbance to contaminated sites (ie reduce earthworks/fill) • Minimises visual impacts and maximises amenity • Minimises the level of impact of noise during operation

The short-listed options analysis is summarised in Table 2-4.

Table 2-4 Options analysis summary

Criteria	Option 1B	Option 2B	Option 4B
Functional	• Similar to Option 2B, but showed greater value for money • Most economically viable solution • Least constructability issues upon further refinement and investigation	• Best suits the proposal objectives • Least utility impacts	• Least cost-effective option • Potentially impacts on future plans for the M5 Motorway
Socio-economic	Best fitted with existing and future planning and connectivity	Demonstrated minimal disruption to traffic during construction and potential construction staging	Largest impact to the community out of all the options
Environmental	Least visual and noise impacts in comparison to Option 2B and 4B	Noise impacts addressed using suitable design treatments	Largest impact in respect to noise and visual impacts

2.4.3 Design refinement of short-listed option

After the Value Management Workshop, design refinements and more detailed investigations were carried out for options 1B and 2B to resolve identified constructability issues.

Additional detailed investigations carried out include traffic assessments, refinement of costs estimates and consultation with traffic management specialists and Transport for NSW internal stakeholders to gain additional information. Additional investigations for both options were focused on the following:

- The structural design of the Georges River bridge led to design refinements common to both options
- Traffic staging associated with the construction of the underpass under Moorebank Avenue in particular:
    - Constructing an underpass under Moorebank Avenue while still maintaining traffic flow along Moorebank Avenue
    - Traffic staging design for the construction of the underpass – this concluded that constructing the underpass in two halves and switching the traffic from one side of Moorebank Avenue to the other during each stage would maintain traffic flow
    - The consequences of a reduction in the lane length on approach to the M5 Motorway and Moorebank Avenue interchange. This lane reduction was assessed as having a minor impact on the capacity of the intersection. After consultation with the Transport Management Centre, the staging of the underpass design was considered constructable.

Both options were also assessed against the needs of the proposal, with Option 1B aligning closest with the objectives of the proposal. This included:

- The alignment that Option 1B has with future planning along the M5 Motorway corridor and the growth of the Liverpool CBD
- The suitability Option 1B has to heavy vehicles due to the low grades included in this option, providing efficient and reliable access to the MLP and State road network
- The potential benefits to the surrounding community and stakeholders through provision of an efficient arterial road network with less noise and visual impacts associated with this option.

2.5 Preferred option

Option 1B was deemed the most suitable option as it provides the following benefits:

- Demonstrates the best value for money – the least expensive option to construct
- Most suitable to meet the proposal objectives (as mentioned above)
- The alignment fits well with the surrounding terrain with minimal visual and noise impacts to the surrounding community and low grades particularly suited to heavy vehicles
- Fits well with future planning along the M5 Motorway corridor
- Best traffic improvements for the least impact to the environment and local community
- Removal of a significant source of congestion that impacts upon the wider Sydney road network
- Increased efficiency of traffic flow across the Georges River

- Safety improvements and likely reduction in road incidents
- Complements adjoining projects and allows road users to realise the full benefit from a network of projects in the vicinity.

2.6 Further design refinements of the preferred option

After identification of the preferred option, further design development occurred to optimise the design. Key design refinements are summarised in Table 2-5.

Table 2-5 Design refinements

Design refinement	Reason
Replace the existing noise wall on the western side of the bridge over Georges River that would be removed, with a new noise wall in a similar location	To minimise noise operational impacts to residents
Cycle connections have been provided to Moorebank Avenue and Lakewood Crescent via shared paths	To provide active transport links between Moorebank and Casula
The shared user path (SUP) coming off the Hume Highway off-ramp (to the east of Moorebank Avenue) and joining Moorebank Avenue southbound has been relocated to only exit the Hume Highway off-ramp once past the Moorebank Avenue	To minimise impacts to existing properties and utilities
The cycle path was extended to the Hume Highway interchange crossing	To provide safer access for cyclists to the Hume Highway coming off the M5 Motorway
The Moorebank Avenue and Hume Highway individual exit ramps were re-configured to a single exit point from the M5 Motorway, with a dedicated lane for Moorebank Avenue and a dedicated lane for the Hume Highway.	To simplify road signage for westbound motorists and simplify construction staging
The Moorebank Avenue and M5 Motorway intersection upgrade was incorporated into the M5 Motorway upgrade design	To minimise cumulative construction impacts including noise, traffic and visual amenity

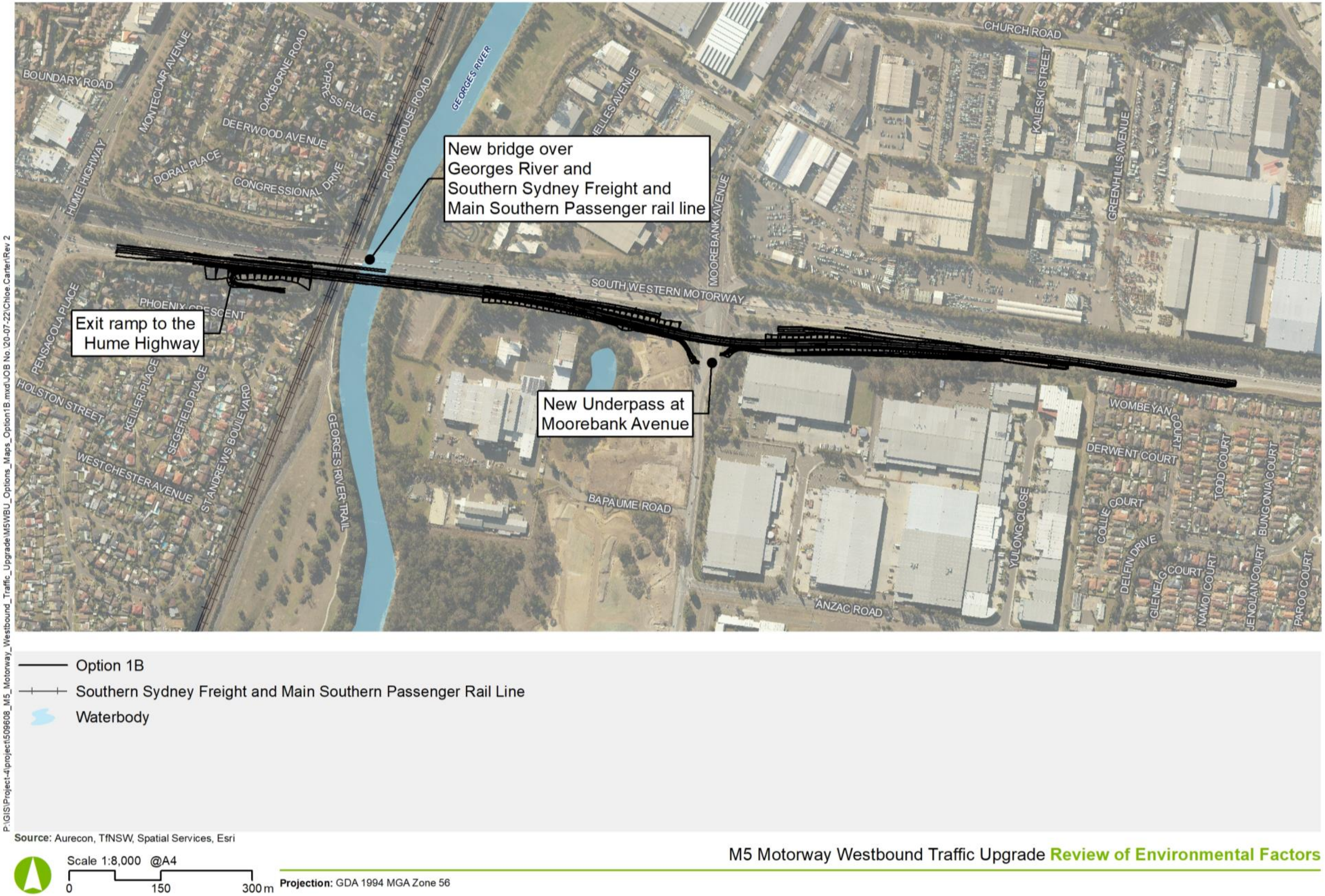


Figure 2-5 Short-listed option 1B design

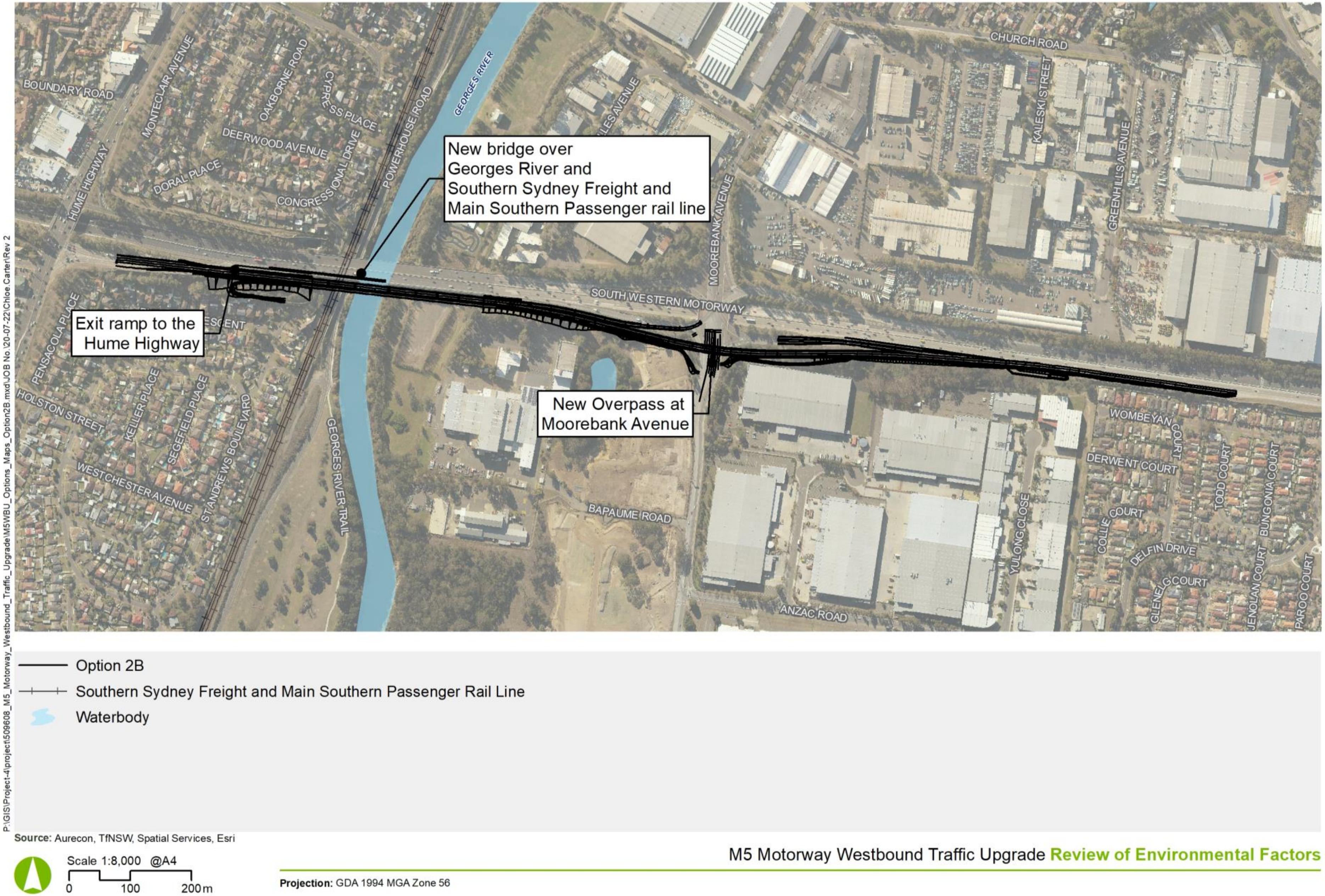


Figure 2-6 Short-listed option 2B design

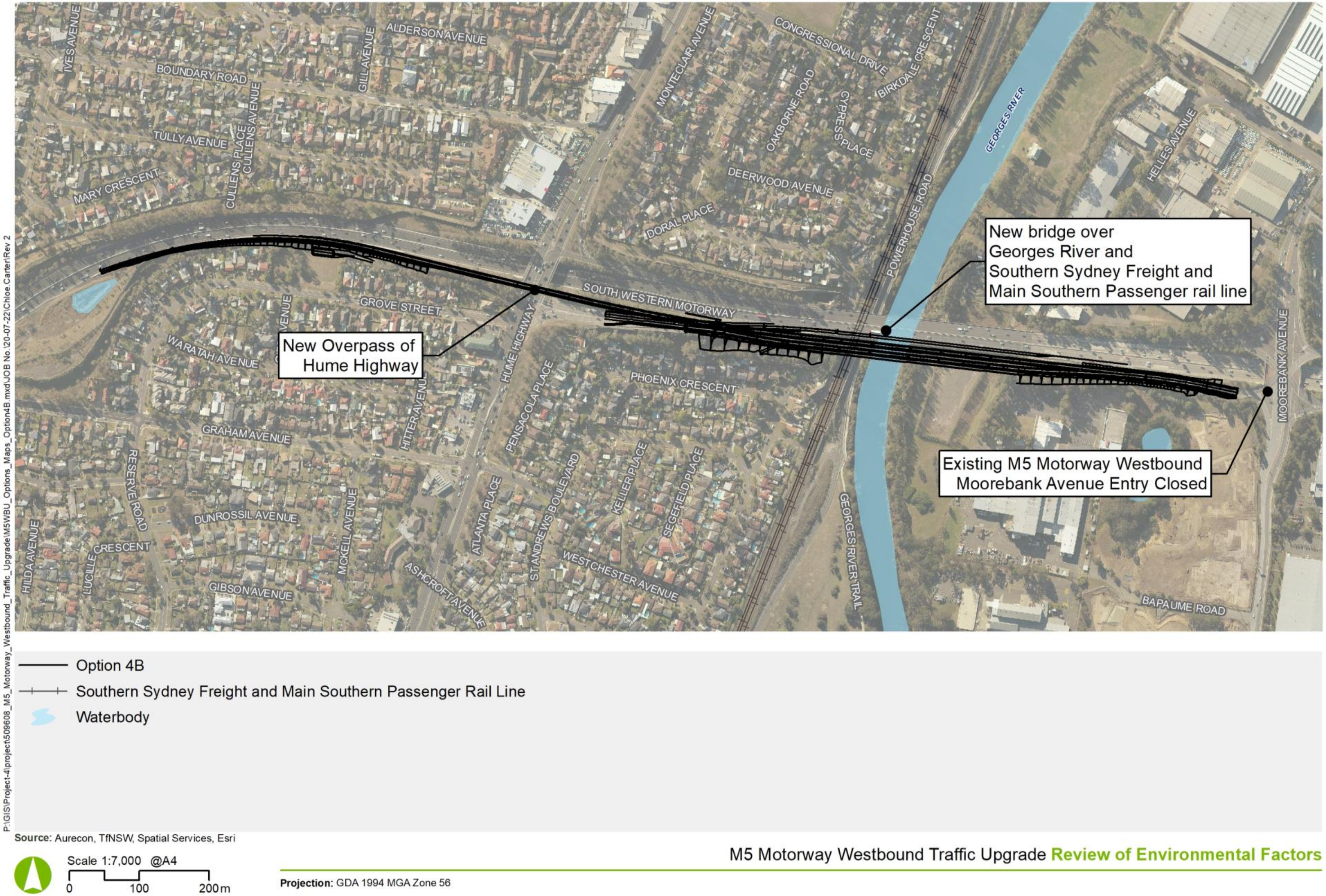


Figure 2-7 Short-listed option 4B design

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

Transport for NSW proposes to upgrade the M5 Motorway westbound between Moorebank Avenue, Moorebank and the Hume Highway, Casula. The proposal would ease congestion by improving connectivity between the M5 Motorway and the Hume Highway.

The key features of the proposal are shown in Figure 3-1, with further details provided in Figure 3-2 to Figure 3-7.

Key features of the proposal include:

- A new two-lane westbound M5 Motorway exit for Hume Highway traffic, located about 1.5 kilometres east of the existing Hume Highway exit. This exit ramp would include:
    - A grade separated underpass beneath Moorebank Avenue
    - A two-lane 290 metre long bridge over the Georges River, Southern Sydney Freight Line, and the T2 Inner West & Leppington and T5 Cumberland rail lines
- Removal of the current M5 Motorway westbound Hume Highway exit
- Upgrade of the M5 Motorway intersection with Moorebank Avenue to cater for future traffic demand
- Upgrade of the Moorebank Avenue westbound entry ramp maintaining access to the M5 Motorway and Hume Highway
- A new shared path on the southern side of the new Hume Highway exit ramp from Moorebank Avenue, across the Georges River on the new bridge and connecting to the Hume Highway and Lakewood Crescent
- Installation of new drainage infrastructure including:
    - Kerb and gutters, pits and pipes
    - Installation of a new operational spill basin under the new bridge, east of the Georges River
    - Removal of the existing spill basin near Yulong Close, Moorebank
- Intelligent Transport Systems (ITS) including installation and adjustments to traffic/SCATS detection, CCTV, a web camera, an emergency breakdown telephone and stopping bay, variable message signs (VMS) and backbone conduit
- Ancillary work associated with the proposal including:
    - Relocating, adjusting or protecting existing utility services that are in conflict with the proposal
    - Installation of new street lighting and various road furniture
    - Delineation including signage, line-marking and other items to facilitate road user safety of the new infrastructure

- Landscaping
- Property adjustments where necessary.

Construction is expected to take about 40 months to complete, assuming no unforeseen disruptions. Construction would be staged to minimise disruptions to transport customers and the community. There would be six construction areas across the proposal, with construction stages occurring concurrently to reduce construction time.

The nominated ancillary construction facility would be located on vacant land on the eastern side of the Georges River, south of the M5 Motorway. This site would provide close access to the motorway and its surrounding features, as well as provide space for fabrication and storage. More information about the use and features of the facility is in Section 3.4.

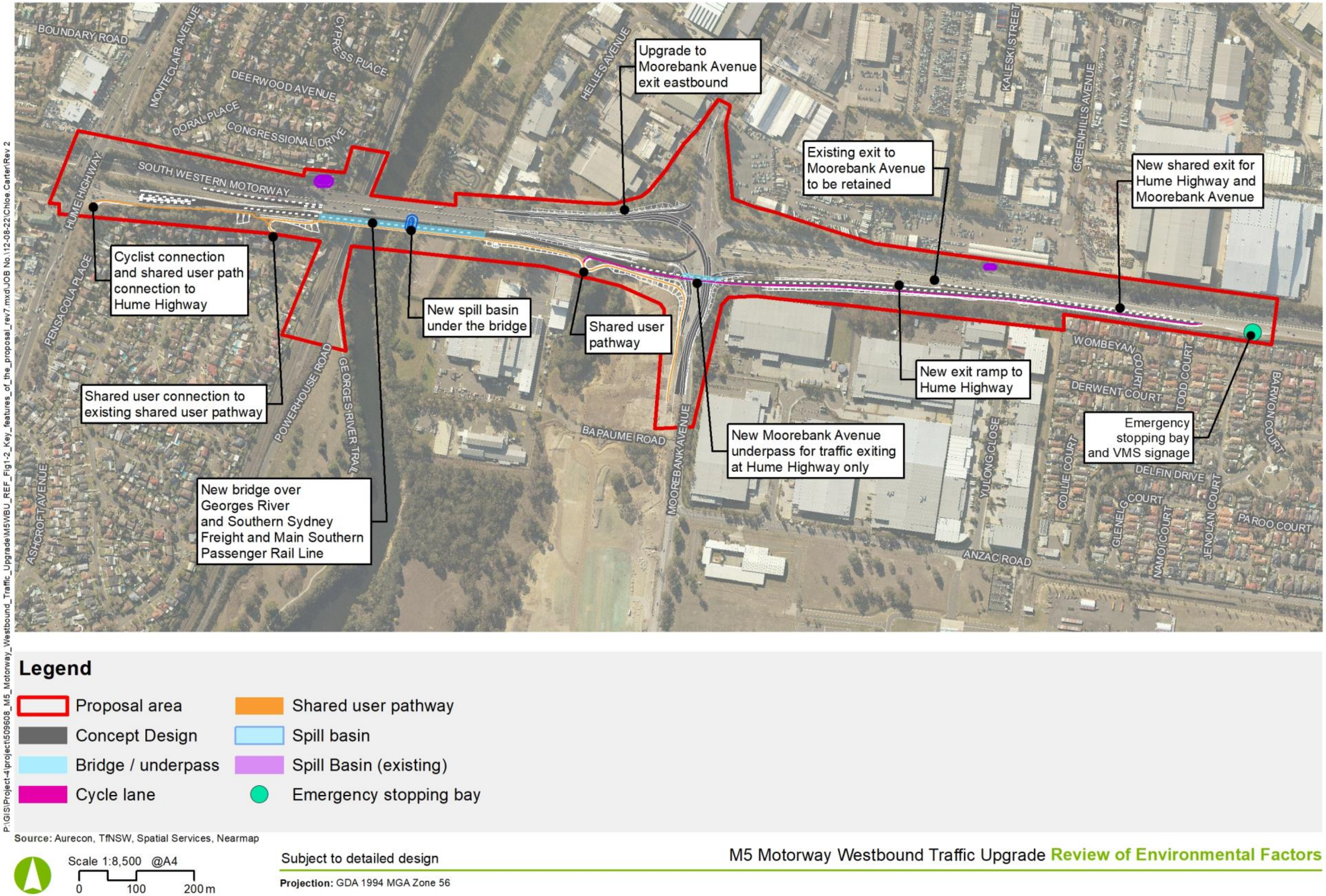


Figure 3-1 Key features of the proposal

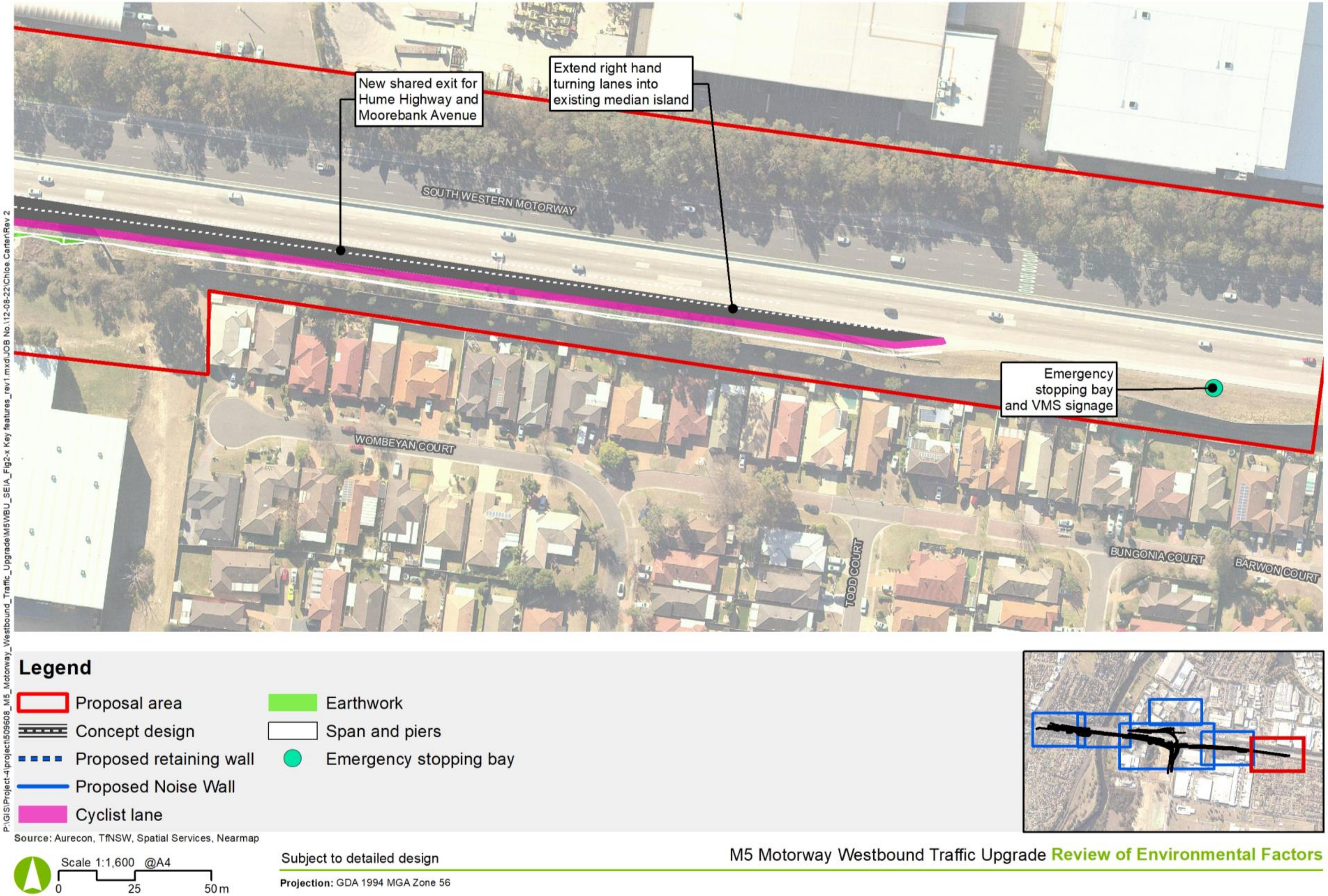


Figure 3-2 Key features

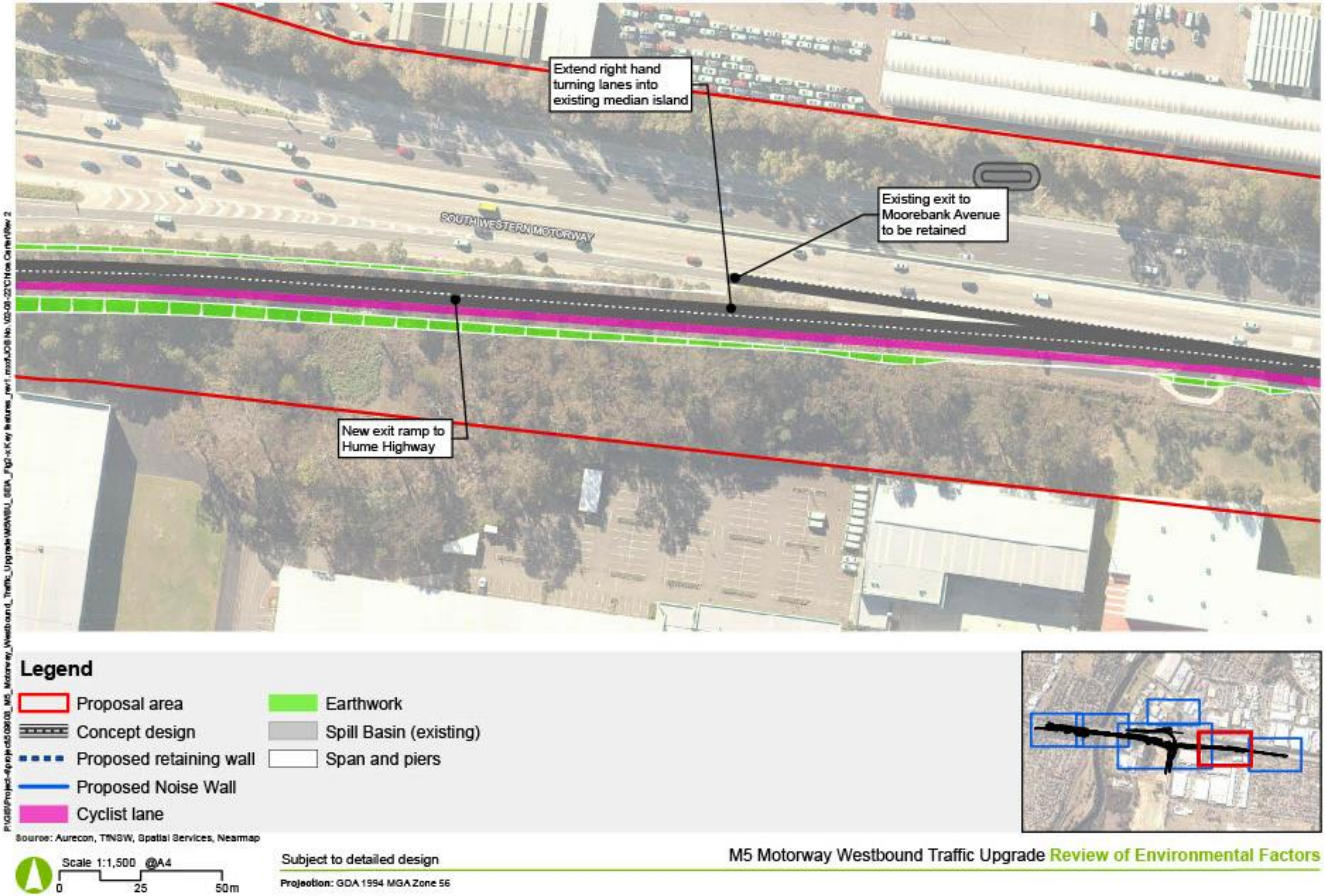


Figure 3-3 Key features

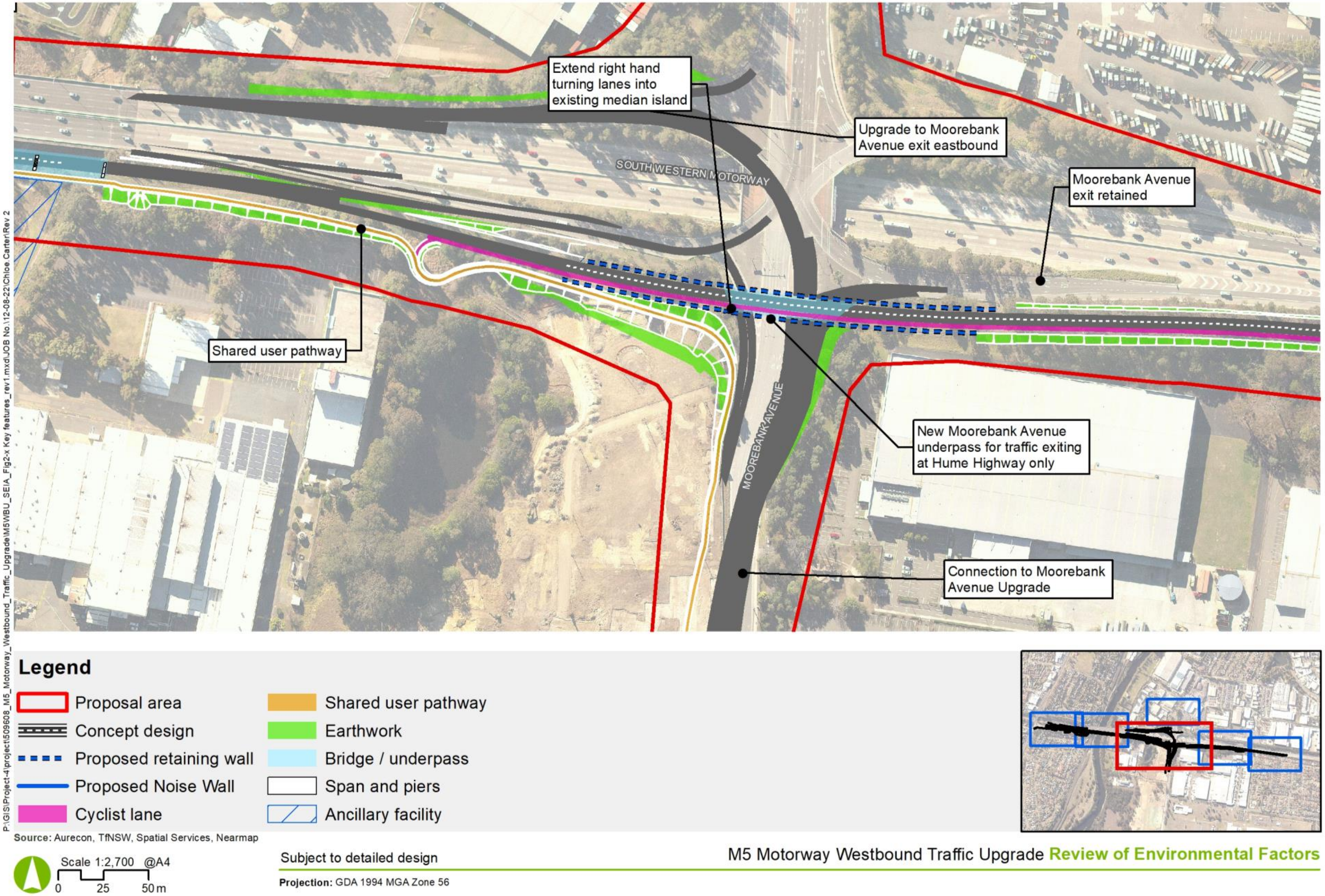


Figure 3-4 Key features

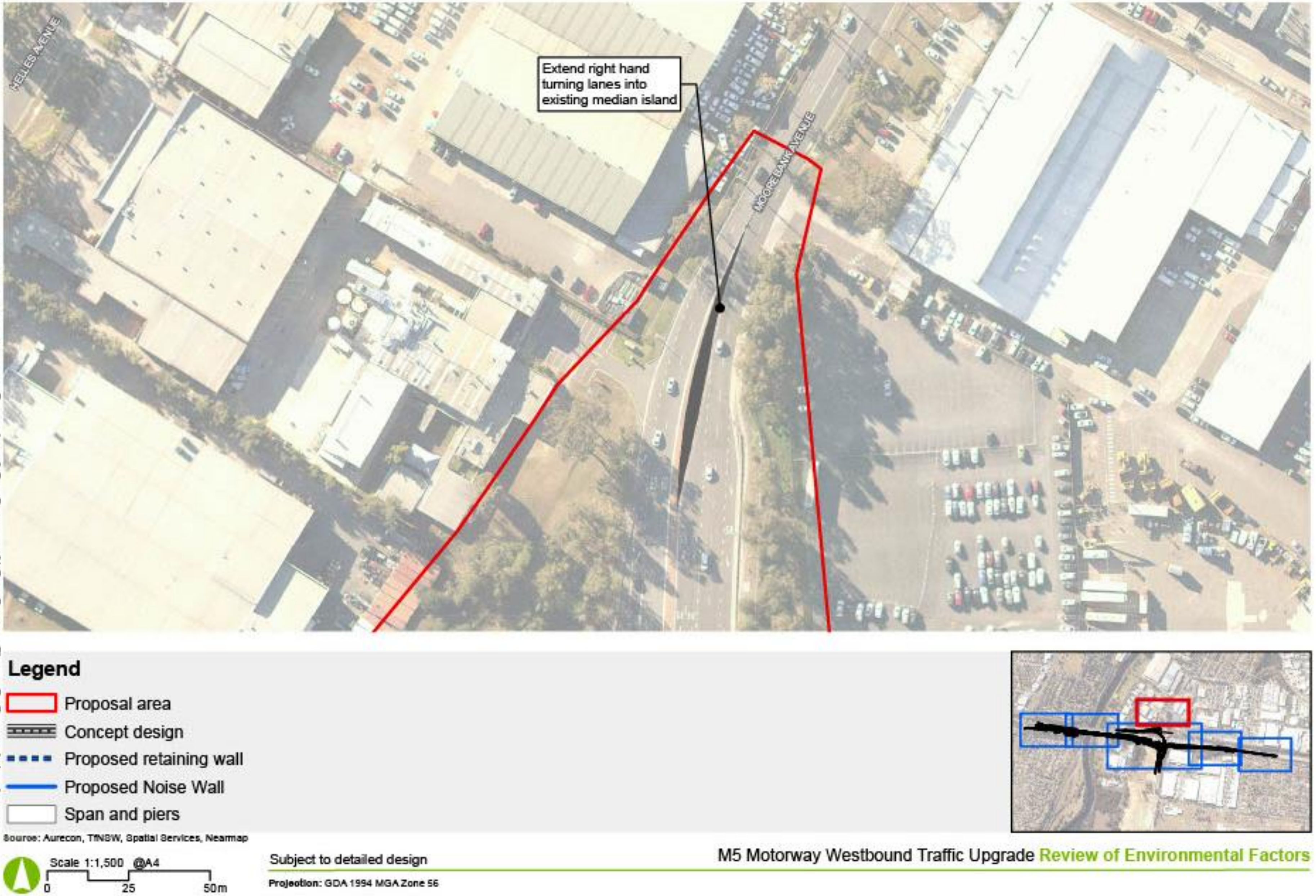


Figure 3-5 Key features

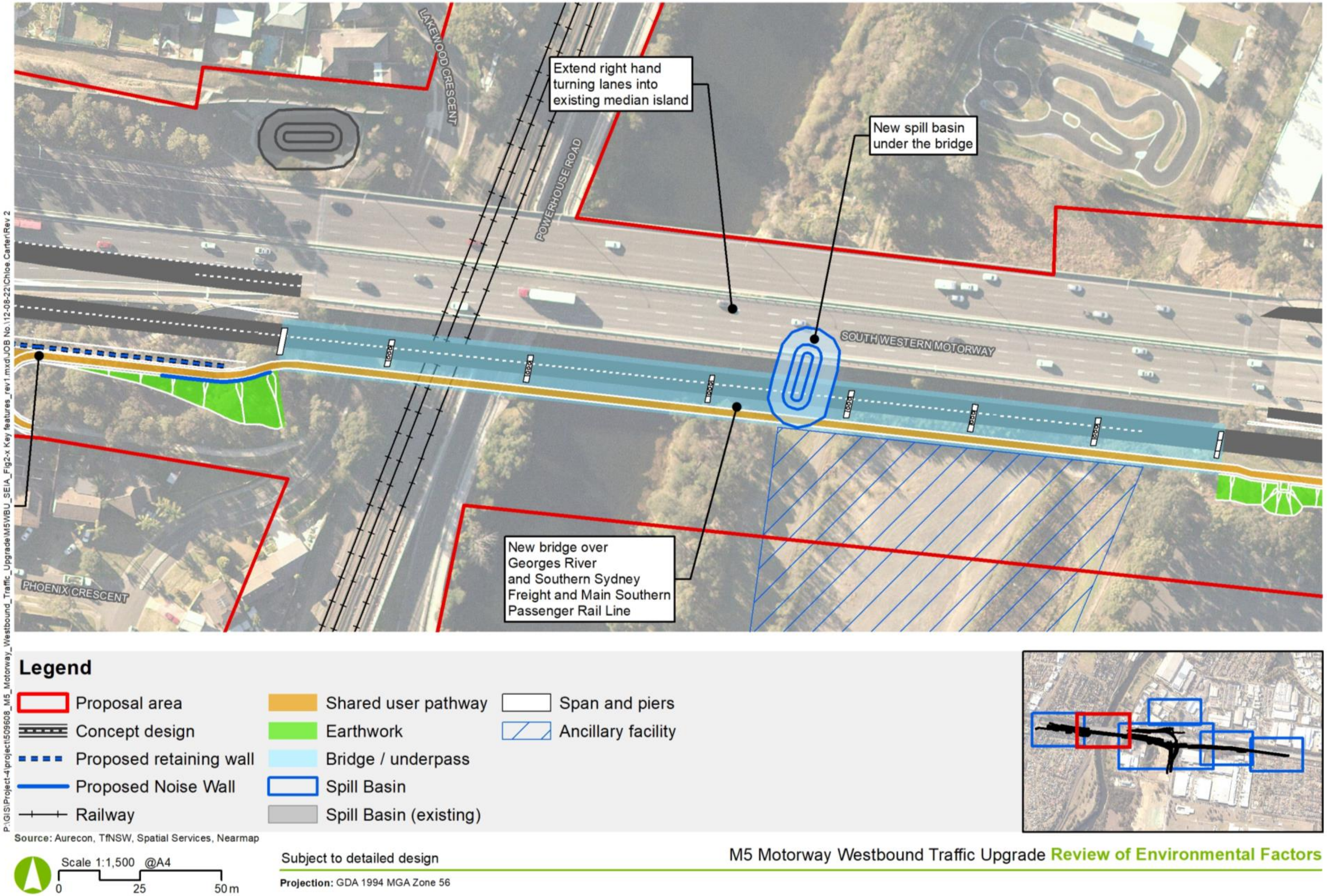


Figure 3-6 Key features

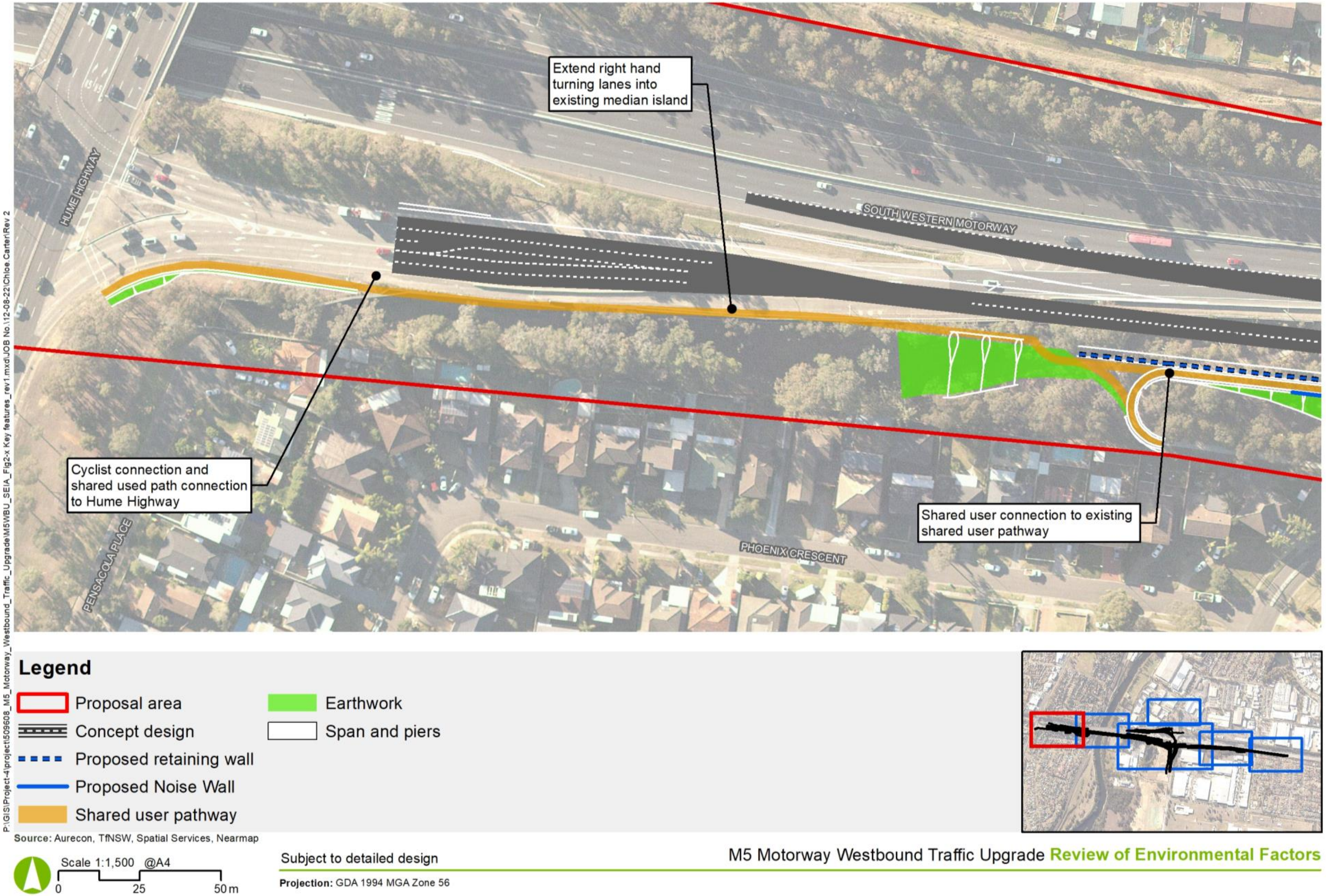


Figure 3-7 Key features

3.2 Design

A description of the proposal design is provided in the following sections and illustrated in Figure 3-2 to Figure 3-7.

3.2.1 Design criteria

The proposal has been designed to satisfy relevant design standards for road and structural design. The design criteria applied in the development of the proposal includes:

- *Guide to Road Design Austroads including Roads and Maritime Supplements (2016)*
- *Professional Services for Concept Design Scope and Requirements – PS201 for P.0011421 – M5 Motorway Westbound Traffic Upgrade (2020)*
- *Transport for NSW/Roads and Maritime QA Specification PS251 – Road Design, version for the M5 Motorway Westbound Traffic Upgrade (2020)*
- *Austroads Guide to Road Design Part 6A – Paths for Walking and Cycling (2017)AS1742 and AS1743*
- *RTA Delineation Guidelines*
- *RMS Guide Signposting Manual (2007)*
- *RMS Supplement to AS1742 Manual of uniform traffic control devices (2013).*

The bridge standards used in the design of the proposal include:

- *Professional Services for Concept Design Scope and Requirements – PS201 for P.0011421 – M5 Motorway Westbound Traffic Upgrade*
- *Professional Services for Bridge and Structure Concept Design – PS261 for P.0011421 – M5 Motorway Westbound Traffic Upgrade*
- *Roads and Maritime Bridgeworks Specifications*
- *Roads and Maritime Bridge Technical Directions (BTD's)*
- *Roads and Maritime Standard Bridge Drawings*
- *AS5100-2017 Bridge*
- *ESC 215 – Transit Space, Clause 6.2T HR CI 12002 ST – Durability Requirements for Civil Infrastructure.*

Elements of the proposal that have specific design criteria are listed in Table 3-1.

Table 3-1 Design criteria

Design feature	Criteria
Carriageway exiting from existing M5	Two lane carriageway
Design speed – roads	90 km/h
Posted speed limit – roads	80 km/h
Design speed – ramps	

Design feature	Criteria
New westbound Moorebank entry ramp onto M5 Motorway Existing Moorebank Entry Ramp	90 km/h 70 km/h
Posted speed – ramps New westbound Moorebank entry ramp onto M5 Motorway Existing Moorebank Entry Ramp	 80 km/h 60 km/h
Design speed – Shared user path	20 km/h
Turning movement	The design vehicle is a prime mover and semitrailer PBS Level 1 (20 m) as specified in Table PS251.A4 – Design Vehicle, with a 3-axle prime mover A-double (3-3-3) PBS Level 3 (36.5 m) as checking vehicle.
Minimum stopping sight distance (SSD)	On the two-lane carriageway for westbound traffic travelling to Hume Highway the minimum required SSD of 126 m for a design speed of 90 km/h with reaction time (Rt) = 1.5s and deceleration coefficient (d) = 0.36 has been achieved. Westbound traffic travelling to Moorebank Avenue from the shared exit complies with the minimum required SSD of 83 m for a design speed of 70 km/h with Rt = 1.5s and d = 0.36. For the connection allowing westbound traffic travelling from Moorebank Avenue to Hume Highway to diverge from traffic entering the M5 Motorway and join the new two lane carriageway, the minimum required SSD of 126 m for a design speed of 90 km/h with Rt = 1.5s and d = 0.36 has been achieved.
Horizontal alignment	R1500 m for 90 km/h, R560 m for 70 km/h
Maximum vertical grade	3 per cent
Traffic lane width mainline **Traffic lane width bridge** **Traffic land width underpass**	3.5 metres 3.5 metres 3.5 metres
Outside shoulder widths	1.0 metres

Design feature	Criteria
Inside shoulder widths	2.5 metres
Batter	2h:1V
Verge width	1.5 metres in fill 1.0 metre behind SO Kerb in Cut
Safety barriers	Austroads Guideline to Road Design, Part 6: Roadside Design, Safety and Barriers. The safety barrier products (including barrier terminals) considered as part of the road furniture design are: Safety barrier products currently accepted for use on classified roads in NSW including the relevant acceptance documentation; and Road and Maritime Roadworks Specification Model (Road) Drawings – Safety Barriers (R132).

3.2.2 Engineering constraints

Constraints identified during the design of the proposal include:

- The proposal area is narrow and workable space is constrained
- Known contaminated land on the eastern side of the Georges River within the proposal area
- Very limited opportunities to reduce posted speed limits and close traffic lanes for extended periods of time on the M5 Motorway during construction, without making lanes smaller
- Detours would be required for pedestrians/cyclists during the construction period
- The need for partial closure of Lakewood Crescent and Powerhouse Road during construction of the bridge over the Georges River, subject to consultation with Liverpool City Council and The Powerhouse Museum
- Limited opportunities to carry out construction work within the rail corridor due to limited scheduled rail possessions
- Unstable geotechnical conditions, including steep batters on the southern side of the proposal area and alluvium soils associated with floodplain deposits on the foreshore of the Georges River
- Need to avoid disruptions to utilities during construction in particular electricity, telecommunications, water and sewer
- Presence of residential properties and other environmentally sensitive areas including heritage features, threatened ecological communities and the Georges River

- Land around the Georges River forms part of the Georges River floodplain, with higher risk of inundation during flood events.

3.2.3 Major design features

M5 Motorway westbound exit to Hume Highway

A westbound exit ramp to the Hume Highway would be provided between the eastern side of Moorebank Avenue near the suburb of Wattle Grove. The ramp would be about 1.85 kilometres long and consist of two 3.5-metre-wide traffic lanes.

The ramp would include:

- A new exit from the M5 Motorway for traffic travelling westbound to the Hume Highway, replacing the existing M5 Motorway exit to the Hume Highway at Casula
- Minor lane reconfigurations to maintain access between Moorebank Avenue and the M5 Motorway and Hume Highway that split traffic entering the M5 Motorway, from traffic accessing the Hume Highway.

Advance signage would be posted on the M5 Motorway to provide motorway users with sufficient warning. Signage would also be installed at the start of the new exit ramp to direct bicycles and motor vehicles to the new exit ramp and Moorebank Avenue entry ramp. There would also be signage for the exit speed limit for both the exit ramps (posted as 80 kilometres per hour).

Further details are provided within Figure 3-2 and Figure 3-3.

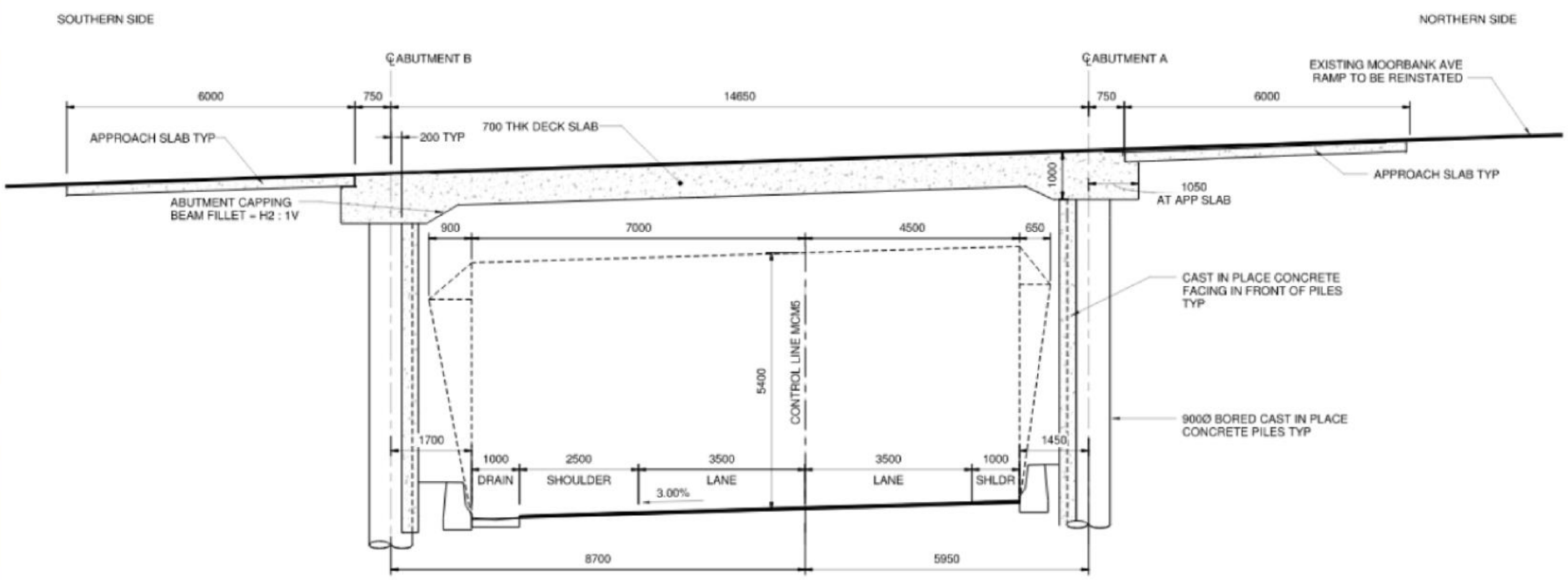
Moorebank Avenue underpass

The proposal includes two new lanes travelling under Moorebank Avenue towards the Hume Highway through a new underpass structure.

The underpass would be about 14 metres wide, with two lanes for westbound travel for vehicles exiting at the Hume Highway (3.5 metres wide per lane). The underpass would also have a 1.0 metre road shoulder on the northern side and a 2.5 metre shoulder on the southern side to allow for cyclists. The undercover length of the underpass would be about 60 metres, with the overall length of the underpass about 242 metres, including retaining walls on the approaches to the underpass.

The underpass would have a minimum height clearance of 5.4 metres in accordance with AS5100.1:2017. The bridge substructure (foundations) would be supported by concrete piles cast in place.

The proposed underpass and Moorebank Avenue intersection upgrade are shown on Figure 3-4. A cross section of the underpass is shown on Figure 3-8.



Source: Aurecon, TfNSW, Spatial Services, Nearmap

NO SCALE

M5 Motorway Westbound Traffic Upgrade

Subject to detailed design

Figure 3-8 Cross section of the underpass under Moorebank Avenue

Moorebank Avenue interchange

The Moorebank Avenue interchange work would include widening the Moorebank Avenue exit and entry ramps that connect Moorebank Avenue and the M5 Motorway. The widening work on Moorebank Avenue (south) would facilitate movements from the MLP to the M5 Motorway.

As shown in Figure 3-4, the Moorebank Avenue interchange work would include:

- Provision of a two-lane exit from the M5 Motorway eastbound to the northern side of Moorebank Avenue (exclusive left lane plus diverge from the adjacent through lane for exiting traffic)
- Widening of the eastbound exit from the M5 Motorway to the southern side of Moorebank Avenue to allow for three right turn lanes onto Moorebank Avenue
- Provision of a two-lane left turn from Moorebank Avenue northbound onto the M5 Motorway westbound
- Extension of the left turn lane on Moorebank Avenue northbound entry onto the M5 Motorway westbound
- Provision of a two-lane left turn from the M5 Motorway westbound onto Moorebank Avenue southbound
- Extension of the two-lane right turn bay from Moorebank Avenue southbound onto the M5 Motorway westbound
- Upgrade to the traffic signals at the intersection of M5 Motorway and Moorebank Avenue, including addition of signalised crossings on the northwest and northeast corners of the intersection and signalised crossings across the southern leg of the intersection.

Bridge over the Georges River

The proposal would include a new bridge over the Georges River and eastern floodplain. The bridge would also pass over Powerhouse Road, the Southern Sydney Freight Line, the Main Southern Passenger Rail Line and Lakewood Crescent in Casula. The existing bridges over Georges River would remain and would be used by vehicles travelling east and west on the M5 Motorway.

The bridge would be about 290 metres long and have two lanes for traffic travelling westbound and exiting to the Hume Highway. Traffic lanes would be 3.5 metres wide. A shared user path would be located along the southern side of the bridge (3.5 metres wide) and would be separated from the traffic lanes by a 2.5 metre road shoulder and concrete traffic barriers with steel railing. A 3.5 metre safety screen would shield the shared user path from the edge of the bridge on the southern side.

The design and features of the new bridge would be similar to those of the existing bridge over the Georges River. This would include the six new spans with new pier alignments to support the bridge and the height of the bridge over the river, rail corridor and local roads (with the clearance being no lower than the existing adjacent bridge). The clearance between the two bridges would be about 4.2 metres.

Where the bridge crosses over the Southern Sydney Freight Line and the Main Southern Passenger Rail Line, the vertical clearance would be 7.3 metres (in accordance with ARTC Code of Practice Section 7: Clearances, double stacking on a non-electrified line requires a minimum vertical clearance of 7.1 meters to Rollingstock Outline F). This would allow the future passage of double stacked container trains beneath on the Southern Sydney Freight Line.

A concrete deck would support the lanes of the new bridge, with associated support elements and drainage features. The six pier columns would have piles beneath the surface level to ground the bridge. Piers would be between 35 metres and 55 metres apart, with the longest distance between two piers being between pier four and pier five on either side of the Georges River. Two abutments (one on either side of the bridge) would connect the bridge to the approach slabs of the new exit ramp.

A concrete barrier with twin steel rails would be located on the northern side of the new bridge structure at about 1.4 metres high. Figure 3-9 shows the proposed new bridge across the Georges River.

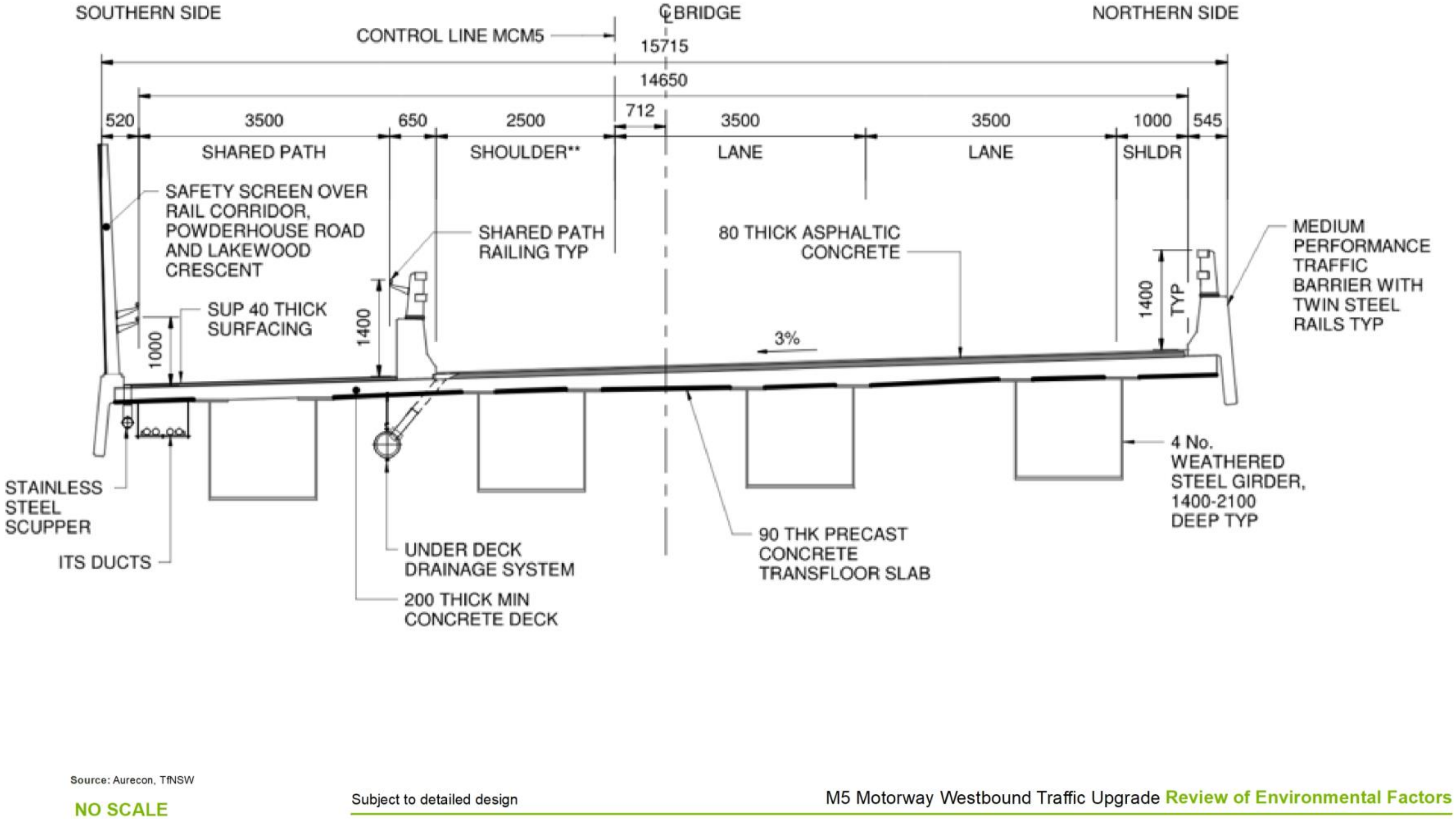


Figure 3-9 Cross section at span 6 of the new bridge over the Georges River

Connection to the Hume Highway

Figure 3-6 provides an illustration of the connection between the new M5 Motorway westbound off-ramp and the Hume Highway. Vegetation removal and earthworks would be required for the development of the new ramp connection. The existing noise wall on the southern side of the M5 Motorway would be adjusted to accommodate road widening for the new ramp. These features are discussed further in Section 3.2.4. New line marking would be provided for the new exit ramp and the traffic signals at the Hume Highway intersection would remain unchanged.

The two-lane exit ramp from the Georges River bridge continues for about 150 metres to tie into the existing exit at the Hume Highway at Casula. Both lanes would be about 3.5 metres wide.

There would be a new incident and management area located immediately west of the Georges River bridge. This area would be used for incident management and potential maintenance. A road shoulder would be provided on each side of the exit. The width of the road shoulder would be about 2.5 metres wide on the southern side of the road and about one metre wide on the northern shoulder. Cyclists would be permitted within the road shoulder on the southern side of the exit ramp, providing access to Casula and the Hume Highway.

Active transport connections

A new active transport connection would be developed for the proposal on the westbound side of the corridor with a shared user path from Moorebank Avenue to the Hume Highway (refer Figure 3-1).

Cycle lane

The shoulder of the new exit ramp would be accessible for cyclists to use (cycle lane). Cyclists would access the shoulder from the eastern extent of the new exit ramp. The shoulder would be about 2.5 metres wide at this point.

Cyclists would be directed to use the new underpass under Moorebank Avenue to continue westbound either onto the Hume Highway or further west on the M5 Motorway. Cyclists would be required to travel within the road shoulder in the underpass.

Access to Moorebank Avenue would be via the western side of the underpass. From the western side of Moorebank Avenue there would be an exit to the shared user path for cyclists wanting to use the path to travel westbound or onto Moorebank Avenue. Cyclists can exit onto the shared user pathway to travel westbound on the new bridge. Cyclists wanting to continue travelling westbound on the M5 Motorway would need to exit the underpass at the same location and continue to the Moorebank Avenue/ M5 Motorway intersection. They would be required to cross a single lane of traffic to then re-join the M5 Motorway via the existing entry ramp.

Shared user path

The shared user path from Moorebank Avenue towards the Hume Highway would connect from the western side of Moorebank Avenue with a maximum down grade (sloping down towards the west) of about five per cent. The shared user path would be about 800 metres long and about 3.5 metres wide.

The path would continue on the new bridge over the Georges River. There would be a 2.5 metre by 2.5 metre stub on the shared user pathway on the eastern side of the new bridge. The stub would be a concrete platform that would be installed to provide a link from the shared user pathway to a future proposed active transport connection below the new bridge, currently being investigated by Liverpool City Council.

On the western side of the bridge, pedestrians and cyclists travelling to Lakewood Crescent in Casula would exit along the new path, which would connect to the existing path. This would then connect with an existing downgrade (sloping down towards the east) of about 8.2 per cent. Due to the level difference between the new and existing paths, there may be a requirement to develop retaining walls and embankments on the southern side of the existing property boundary.

Signage would be installed along the shared user path, including line markings indicating that the shared user path is operational in both directions. A 3.5 metre safety screen would also be installed on the southern side of the shared user pathway. A road safety barrier would separate the road carriageway from the shared user path on the northern side. Refer Figure 3-2 to Figure 3-7 for the location of the proposed shared user pathway.

3.2.4 Other design features

Spill basins

There are three existing spill basins located within the proposal area. Of these, one spill basin located on the westbound side of the M5 Motorway (near Yulong Close, at the western end of the existing noise wall and residential area in Wattle Grove) would be removed to allow for the construction of the new Hume Highway exit ramp. This spill basin would not be required for the operation of the M5 Motorway with flows directed to the basin on the other side of the M5 Motorway, adjacent to the eastbound traffic. The area would be revegetated following the removal of the spill basin.

A new spill basin would be installed under the new bridge over the Georges River. The new spill basin would operate for the new Georges River bridge and eastern side of the proposal area. The spill basin would be concrete lined and fenced and would be designed to accommodate additional capacity that may be needed due to the increased road pavement surface on the M5 Motorway.

The existing spill basin on the eastbound side of the M5 Motorway in Liverpool (near Lakewood Crescent) would collect additional water, as a result of removal of one spill basin. However, this is not expected to have an impact on their capacity. Figure **3-10** provides the location of the existing basins, including the basin that would be removed, and the new basin.

Figure 3-10 Sediment basins

Structures

Retaining walls

There are four proposed retaining walls within the proposal area. The location of these walls are summarised in Table 3-2.

Table 3-2 Proposed retaining walls

Design feature (retaining wall number)	Location	Approximate length	Approximate height
1	East of Moorebank Avenue – the northern wall of the new exit ramp leading into the underpass	90 metres	6.2 metres
2	East of Moorebank Avenue – the southern wall of the new exit ramp leading into the underpass	74 metres	6.1 metres
3	West of Moorebank Avenue – the northern wall of the new exit ramp leading onto the new bridge	50 metres	2.9 metres
4	Along shared user path connection to Lakewood Crescent – between the new exit ramp and pathway	72 metres	3.9 metres

Noise walls

There are three existing noise walls that are located within the proposal area. The existing noise walls are located along the M5 Motorway corridor and are summarised in Table 3-3.

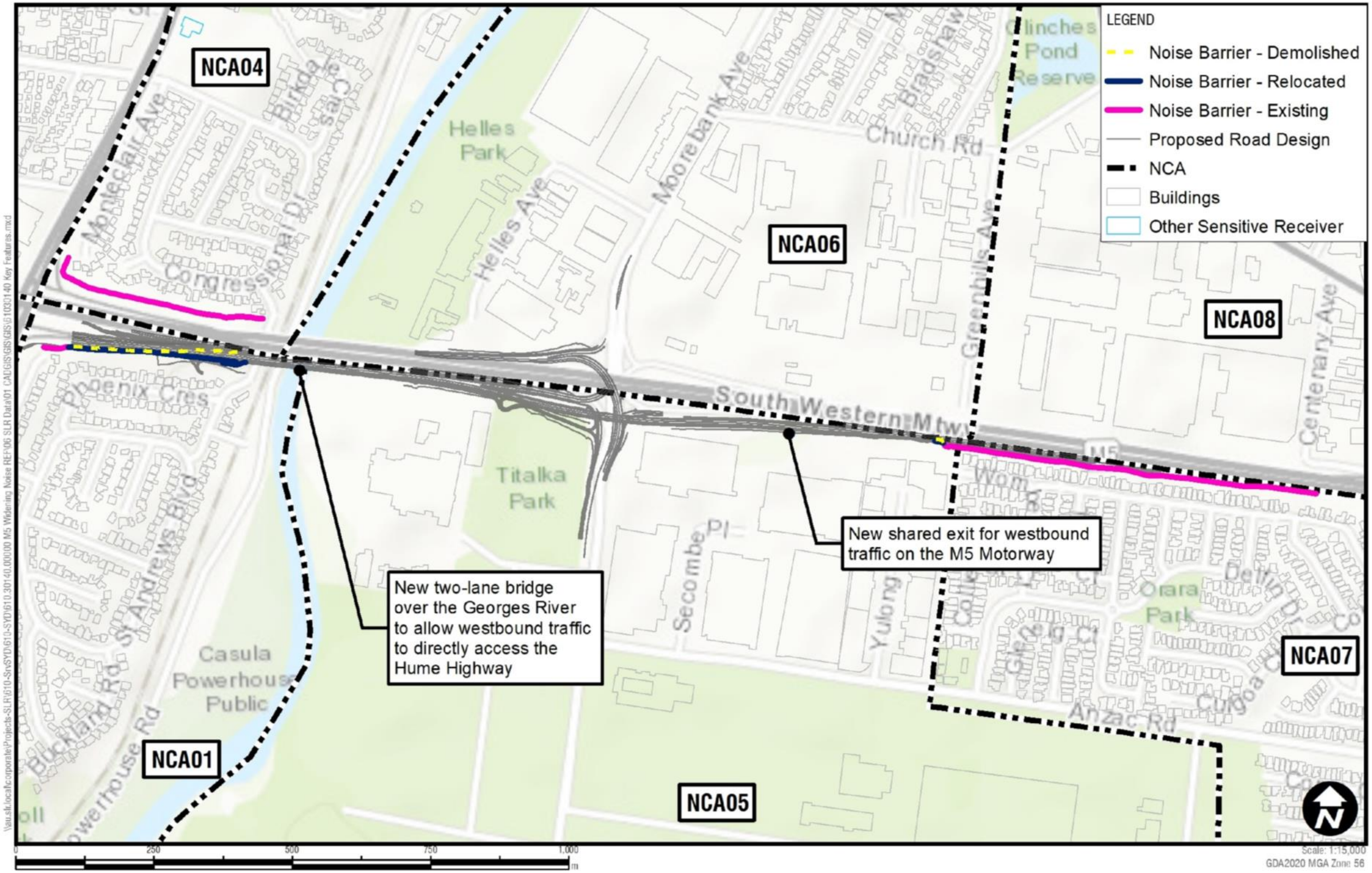
Table 3-3 Existing noise walls

Design feature (noise wall number)	Location	Existing noise wall height	Existing noise wall length	Length of noise wall impacted by the proposal
1	East of the Hume Highway, on the southern side of the M5 Motorway in Casula	Varying along the wall	375 metres	324 metres

Design feature (noise wall number)	Location	Existing noise wall height	Existing noise wall length	Length of noise wall impacted by the proposal
2	East of the Hume Highway, on the northern side of the M5 Motorway in Liverpool	Varying along the wall	145 metres	No impacts to this noise wall are expected
3	East of Moorebank Avenue on the westbound side of the M5 Motorway in Wattle Grove	Ranging between four to five metres	665 metres	25 metres

Adjustments to some of the existing noise walls would be carried out during construction due to the upgrade of the road corridor and the need to re-position some adjoining infrastructure.

Noise wall 1 would be adjusted to accommodate the new exit ramp and associated infrastructure including the shared user path and cyclist shoulder. Noise wall 3 would be adjusted to accommodate road widening work and the removal of the existing spill basin. The proposed changes to the existing noise walls are shown in **Figure 3-11**.



Source: Aurecon, TfNSW

M5 Motorway Westbound Traffic Upgrade **Review of Environmental Factors**

Figure 3-11 Proposed changes to existing noise walls

Drainage

A new drainage line would be located through the underpass which would collect runoff from the new work, along with the existing Moorebank Avenue exit ramp and a section of the westbound main carriageway. It would also collect runoff from the new bridge over the Georges River. Low flows within the new drainage line would be directed through a spill basin before discharging into the Georges River.

Currently, runoff from the westbound ramp to the Hume Highway is directed though an existing spill basin near Powerhouse Road, Liverpool, before discharging into the Georges River.

Some existing drainage culverts and pipes under the M5 Motorway would need to be adjusted and extended to allow for the proposal This would include:

- Relocation of stormwater pipes on the southern side of the M5 Motorway, between Yulong Close and the Georges River. These pipes would be relocated further south to accommodate the proposal. Relocation of these pipes would require a 75 metre long underbore beneath Moorebank Avenue (eastern underbore)
- Extension of stormwater pipes on the western side of the Georges River. Runoff would be collected from the new exit ramp and discharge to the existing spill basin, with runoff from the western portion of the exit ramp connecting to the existing line under the main M5 Motorway carriageway, and runoff from the eastern position of the exit ramp using a new drainage line. This drainage work would require attaching the pipe to a headstock on the existing bridge, west of the new bridge over the Georges River.

Landscape design

An Urban Design and Visual Impact Assessment report has been developed for the proposal. Based on the urban design principles in this report, the following landscape design recommendations are proposed:

- Landscape revegetation that reinforces the two main indigenous vegetation patterns including:
    - Castlereagh Scribbly Gum Forest
    - Cumberland River flat Forest
- Introduction of rock (drystone) retainer edges and local steepening of batters to minimise impacts to existing trees
- Varying of earthwork batters where feasible and where space permits
- Relocation of access tracks to the water quality basin
- Provision of landscaped buffer zones to private properties where possible
- Reinforcement of treed settings to complement existing stands of trees and to screen adjacent residences/ warehouses
- Integration of vegetated swales and infiltration areas to ends of culverts
- Establishment of hardy native grasses and low shrubs to wider median sections to assist in visually articulating and mitigating the new roadwork.

Intelligent Transport System, road infrastructure and signage

Intelligent Transport System

In accordance with the Smart Motorways guidelines, design and surveillance guidance, the Intelligent Transport System (ITS) equipment proposed for the proposal includes:

- Dual traffic detection loops and dual SCATS detection loops located in multiple sections of the proposal
- Two new CCTV cameras would be installed on a single pole between the proposed shared user path and barrier west of Moorebank Avenue on the westbound side of the M5 Motorway. This location was selected to provide access to the cameras for maintenance from the shared user path. One camera is to be located at a height that provides visibility of the underpass. The second camera would be mounted at a height that provides visibility of the exit ramp and shared user path across the new Georges River bridge. The existing CCTV camera would also be moved to the location of the proposed emergency telephone
- One additional web camera would be located on the northern side of the Moorebank Avenue interchange on the existing CCTV pole. This would face east and provide visibility of the M5 Motorway between the Moorebank Avenue and Heathcote Road interchanges
- One new emergency breakdown telephone would be installed east of the Georges River bridge, 90 metres from the existing exit ramp
- Relocation of the existing variable message sign (VMS) located east of Moorebank Avenue would be required to facilitate the widening work. The existing VMS would be relocated about 400 metres east from the new exit ramp. A new VMS is proposed before the Heathcote Road interchange, east of the proposal. The new VMS would provide advance warning to motorists travelling westbound on the M5 Motorway (as shown in Figure 3-2).
- A new ITS backbone conduit and pit arrangement is proposed for the full length of the proposal.

Most of the features listed above would require ducting, pits and cables to support the ITS operation.

Road infrastructure

Roadside furniture that would be installed for the proposal include:

- Safety barriers, including rigid concrete safety barriers (known as F-type barriers) and non-rigid barriers (W-beam barriers)
- Kerbs and gutters along the corridor.

Signage

Signage that would be installed for the proposal includes guidance signage, warning signage and active transport user signage.

Guidance signage

As a result of the widening work and installation of the new exit ramp to the Hume Highway, the existing guide signs would be removed and replaced by overhead mounted guide signs.

The route number to Hume Highway as well as all destinations displayed on the existing guide signs towards Hume Highway and Moorebank Avenue would be retained on the new sign face layouts.

Shared user path and cyclist signage

There would be signage for cyclists travelling westbound on the M5 Motorway within the road shoulder, between the Heathcote Road exit and Moorebank Avenue, to direct them to continue onto the new exit ramp toward the Hume Highway. There would also be signage after the new underpass to direct cyclists wanting to continue westbound on the M5 Motorway. These cyclists would need to travel to the M5 Motorway / Moorebank Avenue intersection and re-join the M5 Motorway via the existing entry ramp.

Standard regulatory and warning signs would also be installed on the M5 Motorway corridor. The installation of signposting and associated lateral and vertical clearance requirements would be carried out in accordance with the *RTA (Roads and Maritime) Installation and Maintenance of Signs guideline.*

3.3 Construction activities

This section provides a summary of the likely construction methodology, work hours, plant and equipment, and associated activities that would be used during construction of the proposal. This section is indicative only and may change once the Construction Contractor is engaged by Transport for NSW.

3.3.1 Work methodology

A construction environmental management plan (CEMP) would be developed prior to the commencement of construction. All construction activities would be carried out in accordance with the requirements of the CEMP to ensure that work complies with Transport for NSW's legislative requirements. Detailed work methodologies would be identified by the Construction Contractor.

The construction of the proposal is likely to be separated into six areas. These areas are:

- Area 1 – Eastern section: from the eastern end of the proposal area to Moorebank Avenue
- Area 2 – Underpass and its approaches, and the Moorebank Avenue and M5 Motorway upgrade
- Area 3 – Central section: between Moorebank Avenue and eastern side of the new bridge over the Georges River
- Area 4 – Bridge over Georges River
- Area 5 – Western section: from the western side of the new bridge over the Georges River to the Hume Highway (western end of the proposal)
- Area 6 – Northbound off ramp from the M5 Motorway to Moorebank Avenue.

Figure 3-12 provides an overview of the six areas proposed to be used during construction. Utility adjustments would be required across the different construction areas, as detailed in section 3.5.1.

Construction within each area would be carried out in stages. Each area would have construction stages that would occur concurrently where possible to reduce construction time and potential cumulative impacts. However, the construction methodology may not allow for this in some situations. Construction staging would specifically consider the proposal's potential adverse impact on surrounding sensitive land uses (particularly in relation to construction noise and vibration).

Indicative construction staging is presented in Table 3-4.

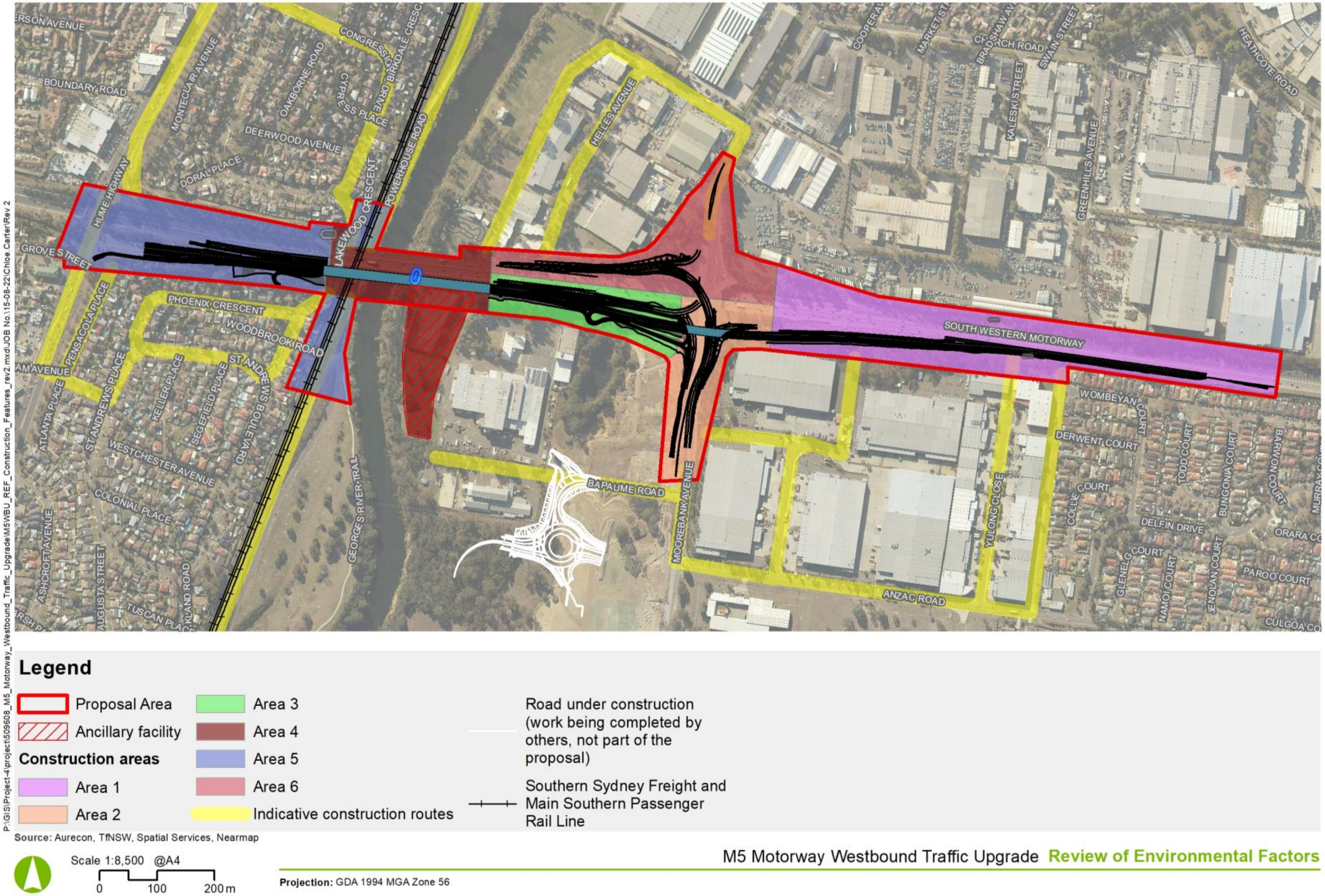


Figure 3-12 Construction features

Table 3-4 Indicative construction staging

Staging	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Preliminary stage (Stage 0)	Enabling work	Enabling work	Enabling work	Enabling work	Enabling work	Enabling work
Stage 1	Widening, embankment and pavement work adjacent to the M5 Motorway	Widening of Moorebank Avenue (western side)	Earthworks and drainage work to underside of bridge	Excavation work and construction of temporary piling access tracks and platforms	Initial earthwork and clearing to the underside the bridge abutment	Embankment widening to ramp and pavement widenings
Stage 2	Opening of construction entry access into the underpass.	Phase 1 of underpass construction (eastern side of Moorebank Avenue)	Tie in work westbound side of the on ramp to M5 Motorway	Undertake piling work for abutment and all piers and construction of bridge substructure, piers and abutments	Complete earthworks and pavement west of Georges River Bridge	Open new ramp widening and build additional right turn lane addition at junction
Stage 3	Pavement work to tie into the new underpass	Open eastern section of underpass and commence Phase 2 underpass construction (western side of Moorebank Avenue)	Complete earthworks, drainage and pavement work	Bridge superstructure construction including girder and in-situ deck construction.	Overlay of existing pavements on the approach to Hume Highway (night works). Complete bridge approach works, including road	Completion of wearing surface over full ramp works (night works)

Staging	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
					barriers and signposting.	
Stage 4	N/A	Open Moorebank Avenue to the final arrangement and complete underpass drainage, pavements and tie into roadwork either side of underpass	N/A	Bridge finishing work including barrier, rail, screen installation	After opening new work, delineate closure of new exit ramp to Hume Highway and remove pavement and rehabilitate area of old ramp pavement.	N/A
Stage 5	N/A	When all other areas are complete open new underpass to traffic	N/A	N/A	N/A	N/A

3.3.2 Key construction activities

Construction of the proposal is expected to involve the following key activities:

- Establishment work
- Utility relocation and protection
- Clearing and earthwork
- Bridge construction
- Underpass construction
- Widening and pavement work
- Landscaping and finishing work.

Establishment work

The establishment work for the proposal would include:

- Marking out of approved construction areas and fencing off environmentally sensitive areas
- Installation of erosion and sediment controls
- Removal of vegetation from within the proposal area
- Installation of fencing and construction lighting
- Establishment of ancillary facilities, including stockpiling/laydown areas, site offices and amenities.

Utility relocation and protection

Utility work would include:

- Protection of existing utilities that would remain during construction and operation
- Excavation and construction of new underground cutover locations within the existing utility network
- Installation of new poles to carry overhead services
- Excavation of trenches along the new utility routes
- Installation of new utilities within the trenches or onto new poles
- Testing and cutover of utilities into new infrastructure
- Decommissioning and removal of redundant utilities where required
- Commissioning of new utilities and shutdown utilities
- Trenchless installation of new utility routes
- Relocation of stormwater drainage.

Earthwork and clearing

The activities that would be carried out for earthwork and clearing would include:

- Clearing vegetation, including the removal and/or trimming of vegetation outlined in the REF and biodiversity assessment

- Stripping, stockpiling and management of topsoil and unsuitable material
- Excavation and fill to the road formation levels, including excavations for embankments and cuttings
- Disposal of unsuitable and/or surplus excavated material to a licensed facility
- Installation of new drainage lines, pits and subsoil drains to connect into the existing drainage lines.

Bridge construction

Construction of the bridge would use material from fabrication facilities and would be hauled into and stored within the ancillary facility. All concrete would be batched away from the site, with precast concrete elements also used. Construction of the bridge would include:

- Set up environmental controls within the waterway
- Sheet pile to stabilise Powerhouse Road and the riverbank
- Construction of a temporary wharf to provide construction access to the barge (including access for a crane and pile rigs). The temporary wharf would comprise a sheet piled structure with possible tie-back anchors
- Mobilise barge, including anchoring it to the riverbed and riverbank
- Construction of the bored piles
- Construction of the piers
- Construction of the headstocks
- Installation of pre-fabricated steel and concrete bridge beams
- Pouring of cast-in-situ deck with waste containment measures to capture water from the concrete curing to prevent it being released into the Georges River
- Completion of roadwork on bridge including asphalting, barrier and lighting installation.

Underpass construction

Construction of the underpass would include:

- Construction of the pile walls and capping beams in two stages, including traffic switching
- Construction of retaining walls for the underpass approach
- Construction of the deck, approach slabs and support beams in two stages, including traffic switching
- Excavation of material from underneath the newly constructed structure, add shotcrete and soil anchors
- Completion of roadwork and underpass fit out, including asphalting, barrier and fascia panel installation.

Widening and pavement work

The activities associated with the widening and pavement work would include work along the approaches of the new bridge, at the Moorebank Avenue interchange and at the proposed new exit ramp. This work would be required for the new exit ramp, shared user path, and tie in work to the existing road network. Work would include:

- Construction of new road pavement, including placing and compacting select fill, subbase and asphalt wearing surface
- Construction of new kerbs and gutters
- Tie in work to existing road network. Tie in work would include pavement connections, line marking, installation of new signage or amendments to existing signage, road furniture installation and adjustments and drainage work.

Landscaping and finishing work

Landscaping and finishing work would be carried out progressively throughout construction and would include:

- Installation of road furniture, including street lights, traffic signals and sign posting
- Rehabilitation of disturbed areas and landscape
- Line marking on road and pathway surfaces
- Removal of ancillary facilities and construction areas.

3.3.3 Construction hours and duration

Construction is expected to take about 40 months to complete, assuming no unforeseen disruptions.

The proposal would be constructed within standard and out of hours construction hours (OOHW). Standard construction hours and OOHW hours are shown in Table 3-5. Most work would be carried out during standard construction hours; however, it is anticipated that OOHW would also be required.

Work that can be carried out within standard construction hours is likely to include work that does not impede the operation of the M5 Motorway and existing road and rail networks. OOHW are likely to be for:

- Work that would require temporary access along sections of the M5 Motorway and Moorebank Avenue
- Tie in work along the M5 Motorway and at Moorebank Avenue
- Work that would require traffic switches outside of peak times to minimise traffic disruptions
- Work to adjust traffic signals at intersections
- Potential utility and drainage work, including relocations and adjustments
- Work on the western side of the bridge over the Georges River that is around the rail corridor.

OOHW would be carried out in accordance with the Construction Noise and Vibration Guidelines (Road and Maritime 2016).

The construction of the proposal would be staged; with generation limited to sections of the proposal area with active construction, therefore providing respite periods for receivers adjacent to other parts of the proposal area. More information about noise impacts is included in Section 6.1.

Table 3-5 Construction hours

Period of work	Monday to Friday	Saturday	Sunday and Public Holidays
Standard hours	7am to 6pm	8am to 1pm	No work
OOHW Period 1	6pm to 10pm	7am to 8am 1pm to 10pm	8am to 6pm
OOHW Period 2	10pm to 7am	10pm to 8am	6pm to 7am

Source: Construction Noise and Vibration Guidelines (Roads and Maritime 2016)

3.3.4 Plant and equipment

An indicative list of plant and equipment that would be required for the construction of the proposal is provided in Table 3-6. The final list of plant and equipment would be determined by the Construction Contractor prior to the commencement of construction.

Table 3-6 Plant and equipment

Phase of work	Typical plant/equipment
Establishment work	• Excavators • Chainsaws • Mulchers • Light vehicles • Trucks • Cranes • Water carts
Utility protection and relocation	• Excavators • Rigid and articulated trucks • Jackhammers • Cranes • Concrete pumps • Welding equipment • Concrete saws • Light vehicles • Concrete trucks • Generators • Oxy-cutting equipment • Cranes • Drilling rigs • Suction dredgers

Phase of work	Typical plant/equipment
Earthwork and clearing	• Excavators • Dump trucks • Compactors • Graders • Loaders • Profilers • Water carts • Bulldozers • Vibratory rollers • Rock breakers
Bridge construction	• Drilling rigs • Pile boring machines • Cranes • Barge • Water carts • Concrete trucks • Generators • Concrete pumps • Welding equipment • Suction dredge • Cutting rods • Hydraulic jacks • Launching trusses/ moving gantries
Underpass construction	• Drilling rigs • Pile boring machines • Cranes • Water carts • Concrete trucks • Generators • Concrete pumps • Welding equipment • Suction dredge • Cutting rods • Hydraulic jacks • Launching trusses/ moving gantries • Excavators • Dump trucks

Phase of work	Typical plant/equipment
	• Compactors • Graders • Loaders • Profilers • Water carts • Bulldozers • Vibratory rollers • Rock breakers
Widening and pavement work	• Concrete trucks • Concrete pumps • Vibratory rollers • Compactors • Concrete saws • Compressors • Bitumen sprayers • Generators • Milling machines • Trucks • Paving machines • Asphalt trucks • Rollers • Curing machines
Landscaping and finishing work	• Sprayers • Cranes • Generators • Trucks • Light vehicles

3.3.5 Earthworks

The proposal would require numerous sections of cut and fill. The main activities that would require cut and fill would be the construction of the bridge, underpass and the adjacent ramp construction areas.

The estimated quantities of materials associated with earthworks are provided in Table 3-7. The proposal would result in a total of about 34,200 cubic metres of cut material and about 28,000 cubic metres of fill material. The final earthwork requirements and source of materials would be confirmed during detail design.

Table 3-7 Earthwork estimated quantities

Design elements	Volume (cubic metres)
Eastern side of the proposal to the eastern side of the new bridge over the Georges River	Cut – 29,900 Fill – 14,200
From the western side of the new bridge over the Georges River to the Hume Highway	Cut – 4,300 Fill – 13,900

Note: These volumes are from proposed surface to the existing ground surface without taking into account work such as pavement boxing, top soil stripping.

Materials would be stockpiled within the proposed ancillary facility. The ancillary facility would be located about 40 metres east of the Georges River. Measures would be implemented to mitigate potential impacts associated with erosion and sediment runoff. This is outlined in Section 3.4 and Section 6.3 Management of materials and waste would be detailed in the Waste Management Plan (WMP) as part of the CEMP.

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:

- Natural resources such as aggregates and sand for use in concrete
- Pavement materials including heavily bound sub-base and asphalt concrete
- Manufactured items, including steel and precast components to build the the new bridge, kerbing, stormwater infrastructure, urban design features and other road infrastructure
- Water for dust suppression and concrete
- Relatively small quantities of additional materials such as paint, oils and fuels.

Wherever possible, materials would be sourced from commercial suppliers in nearby areas. Fill material would be imported from 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

Indicative construction traffic management and access arrangements for the proposal are outlined in the following section. The final construction traffic and access arrangements would be determined by the Construction Contractor prior to the commencement of construction.

Construction traffic and haulage routes

During the construction of the proposal there are expected to be both light and heavy vehicle movements within and surrounding the proposal area that would be typically associated with:

- Delivery of construction materials
- Spoil removal
- Importation of fill material for earthworks

- Delivery and removal of construction equipment and machinery
- Construction worker labour force moving to and from the proposal area.

Indicative construction traffic volumes are shown in Table 3-8.

Table 3-8 Indicative traffic volumes

Vehicle type	Average number of vehicles per day	Peak number of vehicles per day	Typical movement pattern
Heavy vehicles	45	135	Spread throughout the day with a morning peak period expected between 7:30 – 8:30 am and afternoon period expected between 4:00 – 5:00 pm
Light vehicles	100	200	Spread throughout the day with a morning peak period expected between 7:30 – 8:30 am and afternoon period expected between 4:00 – 5:00 pm
Oversized vehicles	0	4	Likely night arrivals due to traffic restrictions for oversized loads

The construction workforce traffic may be noticeable, particularly on local roads such as Lakewood Crescent, Powerhouse Road, Bapaume Road, Anzac Road, Nuwarra Road and Wattle Grove Drive. Construction workforce traffic would generally be less noticeable on busier roads, such as the M5 Motorway, Hume Highway and Moorebank Avenue, where such traffic would be relatively small compared to the existing traffic volumes. Upgrades may be required on roads to facilitate the safe movements of construction heavy vehicles.

The construction workforce would access the nominated ancillary facility and proposal area via a series of routes. These indicative haulage routes are shown in Figure 3-12. The local road network in Moorebank, Liverpool and Casula would be used to access the M5 Motorway and Moorebank Avenue on the northern and southern sides of the proposal area. Roads beneath the M5 Motorway and existing bridge over the Georges River would also be used. These roads include Lakewood Crescent and Powerhouse Road both run through Casula and Liverpool.

Two informal corridors would also be used to access the proposal area. This includes:

- The unnamed access track on the northern side of the proposal area accessible via Helles Avenue in Moorebank to the east of the Georges River
- The utility corridor on the southern side of the proposal area which forms the eastern border of the industrial area and western border of Wattle Grove.

Haulage routes would be confirmed during detailed design and would be included in the Traffic Management Plan.

Construction access arrangements

Changes to property access and the local road network

Construction of the proposal would require temporary changes to private property accesses and existing traffic movements. This includes changes in access to the active transport pathways within the construction areas in Casula and on the M5 Motorway. The existing cycle lane and shared user pathway on the M5 Motorway would remain open for as long as practicable. During traffic switching periods required for construction, particularly during the construction of the new underpass beneath Moorebank Avenue, temporary short-term closures of the cyclist lane are expected.

Access through private property would be required along the southern side of the M5 Motorway, between the eastern end of the proposal and the Georges River. Inter-property access arrangements would be required to access the M5 Motorway intersection with Moorebank Avenue. Access arrangements would be confirmed with these properties prior to construction.

Traffic switches on Moorebank Avenue during the construction of the underpass would be required. Speed limits on the M5 Motorway and within the proposal area during construction may be altered to 80 kilometres per hour during some construction activities. This is subject to Road Occupancy Licence (ROL) approval.

The construction of the new bridge may require temporarily partial closures of Powerhouse Road and Lakewood Crescent restricting north/south access for all road users. These closures would be for up to three weeks at a time and a detour for north/south travel between Casula and Liverpool would be implemented if required in this area. Detours during temporary access changes would be implemented with directional signage along alternate routes. In this instance, it is likely that people wanting access between Casula and Liverpool during temporary closures of Lakewood Crescent would need to use the Hume Highway as a detour to access each side of the M5 Motorway. Light vehicles and pedestrians would be able to access Powerhouse Road south of the M5 Motorway via Woodbrook Road as an alternate route. The Powerhouse Museum could also be accessed via the pedestrian overpass at Casula Station. Due to height restrictions on Woodbrook Road, large vehicle access would generally be maintained along Powerhouse Road. This would include access for garbage trucks. Impacts to changes in access are discussed further in Section 6.2.

Construction access points

There are six construction access points proposed for the development of the new shared user path, exit ramp to the Hume Highway and modified motorway exit to Moorebank Avenue. These include:

- A left turn into the eastern construction area from the M5 Motorway near Wattle Grove and a deceleration lane upstream of the eastern tie-in location
- A left-out access point on Moorebank Avenue, south of the existing off-ramp onto Moorebank Avenue (southbound)
- Access via the utility corridor between the M5 Motorway and Anzac Road which forms the eastern border of the businesses next to Wattle Grove. A temporary pavement may need to be placed along the utility corridor to provide a strong surface for heavy vehicles that could impact the services below. This assessment would be investigated during detail design
- Inter-property accesses via Secombe Place

- Access via Yulong Close in Moorebank. Access would be obtained using the access gate between two properties at the northern end of Yulong Close.

There are three access points proposed for the area to be constructed between Moorebank Avenue and the new bridge over the Georges River. These include:

- A left turn into the construction area from Moorebank Avenue northbound, along the dedicated left turn lane
- Access via Bapaume Road and partially through ABB Australia. This access point would be the main access to and from the proposed ancillary facility
- Access via the unnamed access track on the northern side of the proposal area accessible via Helles Avenue in Moorebank to the east of the Georges River. This access point would be another access to and from the proposed ancillary facility.

The western side of the proposal area between the bridge over the Georges River and the Hume Highway is located in a residential area. Residential roads would be used to access construction areas, including:

- Access using Pensacola Place via the Holston Street intersection, with the cul-de-sac proposed to be used as a right turn-in
- Access using Lakewood Crescent on either side of the proposal area via either St Andrews Boulevard, Casula or Congressional Drive, Liverpool
- Access using Powerhouse Road from Sheppard Street.

A roundabout south of the proposal and west of Moorebank Avenue is currently under construction and may be used as access to the ancillary facility. This is illustrated in Figure 3-12.

These residential streets are likely to be used during the construction of the new bridge over the Georges River when the structural elements of the bridge are being lifted into place. This may result in temporary parking changes for residents and visitors of the surrounding area. Impacts associated with parking and construction access are discussed in Section 6.2.

Traffic management measures

A construction Traffic Management Plan (TMP) would be developed prior to the construction of the proposal in accordance with the Traffic Control at Work Sites Manual (RTA, 2010) and Roads and Maritime Specification G10 – Traffic Management (Roads and Maritime, 2015). The TMP would provide details of the traffic management, including designated routes that construction traffic would use during construction. Timing of construction activities and traffic management for these would also be detailed.

Traffic management measures would include:

- Short-term closures of the active transport pathways within the proposal area in Casula and on the M5 Motorway
- Short-term closures of Powerhouse Road and Lakewood Crescent during construction of the Georges River bridge and associated implementation of detours (to be determined during detail design)
- Traffic switches on Moorebank Avenue during construction of the Moorebank Avenue underpass and minor detour routes
- Reduced speed limits on the M5 Motorway to 80 kilometres per hour

- Reduced speed limits on other roads within the proposal area to 40 kilometres per hour during some construction activities.

Potential traffic and access impacts are discussed further in Section 6.2 and the Traffic and Transport Assessment provided in Appendix D.

Rail possessions

Rail possessions over the Southern Sydney Freight and Main Southern Passenger Rail Line would be required during construction of the new bridge. Possessions would occur for both lines at the same time to lift the individual bridge components in place. Up to three track possessions may be required depending on the utility relocations required for the proposal. Possession periods would occur during the Sydney Trains and ARTC shutdown periods. More information about train movements and peak periods are provided in Section 6.7 and 6.13.

River navigation

A crane barge would be required to construct the bridge over the Georges River. The barge would in place for up to nine months and would restrict access along the river. However, due to the moveable nature of the barge access would not be restricted for the entire duration it is in the river.

3.4 Ancillary facilities

An ancillary facility would be used for:

- Site offices, amenities and parking
- Delivery and storage of stockpiles, materials, equipment and structural elements
- An area for fabrication and assembly. This would primarily be for the assembly of the superstructure for the new bridge. Elements such as piles piers and deck slabs would use a standard construction method of temporary formwork and falsework.

The nominated main ancillary facility would be located on vacant land on the eastern side of the Georges River, south of the M5 Motorway corridor. This site would provide close access to the motorway and its surrounding features, as well as provide space for final fabrication and storage. The site is currently owned by Liverpool City Council and is zoned as RE1-Public recreation under the *Liverpool Local Environmental Plan 2008.*

The ancillary facility is located on Lot 11 DP 881265 and is about 1.95 hectares. Dense riparian vegetation borders the site to the west, separating the property from the Georges River. Most of the site is cleared land with some grassed areas. An industrial facility (the ABB facility) borders the site to east and the M5 Motorway borders the site to the north. Additional smaller sites may be identified as required, at a later stage of design or construction.

The main ancillary facility is located about 40 metres from the Georges River to allow for a sufficient buffer in case of any risks associated with flooding, erosion and sedimentation. This area is a flood prone area, which is prone to flooding in the five per cent annual exceedance probability (AEP) event (20 year average recurrence interval (ARI) event). More information about the potential flooding impacts associated with the use of the ancillary facility is provided in Section 6.3.3.

The location of the ancillary facility has also been identified as a contaminated site, previously used as a landfill area. More information about the previous use and potential impacts during construction within this area is provided in Section 6.6.

No other viable compound sites were identified during the Concept Design phase; however, additional or alternative sites may be required if appropriate measures are not put in place to manage contamination issues prior to work commencing. The site is expected to be remediated by Liverpool City Council prior to Transport for NSW using the site, however there may still be potential landfill gas risks that would be further considered by the Construction Contractor. Transport for NSW would operate under any conditions as required by Council's Remedial Action Plan (RAP).

The facility would have measures to mitigate potential erosion and sediment runoff, which would be detailed in the CEMP. Information about the installation and decommission of the ancillary facility would be provided prior to construction by the Construction Contractor.

The ancillary facility would be accessible via the ABB facility, using Bapaume Road in Moorebank and/or the Helles Road track. The location of the proposed ancillary facility is shown in Figure 3-12.

3.5 Public utility adjustment

Preliminary investigations were carried out for the proposal to review the existing utilities within the proposal area. A desktop review of the existing services has been completed based on Dial Before You Dig (DBYD) data (dated 13/07/2020), Transport for NSW survey data and the geometric bridge and road design. Of the utilities investigated, the following high-risk utilities were identified:

- Sydney Water DN750 wastewater pressure main
- High pressure gas main
- Existing 11kV crossing in Moorebank Ave Bridge conduits
- Connection of relocations – these may need to extend to the opposite side of the motorway.

Consultation with utility providers would be carried out prior to the commencement of construction to mitigate potential impacts. A summary of consultation activities with utilities providers and Transport for NSW following DBYD searches is provided below:

- Telstra – Transport for NSW requested that Telstra provide concept plan and concept scope of work. This was to include budgetary estimate for time and cost.
- Jemena – a meeting was organised to discuss potential impacts to utilities in November 2020. Transport for NSW requested that Jemena provide a clash study, budget estimate and advice on any further required design and risk assessments.
- Sydney Water – Transport for NSW requested that more details for concept design be obtained with the scope to focus on critical work.
- Endeavour Energy – Transport for NSW requested that more details for concept design be obtained and that the scope is to focus on critical work. Future plans for the M5 Motorway crossing were also discussed. Endeavour Energy have confirmed that the future transmission upgrade plans for the intermodal terminal would not affect the proposal.

3.5.1 Utility adjustments and relocations

A number of utility adjustments and relocations would be required as part of the proposal. Most utilities located under the motorway would be sleeved by encasing pipes to protect them from surface work.

Table 3-9 provides a summary of the proposed utility adjustments and relocations required for the proposal.

Table 3-9 Utility relocations

Unique Identifier	Utility provider	Type	Relocation details	Location of proposed utilities work
E01	Endeavour Energy	Electrical services	Relocate to new column locations	Within construction area 5
E03	Endeavour Energy	Electrical services	Relocate to new column locations	Within construction area 5
E04	Endeavour Energy	Electrical services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3
E10a	Endeavour Energy	Electrical services	OH pole to be relocated south and underground conduits extended.	Within construction area 4
E18	Endeavour Energy	Electrical services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3
E20	Endeavour Energy	Electrical services	Relocate to east as trenchless crossing of motorway	Within construction area 2
T1a	Telstra	Telecommunication services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3
T1b	Telstra	Telecommunication services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3
T1c	Telstra	Telecommunication services	Relocate to west as trenchless crossing of motorway	Within construction area 2

Unique Identifier	Utility provider	Type	Relocation details	Location of proposed utilities work
T2	Telstra	Telecommunication services	Relocate along southern boundary to the east	Within construction area 2
OPS2	Optus	Telecommunication services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3
N1a	NBN	Telecommunication services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3
W4	Sydney Water	Water services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3
W5	Sydney Water	Water services	Connection to be checked and maintained	Within construction area 2
S3	Sydney Water	Wastewater services	Relocate along southern boundary to east	Within construction area 2
S4c	Sydney Water	Wastewater services	Relocate on south east corner	Within construction area 2
G6	Jemena	Gas services	Relocate to west as trenchless crossing of motorway	Within construction area 2/3

3.6 Property acquisition

The proposal would require the acquisition of private property, as documented in Table 3-10. This would include the permanent partial acquisition of six areas. No residential properties would be acquired for the proposal, with all acquisition limited to land either owned by Liverpool City Council, the Commonwealth or private businesses (comprising vacant industrial zoned land).

Property acquisition would be in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.

Temporary leasing of privately owned property would also be required to enable construction of the proposal. This would include the leasing of a parcel of land from Liverpool City Council for the proposed main ancillary facility site and additional areas for access to and from the proposal area.

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 work is required to commence, therefore a temporary lease would be agreed with these landholders.

Details about the proposed property acquisition are provided in Table 3-10 and leasing requirements for the proposal in Table 3-11 and shown in Figure 3-13.

Table 3-10 Proposed permanent property acquisition

ID	Description	Total area (m^2 approximate only)	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
1	Required for the widening between Moorebank Avenue and the ABB property. This area would be used for the shared user path, earthworks, and utility relocation	5,117	Partial – permanent	Commonwealth land	LOT 100/ DP1049508	IN1 – General industrial
2	To be acquired for the widening in front of the ABB property on the westbound side of the proposal. This area would be used for the shared user path and earthworks	401	Partial – permanent	Private	LOT 2/ DP547293	IN1 – General industrial
3	To be acquired for the widening in front of the ABB property. This area would be used for the shared user path and earthworks	3,130	Partial – permanent	Private	LOT 2/ DP32998	IN1 – General industrial
4	This area would be used for the new bridge	3,090	Partial – permanent	Liverpool City Council	LOT 11/ DP881265	W1 – Natural waterways
5	To be used for access to construction area from Secombe Avenue	2,370	Partial – permanent	Private	LOT 21/ DP1075884	IN1 – General industrial
6	To be used for upgrades on the Moorebank Avenue off ramp.	132	Partial- permanent	Private	LOT 1/ DP778777	IN1 – General industrial

Table 3-11 Proposed temporary property acquisition

ID	Description	Total area (m^2 approximate only)	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
6	To be leased during construction for the location on the ancillary facility	22,470	Partial – temporary	Liverpool City Council	LOT 11/ DP881265	RE1 – Public recreation
7	To be leased during construction for the access to the M5 Motorway	1,120	Partial – temporary	Private	LOT1/ DP778777	IN1 – General Industrial
8	To be leased during construction for access to construction area from Yulong Close	455	Partial – temporary	Private	LOT 21/ DP1075884	IN1 – General industrial
9	To be leased for the widening between Moorebank Avenue and the ABB property	145	Partial – temporary	Private	LOT 100/ DP1049508	IN1 – General industrial
11	To be leased during construction for access to ancillary facility from Bapaume Road	4,995	Partial – temporary	Private	LOT3/ DP32998	IN1 – General industrial

ID	Description	Total area (m^2 approximate only)	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
12	To be leased during construction for the access to the M5 Motorway	425	Partial – temporary	Private	SP35510	IN1 – General Industrial
13	To be leased during construction for access to construction area from Anzac Road	8,810	Partial – temporary	Private	Multiple (as shown in the Figure 3-13 below)	RE1 – Public recreation
14	To be leased during construction for access to construction area from Secombe Place	2,370	Partial – temporary	Private	Multiple (as shown in the Figure 3-13 below)	IN1 – General Industrial

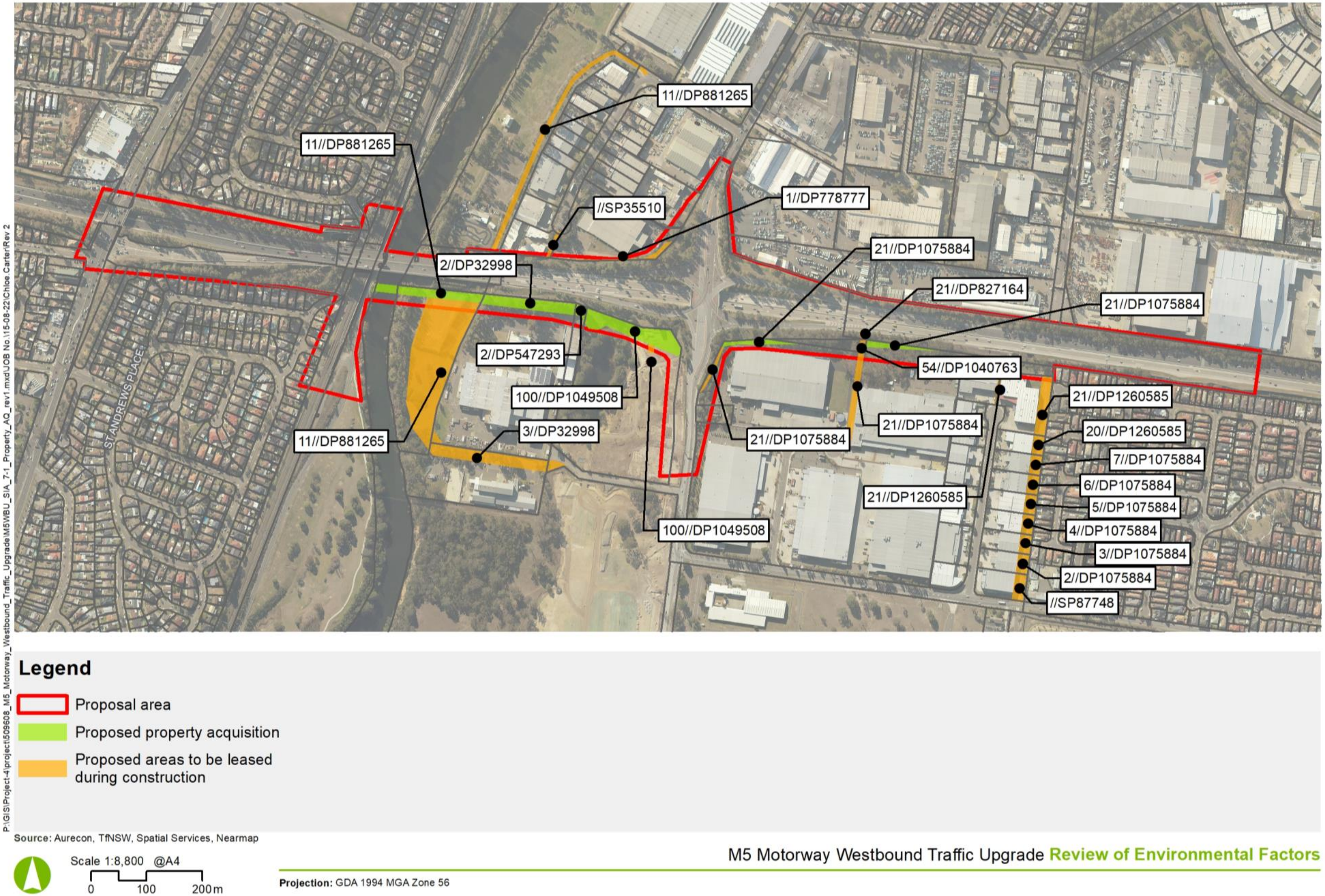


Figure 3-13 Proposed property acquisition

4 Statutory 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 (Transport and Infrastructure) 2021

As of 1 March 2022, the State Environmental Planning Policies (SEPP) have been consolidated. The State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) was repealed and replaced with State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP).

Statutory consultation (required under Part 2 of ISEPP) for the proposal was completed prior to 1 March 2022 and, therefore, made reference to the now repealed ISEPP. Notwithstanding, the consultation requirements are unchanged from the repealed ISEPP to the new Transport and Infrastructure SEPP.

The Transport and Infrastructure SEPP aims to facilitate the effective delivery of infrastructure across the State. Section 2.108 of Transport and Infrastructure SEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road and road infrastructure, and it is to be carried out on behalf of Transport for NSW, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent from Liverpool City 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 (Resilience and Hazards) 2021, State Environmental Planning Policy (Planning Systems) 2021 or State Environmental Planning Policy (Precincts – Regional) 2021.

Part 2.2 of Transport and Infrastructure SEPP 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 Transport and Infrastructure SEPP (where applicable), is discussed in chapter 5 of this REF.

State Environmental Planning Policy (Biodiversity and Conservation) 2021

The Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment 1999 (GMREP) was consolidated into the chapter 11 of SEPP (Biodiversity and Conservation). This SEPP provides planning principles that apply to land within the Georges River Catchment. The GMREP aims to maintain and improve water quality and river flows of the Georges River to ensure that development avoids and/or minimises impacts to the catchment. The other objectives of the GMREP include the need to protect and enhance the environmental quality of the catchment, manage the use of resources in the catchment and deliver the principles of ecologically sustainable development within the catchment.

Part 11.2, Clause 11.5 of the GMREP states that the planning principles identified in the plan apply when a public authority proposes to carry out development or an activity which does not require development consent but which has the potential to adversely affect the water quality, river flows, flood regime or ecosystems within the catchment.

The proposal is consistent with the objectives and planning principles of the GMREP. The proposal has considered potential impacts to water quality, river flows, flooding and ecosystems within the catchment, including erosion and sedimentation and potential water quality impacts, as discussed in Section 6.4 of the REF. Mitigation measures to avoid and reduce the potential impacts on the Georges River are included in Section 7.2.

Table 4-1 outlines how the principles from the Georges River Catchment REP have been considered and addressed in this REF.

Table 4-1 Consideration of the Georges River Catchment REP planning principles

Georges River REP principle	Where considered or addressed
General planning principles	
a) the aims, objectives, and planning principles of this plan;	As detailed in the following sections of this table, the aims, objectives and planning principles of the REP are considered throughout the REF.
b) the likely effect of the proposed plan, development or activity on adjacent or downstream local government areas;	Chapter 6 (Environmental assessment) examines the potential impacts of the proposal on the environment in the immediate vicinity of the proposal, as well as downstream where applicable. Safeguards and management measures have been identified to avoid, minimise or mitigate potential impacts on all receivers, where relevant (refer to Section 7.2).
c) the cumulative impact of the proposed development or activity on the Georges River or its tributaries,	Sections 6.3 and 6.4 outline the potential impacts of the proposal on water quality and hydrology, with a focus on the Georges River. The assessment considered the impacts of the proposal, including cumulative impacts with other known developments.
d) any relevant plans of management including any River and Water Management Plans approved by the Minister for Environment and the Minister for Land and Water Conservation and best practice guidelines approved by the Department of Urban Affairs and Planning (all of which are available	The plans of management considered include but are not limited to: • NSW Metropolitan Water Plan • Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (2011)

Georges River REP principle	Where considered or addressed
from the respective offices of those Departments);	• Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources (2011) These plans have been considered as part of this document and the assessment is consistent with the objectives and requirements of the plans. This is further outlined in Section 6.3.2 and Appendix E and F.
e) the Georges River Catchment Regional Planning Strategy (prepared by, and available from the offices of, the Department of Urban Affairs and Planning);	The NSW Office of Water and the NSW Office of Environment and Heritage (OEH) Water Quality Objectives (WQOs) and the River Flow Objectives (RFOs) for the Georges River catchment supersede the Georges River Catchment Strategy (which is an old document). The specific WQOs and the RFOs are considered for the proposal within Section 6.4. The proposal would meet the specific WQOs.
f) all relevant State Government policies, manuals and guidelines of which the council, consent authority, public authority or person has notice; and	The assessment of hydrology and water quality impacts has been based on: • NSW Water Quality and River Flow Objectives • NSW State Groundwater Policy Framework • NSW Aquifer Interference Policy • NSW Metropolitan Water Plan Relevant legislation and guidelines are further outlined in Section 6.3.2.
g) whether there are any feasible alternatives to the development or other proposal concerned.	Section 2.4 discusses the alternatives identified for the proposal and justifies the preferred option.
Specific planning principles	
(1) Acid sulfate soils **Disturbance of acid sulfate soil areas is to be avoided or minimised and those areas are to be protected in accordance with the requirements set out in the Acid Sulfate Soils Assessment and Management Guidelines prepared by the Acid Sulfate Soils Management Advisory Committee.**	A review of the acid sulfate soil (ASS) mapping on the Australian Soil Resource Information System (ASRIS) identified that there is a low probability of encountering ASS within most of the proposal footprint (CSIRO, 2014). Within the Georges River there is a high probability of encountering ASS, however minimal construction work would occur in the river. As such, it is unlikely that ASS would be disturbed

Georges River REP principle	Where considered or addressed
Measures to minimise that disturbance are to take into account the following— **(a) verification of the existence, locations and extent of acid sulfate soils,** **(b) the capacity of land to sustain the proposed land uses, having regard to—** **(i) potential impacts on surface and groundwater quality and quantity, and** **(ii) potential impacts on ecosystems and on biodiversity, and** **(iii) potential impacts on agricultural, fisheries and aquaculture productivity, and** **(iv) any likely engineering constraints and impacts on infrastructure, and** **(v) cumulative environmental impacts.**	during construction or operation of the proposal.
(2) Bank disturbance **Disturbance of the bank or foreshore along the Georges River and its tributaries is to be avoided and those areas and any adjoining open space or vegetated buffer area must be protected from degradation.**	The construction methodology and materials required for the temporary access to the Georges River, would be subject to design input from a soil conservation specialist and approved construction work method statements, where disturbance of the bank is required. Appropriate erosion and sediment control including progressive stabilisation plans and severe weather event plans would be implemented to mitigate risk of bank disturbance during construction. Disturbed areas would be restored on completion and design features including formalised drainage outlets with scour protection would assist to alleviate risk of bank disturbance during operation. The final safeguards and mitigation measures to be implemented during construction to minimise bank disturbance would be outlined in the Soil and Water Management Plan as part of the CEMP.
(3) Flooding	As discussed in Section 6.3, the proposed ancillary facility is located on

Georges River REP principle	Where considered or addressed
The following are to be recognised— **(a) the benefits of periodic flooding to wetland and other riverine ecosystems,** **(b) the pollution hazard posed by development on flood liable land in the event of a flood,** **(c) the cumulative environmental effect of development on the behaviour of flood water and the importance of not filling flood prone land.**	land that is prone to flooding in the five per cent AEP (ie flood once every 20 years). Flood events during construction could inundate this area and result in loss and/or damage of plant, equipment and construction materials. The use of a temporary barge in the Georges River during construction may also pose a risk during flooding. However, the moveable nature of this barge reduces the risk as it could be moved to a safer location prior to a forecast flood event. Construction impacts would be temporary, as the proposed ancillary facility would be removed and rehabilitated for the operation of the proposal. In addition, the proposed ancillary facility would be designed to minimise the potential impacts, such as the location of portable buildings and large unsecured construction objects. During operation, there would be no significant changes in the flood behaviour of the Georges River due to the proposal. There would be increases in peak flood levels of up to 20 millimetres upstream of the proposed bridge in flood events up to and including the probable maximum flood event. This increase in peak flood levels would affect twelve residential properties located south of the Georges River bridge on either side of the bank; however, significant risk to buildings is not expected.
(4) Industrial discharges **The discharging of industrial waste into the Georges River or its tributaries must be avoided and the requirements of the relevant consent authority and licensing authority must be met in those instances where industrial discharges into the river and its tributaries occur.**	The proposal would not involve any discharging of industrial waste into the Georges River or its tributaries.
(5) Land degradation **Land degradation processes, such as—**	Potential land degradation and contamination impacts as a result of the proposal are discussed in Sections 6.4 and 6.5.

Georges River REP principle	Where considered or addressed
(a) erosion, **(b) sedimentation,** **(c) deterioration of soil structure,** **(d) significant loss of native vegetation,** **(e) pollution of ground or surface water,** **(f)soil salinity and acidity, and** **(g) adverse effects on habitats and sensitive natural environments (aquatic and terrestrial) within the Catchment, must be avoided where possible, and minimised where avoidance is not possible.**	Where potential impacts have been identified, safeguards and mitigation measures have been proposed, to avoid or minimise these impacts.
(6) On-site sewage management **The potential adverse environmental and health impact associated with effluent disposal is to be recognised and guarded against by meeting the criteria set out in the Environment Health Protection Guidelines: On-site Sewage Management for single households and the provisions of the Local Government (Approvals) Regulation 1993.**	On-site sewerage management would be required. Sewage waste would be disposed of by a licensed waste contractor in accordance with Sydney Water and NSW Office of Environment and Heritage requirements.
(7) River-related uses **Uses located on immediate foreshore land on the Georges River and its tributaries must be water-related and public access to the foreshore of the river and its tributaries must be provided in order to enhance the environment of the Catchment.**	The proposal would not change the existing use of the land for the Georges River bridge. There would be temporary changes to the use of the Georges River during construction of the bridge. A crane barge would be in the river for up to nine months, however, would not restrict river access for this whole time. Foreshore access would also be restricted to the public during this time. No additional land uses would be permanently established on foreshore land as a result of the proposal.
(8) Sewer overflows **The adverse impact of sewer overflows, including exfiltration, on the environment within the Catchment, and specifically on the water quality of the river and its tributaries, is to be recognised and that issue is to be addressed through**	The sewer system would be designed in accordance with relevant standards including the Australia Guidelines for Water Recycling: Managing Health and Environmental Risk (Environment Protection and Heritage Council, the Natural Resource Management

Georges River REP principle	Where considered or addressed
appropriate planning and management of development within the Catchment.	Ministerial Council and the Australian Health Ministers' Conference 2006). Capacity issues of the on-site sewage system would be investigated at detailed design. The design would take into consideration the potential impacts of sewer overflows on the environment. As part of the construction process, the proposal would ensure that relevant infrastructure has the capacity to manage generated sewage (with upgrades carried out as necessary).
(9) Urban/stormwater runoff **The impacts of stormwater runoff, including sewage contaminated runoff into or near streams within the Catchment, is to be minimised and mitigation measures that address urban stormwater runoff are to be implemented in accordance with the local council requirements and the Managing Urban Stormwater series of documents.** **Development is also to be in accordance with the NSW State Rivers and Estuaries Policy available from offices of the Department of Urban Affairs and Planning.** **Stormwater management must be integrated so that quality, quantity and land use aspects are all encompassed.**	Potential impacts associated with stormwater runoff during construction and operation of the proposal are discussed in Section 6.4. To minimise the potential impacts, safeguards and management measures would be implemented, including implementation of a Soil and Water Management Plan, site specific Erosion and Sediment Control Plans.
(10) Urban development areas **The environment within the Catchment is to be protected by ensuring that new or expanding urban development areas are developed in accordance with the Urban Development Program and the Metropolitan Strategy and that the requirements of the NSW Floodplain Development Policy and Manual (prepared by and available from the Department of Land and Water Conservation) are also satisfied. It is important to ensure that the level of nutrients entering the waterways and**	The proposal would increase the total area of impervious surfaces in the catchment which would have a marginal increase of pollutants to the surrounding environment, including the Georges River. However, due to the size of the catchment and the marginal increase impacts to the ecological condition of the wider Georges River catchment are low. This assessment was informed by the NSW WQOs – Aquatic Ecosystem, Visual Amenity and Primary and Secondary Contact Recreation.

Georges River REP principle	Where considered or addressed
creeks is not increased by the development.	
(11) Vegetated buffer areas **Appropriate buffer widths (as identified in item 21 relating to Development in Vegetated Buffer Areas in the Planning Control Table in Part 3) must be retained as a means of improving surface runoff entering into the Georges River or its tributaries.**	The potential impacts of the proposal on vegetation is discussed in Section 6.6 and impacts to the stormwater management in Section 6.4. A new spill basin would be constructed near the Georges River. This basin along with management measures such as grass swales, would buffer the impact of increase flow volumes.
(12) Water quality and river flows **Water quality and river flows within the Catchment are to be improved through the implementation of environmental objectives for water quality and river flows agreed between the Minister for Environment and the Minister for Land and Water Conservation and by the application of consistent decisions affecting the use and management of land.**	As detailed above, water quality would be protected through a variety of strategies associated with stormwater management, as well as responsible construction and operation practices (eg to avoid or minimise erosion and sedimentation or other forms of contamination). The environmental values and water quality guidelines specific to the Georges River, and which have been used for the basis of the assessment of water quality impacts, are identified in Section 6.4.
(13) Wetlands **Wetlands must be protected through the application of consistent land use and management decisions that take into account the potential impact of surrounding land uses, incorporate measures to mitigate adverse effects and are in accordance with the NSW Wetlands Management Policy (prepared by and available from the Department of Land and** **Water Conservation). Wetlands must also be protected by requiring adequate provisions where clearing, construction of a levee, draining or landscaping is to be undertaken.**	The proposal does not involve any impact on wetlands.

4.1.2 Draft Cumberland Plain Conservation Plan 2020

The Department of Planning and Environment has prepared the Draft Cumberland Plain Conversation Plan (the Plan) to protect Western Sydney's biodiversity and support its growth to 2056 and beyond. The Plan's vision is to 'support Western Sydney's biodiversity and growth'. This means it will support the delivery of infrastructure, housing and jobs for Western Sydney in a planned and strategic way that protects and maintains important biodiversity.

The proposal is located in an area covered by the Plan and involves upgrades to road infrastructure on and surrounding the M5 Motorway. A Biodiversity Assessment Report was completed for the proposal (refer to Section 6.6) that determines no significant impact to biodiversity is expected.

4.1.3 Local Environmental Plan

Liverpool Local Environmental Plan 2008

The proposal is located within the Liverpool LGA. Development within the Liverpool LGA is subject to the provisions of the *Liverpool Local Environmental Plan 2008* (Liverpool LEP). The proposal is predominantly located within the road corridor on land zoned SP2 Infrastructure. There would also be some minor sections outside the road corridor that would be impacted by the proposal which are zoned as follows (refer to Figure 4-1):

- E3 – Environmental Management
- IN1 – General Industrial
- RE1 – Public Recreation
- W1 – Natural Waterways.

Land that is zoned E3 Environmental Management and IN1 General Industrial would be required for the proposed new entry ramp and exit ramp of Moorebank Avenue. Land that is zoned RE1 Public Recreation and W1 Natural Waterways would be required for the proposed new bridge over the Georges River and associated structural elements (such as piers). Table 4-2 outlines the consistency of the proposal with the objectives of these zoning regulations.

The Liverpool LEP and zoning requirements state that roads are permissible within the above zones with development consent; however, as discussed in Section 4.1.1, the Transport and Infrastructure SEPP operates to remove these consent requirements.

Table 4-2 Land zoning

Land zoning	Objectives	Proposal consistency
SP2 – Infrastructure	• To provide for infrastructure and related uses • To prevent development that is not compatible with or that may detract from the provision of infrastructure.	The proposal is for a road and road related infrastructure and would be consistent with the objectives for development in the SP2 Infrastructure zone.
E3 – Environmental Management	• To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values • To provide for a limited range of development that does not have an adverse effect on those values	• The proposal would require some vegetation removal next to the existing road corridor and in the vicinity of the proposal • The proposal would not be consistent with the zone objectives to

Land zoning	Objectives	Proposal consistency
	• To enable the recreational enjoyment or scientific study of the natural environment.	protect, manage and restore ecological values • The proposal would aim to mitigate impacts of vegetation removal through urban design and landscaping measures discussed further in Section 7.2.
IN1 – General Industrial	• 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 particularly encourage research and development industries by prohibiting land uses that are typically unsightly or unpleasant • To enable other land uses that provide facilities or services to meet the day to day needs of workers in the area.	• The proposal would be consistent with some of the objectives for development in IN1 General Industrial • The proposal would seek to support industrial land for industrial uses and enable other land uses to meet the needs of workers in the area.
RE1 – Public Recreation	• 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 provide sufficient and equitable distribution of	• The proposal would not be consistent with the objectives of this zone as the new bridge over the Georges River and proposed ancillary facility would occupy this area • Impacts to the public recreational space would be mostly temporary, with the ancillary facility removed following the

Land zoning	Objectives	Proposal consistency
	public open space to meet the needs of residents • To ensure the suitable preservation and maintenance of environmentally significant or environmentally sensitive land.	completion of construction • The proposal would provide better access to public recreation land within the area through improved active transport links.
W1 – Natural Waterways	• To protect the ecological and scenic values of natural waterways • To prevent development that would have an adverse effect on the natural values of waterways in this zone • To provide for sustainable fishing industries and recreational fishing • To enable the recreational enjoyment or scientific study of the natural environment • To allow development for water recreation purposes that does not have a significant adverse effect on the natural values of waterways in this zone.	• The proposal would not be consistent with the objectives of the W1 – Natural Waterways zone to protect the ecological and scenic values of the natural waterway • The proposal would result in additional infrastructure in this zone, with the new bridge located above the Georges River • The proposal would aim to minimise impacts to the waterway, which is discussed further in Chapter 6 • A new shared user path on the new bridge over the Georges River, would maintain views from the bridge for users on the western side of the river, and enhance views for users on the eastern side of Georges River who currently do not have access to the bridge.

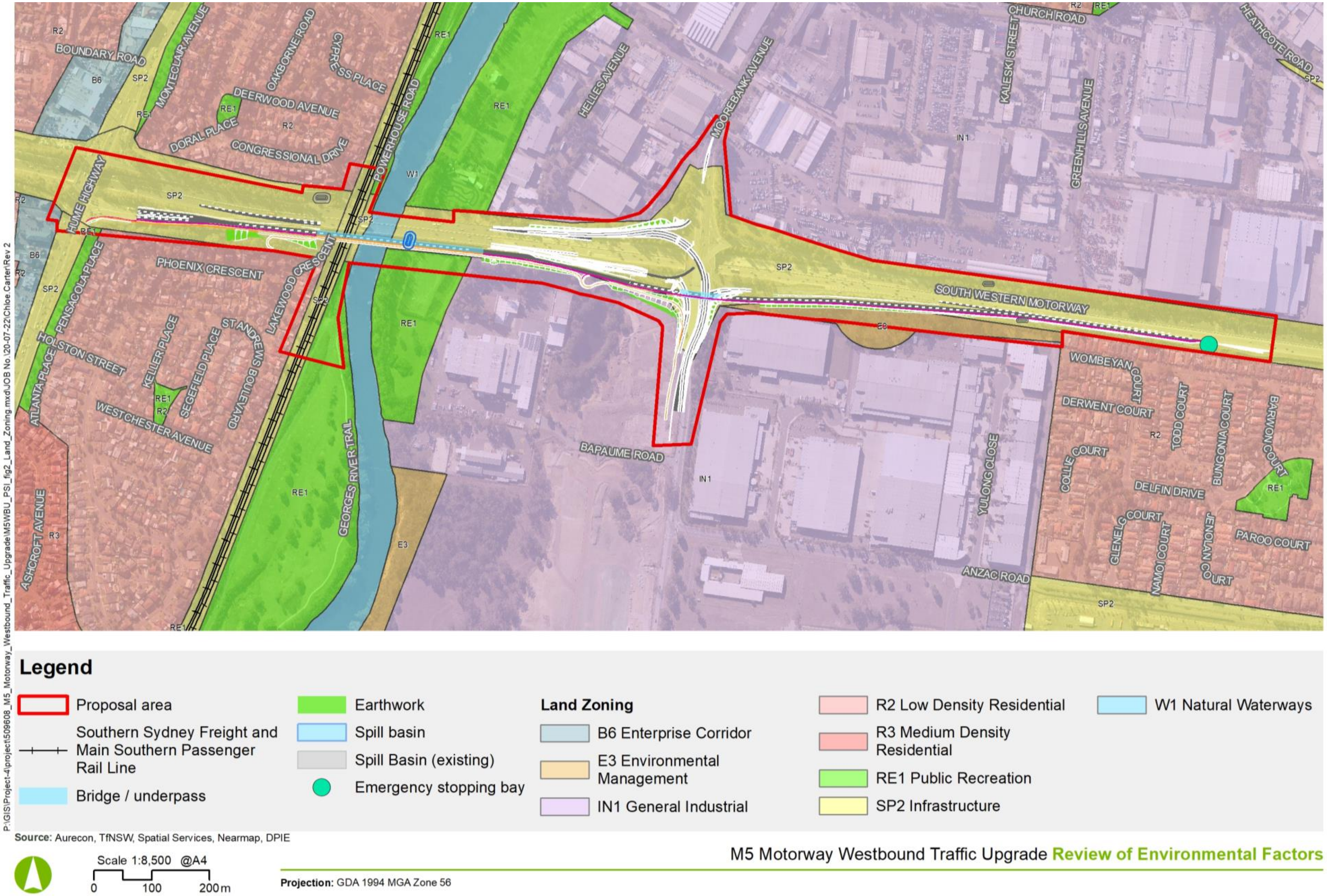


Figure 4-1 Land use zones

4.2 Other relevant NSW legislation

4.2.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) was established to protect, restore and enhance the quality of the environment in NSW. The POEO Act also aims to reduce risks to human health and prevent degradation of the environment, regulating the activities that could lead to impacts on the environment. Under the provisions of the POEO Act, Transport for NSW is required to notify the Environmental Protection Authority (EPA) if a 'pollution incident' occurs that causes or threatens 'material harm' to the environment.

Part 3.2 of the POEO Act states that an environmental protection licence (EPL) is required for scheduled activities or scheduled development work as defined in Schedule 1. An EPL authorises the carrying out of scheduled development work or scheduled activities. Clause 35 of Schedule 1 'road construction' is relevant to the proposal. Road construction is defined as the construction of roads, including widening or rerouting of existing roads. The clause applies to road construction that results in:

- The extraction or processing of more than 50,000 tonnes of material over the life of the proposal
- The existence of four or more traffic lanes (other than bicycle lanes or lanes used for entry or exit) for a continuous length of at least one kilometre (in a metropolitan area and is classified, or proposed to be classified, as a freeway or tollway).

The proposal area includes four or more traffic lanes for a continuous length of at least one kilometre (excluding exit ramps, shoulders and shared paths). The proposal is classified as a 'scheduled activity' under Schedule 1 of the POEO Act and would require an EPL.

Protection of the Environment Operations (Waste) Regulation 2014

Clause 110A of the Protection of the Environment Operations (Waste) Regulation 2014 requires the EPA to be notified in writing at least two days before work commences that would exhume waste from a landfill site or former landfill site. This work is also required to be outlined on the EPL. Construction of the proposal would require waste to be exhumed from a former landfill site (located on the eastern side of the Georges River). Transport for NSW would be required to notify the EPA prior to commencement of construction activities within the former landfill site, in accordance with the requirements of Clause 110A of the Protection of the Environment Operations (Waste) Regulation 2014.

4.2.2 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* (CLM Act) sets the framework for investigating and remediating land that the EPA considers to be contaminated enough to require regulation. The CLM Act establishes the responsibility and accountability involved in managing and assessing contamination.

There are existing contaminated areas within and close to the proposal area. The ABB site on the eastern side of the Georges River is an EPA regulated site for Polychlorinated biphenyls (PCB) contamination and adjacent to this site is a former landfill containing asbestos fragments and PCBs with potential methane gas within the soil. If the former landfill site were to become an EPA regulated site, work at the site would need to adhere to the sites Voluntary Management Proposal (VMP) as developed by the responsible party. Liverpool City Council are expected to remediate the site prior to Transport for NSW's use and therefore Transport for NSW would operate under the Councils RAP.

More details about these areas and their location are provided in Chapter 6. Mitigation to avoid impacts to contaminated land and potential impacts are provided in Chapter 7. As stated in the Preliminary Site Investigation carried out for the proposal (included in Appendix G, a range of guidelines are provided under the CLM Act to manage and assess contamination to reduce risk to human health and the environment. A contamination management plan would be prepared prior to the commencement of construction and implemented during construction by the Construction Contractor.

4.2.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of the State. The Georges River is located within the proposal area and is classified as key fish habitat.

Section 219 of the FM Act states that the passage of fish is not to be blocked. During construction of the new bridge and associated piers a temporary barge would be required within the Georges River. This barge would be floating and secured by anchors. Silt booms would be positioned to ensure they do not impede upstream/downstream movement of fish; therefore, construction of the new bridge would not block fish passage and a permit would not be required for this work.

4.2.4 Roads Act 1993

The *Roads Act 1993* provides guidance on the use and access of public roads, including procedures regarding the opening and closure of public roads. The *Roads Act 1993* states that a road authority may carry out road work on any public road for which it is the road's authority and on any other land under its control (Division 1, Clause 71). The M5 Motorway is under the operational control of InterLink. Clause 62 – 'Roads agreements between Roads and Maritime (now Transport for NSW) and roads authorities' also applies to the proposal. The clause states that Transport for NSW as a roads authority may enter into an agreement under which some or all of the functions of the roads authority with respect to a classified road become, to the extent provided by the agreement, the responsibility of Transport for NSW.

A Road Occupancy Licence would be required from the relevant roads authority by the Construction Contractor prior to work on public roads and any temporary road closures during construction of the proposal.

4.2.5 Crown Lands Management Act 2016

The *Crown Lands Management Act 2016* establishes the requirements of the ownership, use and management of the Crown land in NSW. The Act takes into consideration the environmental, social, cultural heritage and economic factors associated with land ownership. Ministerial approval is required to grant a lease, licence, permit, easement or right of way over Crown land.

The Georges River is classified as Crown Watercourse. Should areas within the Georges River be required for the proposal, Transport for NSW would need to obtain approval in accordance with the Act. As stated in DPIE's Licensing of Crown Land

Policy 2.0, a license may be issued for the occupation/use of the land that is to be for a short, temporary or intermittent term (DPIE, 2018b).

An enclosure permit would be required, as the proposal would result in partial closure of a crown watercourse.

4.2.6 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) seeks to conserve biological diversity, promote ecologically sustainable development, prevent extinction and promote the recovery of threatened species, populations and ecological communities and to protect areas of outstanding biodiversity value. The BC Act provides a listing of threatened species, populations and ecological communities, areas of outstanding biodiversity value, and key threatening processes.

In accordance with the objectives of the BC Act, the proposal would aim to avoid and minimise the impacts of proposed development and land use changes on biodiversity. A biodiversity assessment was carried out for the proposal and is summarised in Section 6.6.

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities (EEC) listed under the BC Act or FM Act, are assessed using a five-part test. Where a significant impact is likely to occur, a Species Impact Statement (SIS) or Biodiversity Development Assessment Report (BDAR) must be prepared in accordance with the Secretary's requirements.

Clause 5.16(1) of the BC Act states that a public authority must not carry out development on a biodiversity stewardship site unless:

- It has given written notice of the proposed development to the Minister and the owner of the biodiversity stewardship site
- It has received written notice from the Minister consenting to the development.

The proposal would impact on a biodiversity stewardship site located adjacent to the south western corner of the M5 Motorway and Moorebank Avenue intersection. This biodiversity stewardship site is owned by the Commonwealth of Australia – Department of Infrastructure, Regional Development and Cities. In accordance with Clause 5.16(1) of the BC Act, Transport for NSW would need to comply with the following requirements before commencing work on the biodiversity stewardship site:

- Provide written notice of the proposed development to the NSW Minister for Environment and the owner of the biodiversity stewardship site (Commonwealth of Australia – Department of Infrastructure, Regional Development and Cities)
- Receive consent from the NSW Minister for Environment prior to commencing work on the biodiversity stewardship site.

4.2.7 Biosecurity Act 2015

To prevent, eliminate and minimise biosecurity risks posed by biosecurity matter and carriers, the NSW Government established the *Biosecurity Act 2015*. The *Biosecurity Act 2015* promotes biodiversity and the management of:

- Pests, diseases, contaminants and other biosecurity matter that are economically significant for primary production industries
- Threats to terrestrial and aquatic environments arising from pests, diseases, contaminants and other biosecurity matter

- Public health and safety risks arising from contaminants, non-indigenous animals, bees, weeds and other biosecurity matter known to contribute to human health problems
- Pests, diseases, contaminants and other biosecurity matter that may have an adverse effect on community activities and infrastructure.

The proposal would not require approvals or permits under this Act; however, management of weed species may be required. Part 3, Clause 22 ‘General biosecurity duty’ outlines biosecurity duty and dealings with biosecurity matter and carriers. The Act states that any person who deals with biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.

A total of ten priority weeds were observed within the biodiversity study area: African Olive, Rhodes grass, Lantana, Bridal Creeper, Balloon vine, Ground Asparagus, Camphor Laurel, Large Leaf Privet, Green Cestrum and Blackberry. The Construction Contractor would be required to implement measures to prevent, eliminate and minimise the potential risks associated with the spread of weeds as well as the risks associated with potential contaminants. Section 6.6.4 includes safeguards and management measures to manages these weeds during construction and operation of the proposal.

4.2.8 National Parks and Wildlife Act 1974

Under Section 86 Clause 4 of the *National Parks and Wildlife Act 1974* (NPW Act), it is an offence to destroy, deface, damage or desecrate an Aboriginal object or place. Where harm cannot be avoided, an Aboriginal heritage impact permit (AHIP) issued by Heritage NSW under Section 90 of the NPW Act is required.

An Aboriginal heritage assessment report has been prepared for the proposal in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime Services, 2011) (refer to Section 6.7). A stage 2 PACHCI was carried out for the proposal, which concluded that no sites would be impacted by the proposal.

4.2.9 Heritage Act 1977

The *Heritage Act 1977* aims to provide for the identification, registration and conservation of items of State heritage significance. Investigations of the proposal’s potential to interact with or impact on items of heritage significance is discussed in Section 6.7 and 6.8.

As stated in the Aboriginal and Non-Aboriginal Heritage Impact Assessment carried out for the proposal (provided in Appendix I), there are no heritage items within the proposal area listed on the State Heritage Register (SHR) or a Section 170 Heritage and Conservation Register.

The Heritage Act also protects archaeological relics, which can be defined as any deposit, artefact, object or material evidence that:

a) Relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
b) Is of State or local heritage significance.

Under Section 139 of the Heritage Act, a person must not disturb or excavate any land that may result in a relic being discovered, exposed, moved, damaged or destroyed; unless the work is carried in accordance with an excavation permit or approval issued by the Heritage Council of NSW. However, if a relic is required to be disturbed, an Excavation Permit under Section 140 of the Heritage Act, would need to be applied for. An Excavation Notification or Excavation Permit would be required before ground disturbance commences in the area directly west of Moorebank Avenue and adjacent to the BioBanking site, with historical archaeological potential (refer to Figure 8.4 of the Aboriginal and Non-Aboriginal Heritage Impact Assessment in Appendix I).

4.2.10 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.

Property acquisition would be required for the proposal in the form of strip acquisition and partial acquisition in the proposal area. This would be required to accommodate the proposal including the new road and associated infrastructure. All land acquisitions, excluding Commonwealth land, would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. Property requirements for the proposal are discussed in Section 3.6.

4.2.11 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 proposal is located with the Sydney Basin Central Groundwater Source and the Southern Sydney Rivers Water Source as per the water sharing plan under the WM Act.

The WM Act includes requirements for:

- A water access licence to take water from a river, lake, dam or groundwater for irrigation, industrial or commercial purposes
- A water supply work approval to construct and use a water supply work, such as a pump, dam, channel or bore
- A water use approval to use water for a specific purpose at a particular location
- A flood work approval for works on floodplains that divert floodwaters
- A controlled activity approval 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 proposed ancillary facility would be located on flood prone land. However, Transport for NSW is exempt from controlled activity approvals under Subdivision 4, Clause 41 of the Water Management (General) Regulation 2018 as they are a public authority.

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.

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 and Appendix H.

Findings – matters of national environmental significance

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.

A self-assessment has been completed with reference to *Actions on, or impacting upon, Commonwealth land,* and *Actions by Commonwealth agencies Significant impact guidelines 1.2* (Department of Sustainability, Environment, Water, Population and Communities 2013) (refer to Appendix A) and determined a significant impact is unlikely on the Commonwealth land required for the proposal.

Findings – nationally listed biodiversity matters

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. Section 7 of the REF describes the safeguards and management measures to be applied.

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, with one active Native Title holders/claimants identified in the Liverpool City Council LGA. The claim is listed as NC2017/003 – South Coast People which was filed on 3 March 2018. Upon review of the claim, it was identified that the claim area is located outside of the proposal area and would not be impacted by the proposal.

4.3.3 National Environmental Protection Measures for the Assessment of Contaminated Site 1999 (Amendment 2013)

The National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) provides a national risk-based framework for the assessment of site contamination in Australia. The legislation ensures there is adequate protection of human health and the environment, where site contamination is found to exist.

The ASC NEPM promotes sound environmental management practices that should be adopted by relevant stakeholders including regulators, site contamination consultants, site contamination auditors, landowners, developers and industry parties. The investigations carried out for the proposal have been done so in accordance with the requirements of the ASC NEPM.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and/or road infrastructure facilities and is being carried out by or on behalf of a public authority. Under clause 2.108 of Transport and Infrastructure SEPP, 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.

Transport for NSW is the determining authority for the proposal. 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.

5 Consultation

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

5.1 Consultation strategy

A community consultation and stakeholder engagement plan (Transport for NSW, 2020) was prepared and implemented to guide consultation activities. The communications plan identifies key objectives and outcomes of consultation activities with the community, stakeholders and government agencies. The engagement plan for this proposal also includes public display of the REF for comment and targeted engagement with identified key stakeholders. The community consultation and engagement objectives for the proposal are to:

- Provide regular and targeted information to build awareness about the program and the likely impacts and benefits of the proposal
- Provide clear direction to the community and stakeholders about whether we are providing information or seeking feedback so that expectations are clear at all stages of engagement
- Ensure community and stakeholder views are continuously fed into the proposal's development and used to understand and effectively assess impacts
- Collaborate with government agencies and local councils to ensure a whole-of-government approach and consistent key messages
- Provide clear guidance to the community and stakeholders about when we are seeking feedback and on exactly what aspects we are taking comments on.

Consultation was carried out with potentially impacted stakeholders and the wider community. Consultation also included the involvement of local interest groups, Liverpool City Council and State government agencies. A summary of consultation activities carried out to date is provided in Section 5.2.

5.2 Community involvement

5.2.1 Community consultation activities

Community consultation and engagement was carried out during the following three stages of the proposal's development:

- Options development
- Concept design and REF preparation
- Business surveys during socio-economic impact assessment.

Consultation activities and the outcomes of this consultation are described in the following sections.

5.2.2 Options development

Community consultation on the recommended design was carried out through the 'Have your say' consultation period between 14 December 2019 and 21 February 2020. This consultation was carried out to inform the community and stakeholders of the recommended design, invite feedback and gather local knowledge. Community members were encouraged to provide their input and make submissions through a range of communication channels including information sessions, via email, mail, or phone contact with the project team.

The key consultation tools used were:

- Key stakeholder meetings
- Community update
- Media releases
- Community information sessions
- Emails, phone calls and door knocking to key stakeholders
- Print and social media advertisements
- The project webpage.

During this period there were 36 submissions received including submissions from the Australian Government (Department of Infrastructure, Transport, Regional Development and Communications), south west Sydney Local Health District and Melanie Gibbons MP, Member for Holsworthy. The key issues identified through submissions were related to the overall design, noise impacts, traffic impacts and active transport. These are outlined in more detail in the community consultation report that is available on the project website.

A summary of consultation carried out with public utility owners is included in Section 3.5.

5.2.3 Concept design and REF

Transport for NSW has engaged with community and stakeholders during the preparation of the concept design and REF for the proposal.

The key consultation tools used were:

- Community notification confirming the preferred design in July 2020 and availability of the community consultation report on the project website
- Community notifications informing about ongoing investigation work along the proposal area as part of concept design development from October 2020 to March 2021
- Operation of a dedicated proposal phone number and email address to allow the community to ask questions and provide feedback
- Ongoing consultation with government agencies.

A number of meetings were held with Liverpool City Council in February, March and August 2021 to discuss key issues surrounding the remediation of the formal landfill site and reporting requirements to EPA. Transport for NSW continues to liaise with Council to provide updates as the proposal progresses.

5.2.4 Business survey

A business survey was carried out in Moorebank and Liverpool over a three-month period between 7 December 2020 and 19 March 2021. The purpose of the survey was to understand operations and needs of businesses in relation to the M5 Motorway and current sentiment towards the proposal. Businesses chosen for the survey were based on their proximity and use of the M5 Motorway as well as the potential to experience disruption from the construction and operation of the proposal.

116 businesses were provided the opportunity to complete the survey. A total of 54 responses were received, which included responses from those who confirmed they did not want to complete the survey. Of the 54 respondents, 17 were businesses closest to the proposal area and 37 were businesses near the proposal area.

Details of the findings of the business survey are provided in more detail in Section 6.10 and Appendix I.

5.2.5 Summary of community consultation outcomes

A summary of the key issues raised by the community, government agencies and stakeholders during the consultation activities is provided in Table 5-1. The summary outlines key issues and how they have been addressed in the REF.

Table 5-1 Summary of issues raised by the community, stakeholders and agencies

Category	Issue raised	Response / where addressed in REF
Design	Concerns that the cross weave still exists with the new design	The proposal would remove the weaving issue through the introduction of a new exit ramp from the M5 Motorway to the Hume Highway. The new exit ramp would be separated from westbound traffic. Provisions for people travelling westbound would be maintained from Moorebank Avenue, with the option to either access the new exit ramp or continue westbound on the M5 Motorway. The existing off ramp from the M5 Motorway westbound to Moorebank Avenue would be retained and modified to a shared exit. M5 Motorway westbound traffic bound for Moorebank Avenue would share an exit with traffic bound for the Hume Highway. Refer to Section 3.2 for more details.
	Impact of short merge lengths on traffic flow	The short merge on the Moorebank Avenue westbound on ramp to the M5 Motorway would be removed. The two lanes on the Moorebank Avenue westbound on ramp would split into the traffic heading towards the M5 Motorway and traffic heading towards Hume Highway. Sufficient warning signage and lane markings would also be installed. Refer to Section 3.2 for more details.
Options	Preference states for option 4b, and different options suggested	Several alternative designs were investigated during the strategic options investigations, including various configurations of M5 Motorway westbound entry and exit ramps between Moorebank Avenue and the Hume Highway. Refer to the Options Evaluation Report available on the project website for details of other designs considered. Refer to Section 2.4 for more information.
Visual amenity	Concern over the appearance of new infrastructure, including the new bridges	The proposal has been developed using urban design principles and standards, which have been used throughout the development of the design. Transport for NSW notes the opportunity to design the new bridge in a visually appealing manner. An urban design assessment and landscape and visual impact assessment has been developed for Concept Design. Opportunities to minimise

Category	Issue raised	Response / where addressed in REF
		the visual impact of the new bridge have been adopted as part of the proposal. This is discussed further in Section 6.9.
	Concern about the amenity of the area being negatively impacts due to the removal of trees along the site boundary, and the impact on properties	An urban design and landscape and visual impact assessment has been developed for the proposal. Transport for NSW would propose landscape planting to reduce the visual impact of the loss of trees along the corridor. Visual impacts of the proposal are discussed further in Section 6.9.
Noise and vibration	Concern regarding the noise impacts from tree removal. Questioning what the proposed noise management strategies would be, with suggestion of changes to noise walls, use of noise absorbing materials and residential property treatment.	A noise and vibration impact assessment has been prepared for the proposal and is summarised in Section 6.1. 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 Guidelines (Roads and Maritime, 2016). Operational noise impacts would be minimised through provision of feasible and reasonable noise mitigation to eligible receivers in accordance with the Noise Mitigation Guideline (Roads and Maritime Services, 2015). Operational noise mitigation that could be considered during detailed design includes the low noise pavements, noise barriers and at-property mitigation. This is discussed further in Section 6.1.5.
Traffic and transport	Concerns raised with heavy vehicles travelling from Moorebank Logistics Park, accessing the M5. Concern regarding an increase in accidents.	The new exit ramp would provide better efficiency through traffic separation and access to the intersections with Moorebank Avenue and the Hume Highway. The upgrade of the Moorebank Avenue intersection would aim to support heavy vehicle movements and their ability to enter and exit the M5 Motorway. The proposal would not restrict access for heavy vehicles to the Hume Highway, which would be accessible via the new exit ramp. More information is provided in Section 3.2 and Chapter 6.2.
Cumulative impacts	Concern over cumulative construction impacts associated with other major developments in the area such as the Moorebank	Construction would be staged based on the multiple upgrade activities required. There would be six construction areas across the proposal, with construction

Category	Issue raised	Response / where addressed in REF
	Logistics Park and large-scale warehouse developments	stages occurring concurrently to reduce construction time and potential cumulative impacts. More information about construction is provided in the Section 3.3 of the REF. Cumulative impacts of the proposal are discussed in Section 6.12.
Air quality	How will air quality impacts be assessed?	The impacts on air quality have been be assessed as part of this REF using Transport for NSW's tool for Roadside Air Quality (TRAQ). This assessment is presented in Section 6.11.
Biodiversity	At what stage will ecological impacts be assessed and the management approach to protect existing population of flora and fauna	Ecological impacts are assessed in Section 6.6.
Heritage impacts	Will there be impacts on heritage items in the area?	An Aboriginal Heritage and Non-Aboriginal Heritage Assessment has been developed for the proposal. No Aboriginal or non-Aboriginal heritage items would be impacted by the proposal. Heritage impacts are discussed further in Section 6.7 and 6.8.
Drainage and flooding	What are the proposed drainage plans and how will they impact flooding?	The drainage design would be further developed as part of the detailed design. The proposal has been designed in accordance with Australian Rainfall and Runoff (ARR) guidelines and standards. All drainage work would be designed to form a complete system for carrying water through and away from the proposal. As part of the REF, a hydrology and flooding assessment has been carried out as part of the REF and is summarised in Section 6.3.
Acquisition	Questions raised about proposed property acquisitions and concerns raised about the proposal's impact on property values	No residential properties would be acquired as part of the proposal. Some partial property acquisitions are required from industrial, Council and Commonwealth properties. The properties likely to be affected for partial acquisition are those to the south of the current M5 Motorway. Some land would also be temporarily

Category	Issue raised	Response / where addressed in REF
		leased for the proposed ancillary facility and access to construction areas. Transport for NSW would continue to consult with impacted property owners and occupiers. The value of industrial land is subject to a wide range of factors including efficient access to the transport network. Land to be acquired would be purchased in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. Details are provided in Section 3.6.
Access	The need for access to properties to be maintained during construction	The concept design has taken into account access required to local properties and businesses. Access to properties including residences and businesses would be maintained during construction and operation. More information about access is provided in Section 3.3 and 6.10.
	Concerns around access to the ramp south of the M5 Motorway bridge over the Georges River	Transport for NSW would continue to consult with the Barefoot Water Ski Club to ensure any potential impacts are communicated.
Consultation	Request for continued consultation and notification of information sessions	Transport for NSW would continue to consult the community and stakeholders about the proposal. Feedback from the REF and the consultation sessions would be used to inform the submissions report, determination and construction of the proposal.
Local procurement	Request for consideration of employment opportunities for local residents during construction and workshops with local businesses	Transport for NSW encourages contractors to create employment opportunities for the local community on our projects. This is taken into consideration during tendering for construction and awarding the contract.
Surface water	Concerns for construction of the piers to create backwash in the Georges River	Transport for NSW would continue to consult with the Barefoot Water Ski Club to ensure any potential impacts are communicated.

Category	Issue raised	Response / where addressed in REF
	The Barefoot Water Ski Club advised of their busy periods being August/September through to April. World championship competitions are held during this period. It was requested that consideration of the activities involving Georges River be given in view of the Barefoot Water Ski Club's operations. The Barefoot Water Ski Club also advised on the following existing hazards within the Georges River, which prevent their activities to be moved away from the M5 Motorway bridges: • Section of the river south of M5 Motorway: A rock shelf and a tree in the centre of the river that sits about 1 metre below the surface (depending on water levels) • The railway embankment on the downstream section of the Georges River (past the weir) creates favourable water conditions for barefoot water skiing (reducing the wash / waves being produced by passing boats).	

5.3 Transport and Infrastructure SEPP consultation

As detailed in Section 4.1.1, State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) was repealed and replaced with State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP).

Statutory consultation (required under Part 2 of ISEPP) for the proposal was completed prior to 1 March 2022 and, therefore, made reference to the now repealed ISEPP. Notwithstanding, the consultation requirements are unchanged from the repealed ISEPP to the new Transport and Infrastructure SEPP.

Part 2.2 of Transport and Infrastructure SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development.

Liverpool City Council and the NSW State Emergency Service (SES) have been consulted about the proposal as per the requirements of clause 2.10 (council infrastructure and services) and clause 2.13 (development with impacts on flood liable land) of Transport and Infrastructure SEPP.

Issues raised by these stakeholders during consultation, and how these issues have been addressed in the REF, is outlined in Table 5-2.

Table 5-2: Issues raised through Transport and Infrastructure SEPP consultation

Agency	Issue raised	Response/where addressed in REF
Liverpool City Council	No comments or concerns relating to Transport and Infrastructure SEPP consultation were raised at the time of public display.	N/A
State Emergency Service	The State Emergency Service noted that the proposal appeared to have minimal risk to the agencies response operations. No further comments or concerns were raised.	Potential flooding impacts have been addressed in Section 6.3.

5.4 Government agency and stakeholder involvement

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

- Liverpool City Council planning staff and Councillors
- Department of Planning and Environment
- Department of Infrastructure, Transport, Regional Development and Communications
- Interlink Roads (M5 western motorway deed holder)
- Qube now LOGOS (Moorebank Logistics Park Developer)

- Melanie Gibbons MP, Member for Holsworthy
- Local community including property owners/occupiers, businesses and the NSW Barefoot Water Ski Club
- Community groups such as the Moorebank Residents' Action Group, Liverpool Action Group and Residents Against Intermodal Development (RAID) community action group
- Emergency and health services (South West Sydney Local Health District)
- Internal stakeholders at Transport for NSW.

A summary of the key issues raised by government agencies and stakeholders during the consultation activities is provided in Table 5-1. Consultation has been ongoing since 2019 and has involved community information sessions, stakeholder meetings, participation in the submissions process and ongoing digital correspondence.

5.5 Ongoing or future consultation

Transport for NSW would continue to consult with the community and relevant stakeholders during the design and construction of the proposal.

5.5.1 Consultation during the public display of the REF

Transport for NSW is committed to continue the engagement of the community and stakeholders throughout the development of the proposal. The REF will be placed on public display for 28 days and comments invited. Consultation activities during this display period would include:

- Advertisement in local newspapers
- Drop in community sessions and an online community engagement session and update to the Transport for NSW project webpage
- Community update distributed to the community and stakeholders inviting feedback on the proposal.

5.5.2 Consultation following the public display of the REF

Following the public display period, Transport for NSW 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 would be published which would respond to the comments received. The submissions report would be made available to the public via the Transport for NSW website. The community would be informed of any major design changes that are required to address concerns raised in submissions.

Following determination, the community would continue to be updated about the progress of construction and provided notification of any road closures or night work in advance of the work 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

6.1 Noise and vibration

This section describes the noise and vibration impacts associated with the proposal. This section is informed by the noise and vibration assessment (SLR, 2022), which is provided in Appendix C.

6.1.1 Methodology

The noise and vibration assessment involved:

- Identifying and describing the noise and vibration assessment study area, sensitive receivers, noise catchment areas (NCAs) and 'realistic worst-case' construction scenarios
- Measuring the existing background noise levels at eight noise monitoring locations to define relevant assessment criteria to assess noise and vibration impacts
- Conducting traffic count surveys to validate the existing road noise models
- Predicting and assessing construction noise levels for identified construction scenarios in line with *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 construction and operational road traffic noise levels in accordance with the *Road Noise Policy* (RNP; 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, 2015).

Noise monitoring

Noise monitoring was carried out to determine the existing background noise environment near the proposal. Unattended noise monitoring was completed in the proposal area during October and November 2020. At this time the Greater Sydney Region was not in a COVID-19 lockdown and movement was not restricted. The noise monitoring locations (refer to Figure **6-1**) 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.

Short-term attended noise monitoring was also completed at each monitoring location. These 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 V8.1 software. Fourteen construction scenarios were developed for noise modelling to provide 'realistic worst-case' activities for different construction activities. These scenarios are listed in Table 6-1 and are discussed in detail in Section 4.1.1 of Appendix C to the REF.

Table 6-1 Construction scenarios

ID	Scenario
W.01	Site establishment
W.02	Utility work and earthworks – peak
W.03	Utility work and earthworks – typical
W.04	Bridge construction – peak
W.05	Bridge construction – typical
W.06	Underpass construction – peak
W.07	Underpass construction – typical
W.08	Widening and pavement work – peak
W.09	Widening and pavement work – typical
W.10	Widening and pavement work – OOHW tie-ins
W.11	Landscape and finishing work
W.12	Compounds – operations
W.13	Bridge construction barge – peak
W.14	Bridge construction barge – typical

These scenarios represent one possible way that the proposal could be constructed. The exact construction methodology and the expected construction noise levels would be confirmed during further design stages.

Some construction activities have been broken into 'peak' and 'typical' work scenarios. The 'peak' work represents the noisiest stages and may require noise intensive equipment such as rockbreakers or concrete saws. While 'peak' work would be required at certain times in most locations, the highest noise impact work would only last for relatively short periods. The 'typical' work represents typical noise emissions from the proposal when noise intensive equipment is generally not in use.

The assessment has considered potential noise impacts from work during standard working hours for all construction scenarios, as well as daytime out of hours, evening and night-time periods for scenarios W.02, W.03, W.05, W.06, W.07, W.10 and W.12.

Construction traffic noise assessment

The potential noise impacts from construction traffic on public roads have been predicted using the *Calculation of Road Traffic Noise* (CoRTN) (UK Department of Transport, 1988) algorithm. Where the criteria are found to be exceeded, feasible and reasonable mitigation and management measures should be considered.

Operational noise assessment model and scenarios

A noise model of the operational study area (refer to Figure 6-5) has been used to predict the noise levels from the operation of the proposal to surrounding receivers.

The model uses CoRTN algorithms in SoundPLAN v8.1 software. Inputs into the model included ground topography, surrounding buildings, traffic volumes and typical vehicle speeds and road surfaces.

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 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, 2015). 'Project roads' are roads which would experience design or engineering changes due to the proposal.

The noise model was validated using the measured road traffic volumes and background noise measurements in the proposal area. The model was identified to be conservative and no calibration required. It was considered valid for predicting road traffic noise levels for the proposal. Refer to Section 4.5.6 of Appendix C to this REF for further details.

6.1.2 Existing environment

Noise catchment areas and sensitive receivers

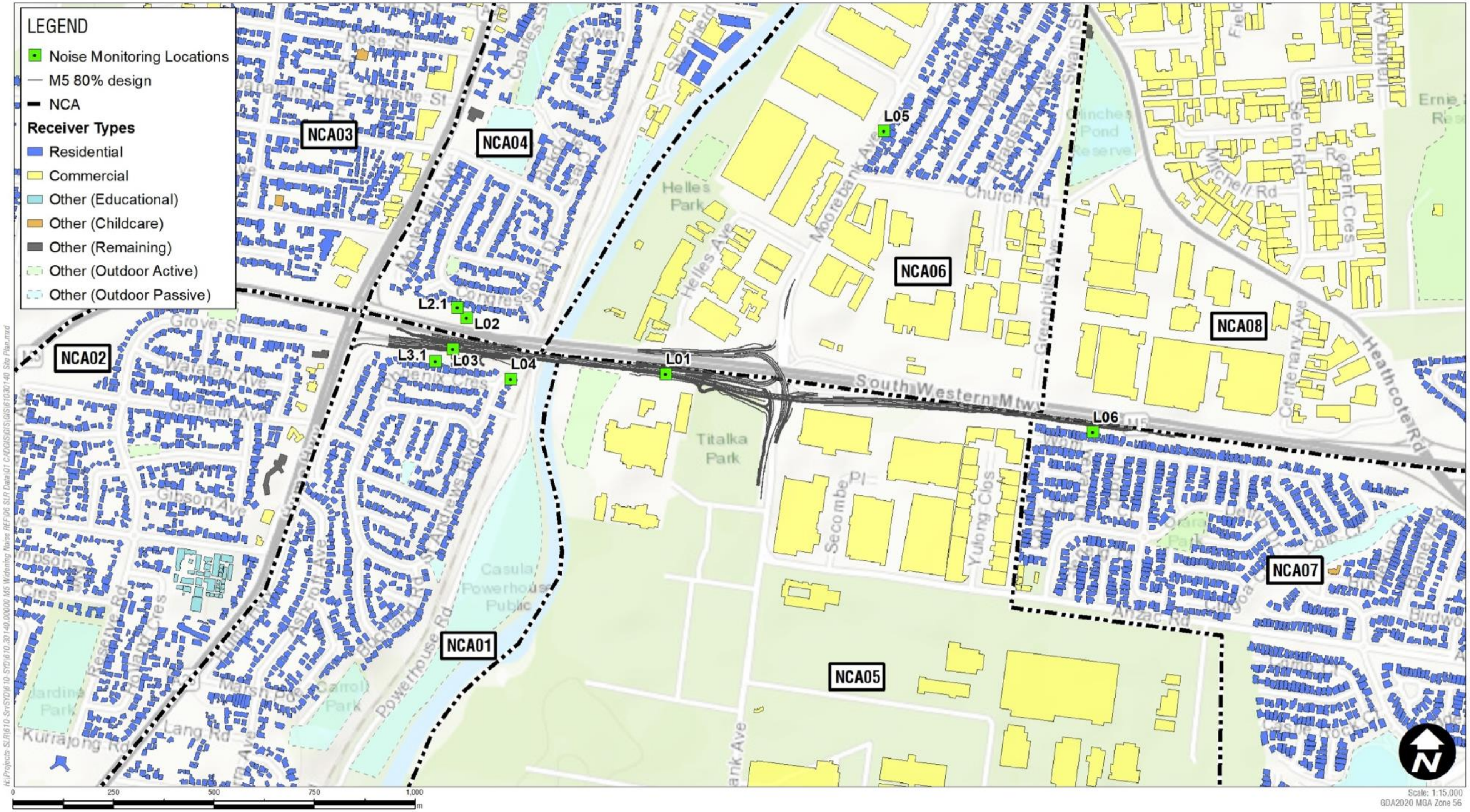
Receivers that are adjacent to the proposal are typically residential properties with various commercial properties (refer to Figure **6-1**). Existing noise levels are influenced by road traffic noise from the M5 Motorway, Hume Highway and Moorebank Avenue.

Eight noise catchment areas (NCAs) have been identified surrounding the proposal, which represent an area that contains a group of receivers that may be similarly affected by noise from the proposal. This may reflect different land uses and existing background noise levels within the surrounding proposal area. The NCAs are shown in Figure **6**-**1**. There are residential receivers in all NCAs except NCA05. The non-residential 'other sensitive' receivers in each NCA are described in Table 6-2.

Table 6-2 Noise catchment areas for the proposal

NCA	Description of non-residential 'other sensitive' receivers	Type
NCA01	McGrath Park	Active Recreation
	St Andrews Park, Casula Parklands and Carroll Park	Passive Recreation
NCA02	Jardine Park, Pullbrook Park, Gimes Park	Active Recreation
	Casula Public School	School
	The Fontainebleau Motor Inn, Ibis Budget Casula Liverpool	Hotel
NCA03	Young Achievers Early Learning Centre, Happy Start Child Care	Child Care Centre
	Liverpool Veterinary Hospital	Medical

NCA	Description of non-residential 'other sensitive' receivers	Type
NCA04	Hazel Bradshaw Park, College Park	Active Recreation
	Discovery Park, Mill Park	Passive Recreation
	Al Amanah College	Educational
	Play 2 Learn,	Child Care Centre
	Clovel Child Care and Early Learning Centres	Child Care Centre
	Macedonian Orthodox Church	Place of Worship
NCA05	Rifle Range Park	Active Recreation
NCA06	John Grant International Raceway, Helles Park	Active Recreation
NCA07	Orara Park	Active Recreation
	Anzac Creek Park, J Edmondson VC Memorial Park, Lakeside Park	Passive Recreation
	Wattle Grove Long Day Care Centre	Child Care Centre
NCA08	Ernie Smith Recreation Area	Active Recreation
	Clinches Pond Reserve	Passive Recreation



Source: Aurecon, TfNSW

Subject to detailed design

M5 Motorway Westbound Traffic Upgrade **Review of Environmental Factors**

Figure 6-1 Noise catchment areas and noise monitoring locations near the proposal area

Background noise levels

The background noise levels (RBLs) for the proposal have been calculated using the attended and unattended noise monitoring results and are summarised in Table 6-3. Existing noise levels were found to be dominated by road traffic noise from the surrounding road network.

Table 6-3 Summary of unattended noise logging results

ID	Address	Measured Noise Level (dBA)							
		Construction[1]						Operational[2]	
		Background Noise (RBL)			Average Noise (L_{Aeq})			Average Noise (L_{Aeq})	
		Day	Evening	Night	Day	Evening	Night	Day	Night
L01[3]	ABB site	70	69	56	76	75	73	76	74
L02[4]	Above northern barrier	71	67	55	75	73	71	74	71
L02.1	45 Congressional Drive, Liverpool	52	50	42	56	55	52	56	53
L03[4]	Above southern barrier	74	68	54	79	77	75	79	75
L03.1	21 Phoenix Crescent, Casula	52	49	41	56	55	52	56	52
L04	18 Lakewood Crescent, Casula	56	53	44	62	61	58	62	58
L05	78 Moorebank Avenue, Moorebank	56	49	41	71	69	67	71	67
L06	35 Wombeyan Court, Wattle Grove	57	57	47	64	63	61	63	61

Note 1: Construction noise is assessed during the daytime which is 7 am to 6 pm, the evening which is 6 pm to 10 pm and the night-time which is 10 pm to 7 am. See the NSW EPA Interim Construction Noise Guideline.

Note 2: Operational road traffic noise is assessed during the daytime which is 7 am to 10 pm and the night-time which is 10 pm to 7 am. See the NSW EPA Road Noise Policy.

Note 3: The weather station was positioned at this location.

Note 4: Microphone of noise monitor positioned above noise barriers to measure direct noise levels from the M5.

The measured existing noise levels are representative of the background noise levels at receivers likely to be affected by the construction and operation of the proposal. They have been used to determine the existing noise environment and to set the criteria to assess the potential impacts of the proposal.

Existing maximum noise levels

Existing maximum noise levels were measured in the operational study area during the noise monitoring survey. Maximum noise events were typically between 65 and 85 decibels (refer to Table 6-4). Higher maximum noise levels were likely due to heavy vehicles on the M5 Motorway and lower maximum noise levels were likely due to nearby light vehicles.

Table 6-4 Existing maximum noise level events

Monitoring Location[1]	Total Night-time Events[2]	Measured Maximum Noise Levels (dBA LA_{max})	
		Range	Median
L02.1 – 45 Congressional Drive, Liverpool	77	65-74	67
L03.1 – 21 Phoenix Crescent, Casula	85	65-81	70
L04 – 18 Lakewood Crescent, Casula	302	65-83	72
L06 – 35 Wombeyan Court, Wattle Grove	25	69-81	74

Note 1: Location L01 has been excluded from the assessment as there are no residential receivers nearby and L05 has excluded as this location is distant from the proposal.

Note 2: Monitoring period for all locations was October and November 2020.

6.1.3 Criteria

This section outlines the criteria adopted for the assessment of construction and operational noise and vibration impacts.

Construction

Construction noise assessment periods

The construction noise assessment time periods used in the assessment are defined in the ICNG and summarised in Figure 6-2.

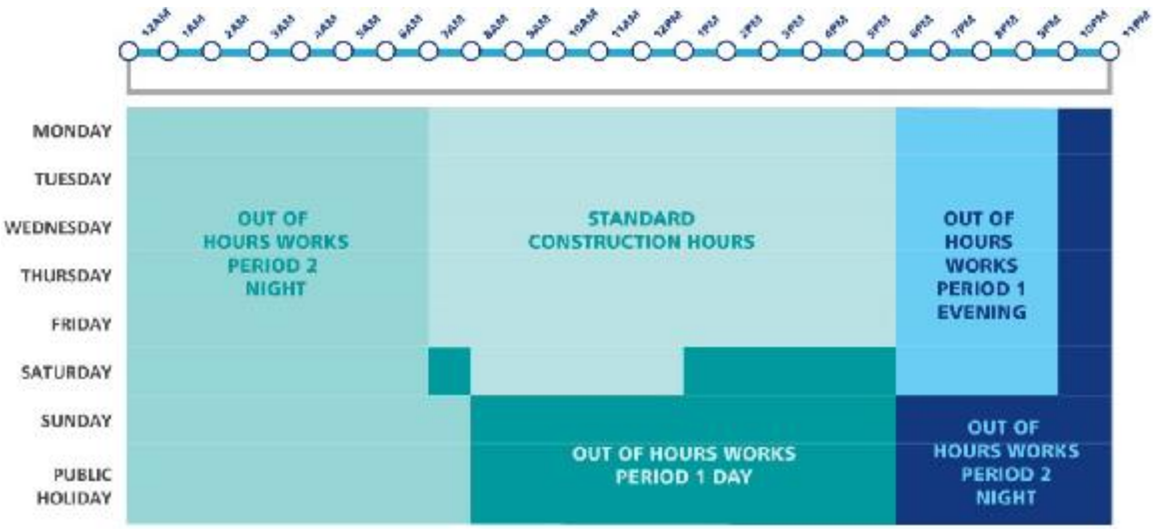


Figure 6-2 Standard Construction Hours[1, 2, 3]

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 Wok' (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 proposal-specific Noise Management Levels (NMLs) to be established for noise affected receivers. The residential NMLs for the proposal are presented in Table 6-5 and are based on the RBLs (refer to Table 6-3) as defined in the *Noise Policy for Industry* (NPfI; NSW EPA, 2017).

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 6-5.

Table 6-5 Residential Receiver Construction NMLs

NCA	Representative Background Monitoring Location	Noise Management Level ($LA_{eq(15minute)}$ – dBA)				Sleep Disturbance Screening Criteria (RBL +15 dB)
		Standard Construction (RBL +10dB)	Out of Hours (RBL +5 dB)			
		Daytime	Daytime[1]	Evening	Night-time	
NCA01	L03.1	62	57	54	46	56
NCA02	L03.1	62	57	54	46	56
NCA03	L02.1	62	57	55	47	57
NCA04	L02.1	62	57	55	47	57
NCA05[2]	-	-	-	-	-	-
NCA06	L05	66	61	54	46	56

NCA	Representative Background Monitoring Location	Noise Management Level ($LA_{eq(15minute)}$ – dBA)				Sleep Disturbance Screening Criteria (RBL +15 dB)
		Standard Construction (RBL +10dB)	Out of Hours (RBL +5 dB)			
		Daytime	Daytime[1]	Evening	Night-time	
NCA07	L06	67	62	62	52	62
NCA08	L06	67	62	62	52	62

Note 1: 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.

Note 2: No residential receivers identified in this noise catchment area.

The ICNG also identifies 'Highly noise affected' residential receivers where construction noise levels are above 75 dBA during standard hours, requiring additional consideration for noise mitigation.

NMLs for 'other sensitive' receivers have been identified in the study area. These are presented in Table 6-6.

Table 6-6 NMLs for 'other sensitive' receivers

Land Use	Noise Management Level $LA_{eq(15minute)}$ (dBA) (Applied when the property is in use)	
	Internal	External
ICNG 'Other Sensitive' Receivers		
Classrooms at schools and other educational institutions	45	55[1]
Hospital wards and operating theatres	45	65[2]
Places of worship	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	-	60
Commercial	-	70
Industrial	-	75

Land Use	Noise Management Level $LA_{eq(15minute)}$ (dBA) (Applied when the property is in use)	
Non-ICNG 'Other Sensitive' Receivers		
Hotel – daytime & evening[3]	50	70[2]
Hotel – night-time[3]	40	60[2]
Childcare centres – sleeping areas[4]	40	50[1]
Public building[3]	50	60[1]

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

Note 3: Criteria taken from *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors.*

Note 4: Criteria taken from Association of Australian Acoustical Consultants *Guideline for Child Care Centre Acoustic Assessment.*

Noise impacts that exceeded the NMLs have been assessed using the perception categories taken form the CNVG (refer to Table 6-7).

Table 6-7 NML Exceedance Bands and Corresponding CNVG Perception Categories

CNVG Perception Categories	Daytime –Standard Construction Hours	Out of Hours Periods
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

Construction traffic noise

The potential impacts from construction traffic associated with the proposal are assessed under the NSW EPA RNP and CNVG. Further assessment is required where construction traffic would increase existing road traffic noise levels by more than two decibels. RNP and NCG criteria for assessing construction traffic on public roads is summarised in Table 6-8.

Table 6-8 RNP/NCG Criteria for Assessing Construction Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$LA_{eq(15hour)}$ 60 (external)	$LA_{eq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$LA_{eq(1hour)}$ 55 (external)	$LAe_{q(1hour)}$ 50 (external)

Construction vibration

Construction vibration impacts have been assessed using the CNVG minimum working distances for:

- Human comfort, where occupants of buildings are disturbed
- Building contents, where building contents may be affected
- Structural/cosmetic damage, where the integrity of the building may be compromised.

The criteria were developed using the following guidelines:

- Human comfort vibration – *Assessing Vibration: a technical guideline* (DEC, 2006)
- Structural damage criteria – 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).

No vibration sensitive equipment was identified in the study area, and so the human comfort vibration criteria was deemed suitable to assess building contents vibration impacts.

Heritage listed buildings and structures should be considered on a case-by-case basis, however, 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 typical vibration intensive construction equipment are provided in the CNVG and are shown in Table 6-9. The minimum working distances are for both human comfort (from the NSW EPA Vibration Guideline) and cosmetic damage (from BS 7385 and DIN 4150). Vibration impacts are not considered likely where work is further than the minimum distances from the receiver.

Table 6-9 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	
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
	>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

Operational

Operational noise

The RNP (DECCW, 2011) is used to assess and manage potential noise impacts from new and redeveloped road projects. The NCG (Roads and Maritime Services, 2015a) is Transport for NSW's interpretation of the RNP and was used to achieve a consistent approach to identifying road noise criteria for infrastructure projects.

The proposal would ‘redevelop’ the M5 Motorway and connections to surrounding roads. NCG criteria applicable to redevelopment of roads for residential receivers are shown in Table 6-10 and the NCG criteria for ‘other sensitive’ receivers are shown in Table 6-11. The NCG does not consider commercial and industrial receivers as being sensitive to operational road traffic noise impacts.

Table 6-10 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 6-11 NCG Criteria for Other Sensitive Receivers

Existing Sensitive Land Use	Assessment Criteria (dB)	
	Daytime (7am – 10pm)	**Night-time (10pm – 7am)**
School classrooms	$L_{Aeq(1\ hour)}$ 40 (internal)	-
Hospital wards	$L_{Aeq(1\ hour)}$ 35 (internal)	$L_{Aeq(1\ hour)}$ 35 (internal)
Places of worship	$L_{Aeq(1\ hour)}$ 40 (internal)	$L_{Aeq(1\ hour)}$ 40 (internal)
Open space (active use)	$L_{Aeq(15\ hour)}$ 60 (external)	-
Open space (passive use)	$L_{Aeq(15\ hour)}$ 55 (external)	-
Childcare facilities	Sleeping rooms $L_{Aeq(1\ hour)}$ 35 (internal)	-

Existing Sensitive Land Use	Assessment Criteria (dB)	
	Daytime (7am – 10pm)	Night-time (10pm – 7am)
	Indoor play areas $L_{Aeq(1\ hour)}$ 40 (internal) Outdoor play areas $L_{Aeq(1\ hour)}$ 55 (internal)	
Aged care facilities	-	-

Note: refer to Section 3.2.1 of Appendix C to 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 (ie the noise predictions for with the proposal minus without the proposal) is greater than two decibels
- **Trigger 2** – the predicted noise level with the proposal is five decibels or more above the NCG controlling criterion (ie 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 $L_{Aeq(15hour)}$ 65 dBA or higher, or night-time $L_{Aeq(9hour)}$ 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 carried out 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_{Amax}
- The L_{Amax} – $L_{Aeq(1hour)}$ is greater than or equal to 15 dB.

6.1.4 Potential impacts

Construction

Construction noise impacts from the proposal are expected to be relatively low as work would not be substantially noisy in comparison to existing background noise levels from the M5 Motorway. 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. There would also 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.

Construction noise impacts for residential receivers

Most residential receivers are either shielded from the work by existing noise barriers, or experience high existing background noise levels. Residential receivers in NCA01, NCA02, NCA04 and NCA07 near the M5 Motorway would experience the highest noise levels during construction due to their proximity to construction work. The greatest noise impacts would occur when noise intensive equipment is being used.

During daytime construction periods, the only two predicted exceedances of the NMLs are in NCA01 *in 'W.01 – Site Establishment'* and *'W.02 – Utility work and earthworks – peak',* which would have 'Highly intrusive' worst-case impacts. Front-row residential receivers to the south of the M5 Motorway in NCA01 are predicted to have 'Highly Intrusive' or 'Moderately Intrusive' worst-case daytime impacts when work is being completed nearby. Front-row residential receivers in NCA02, NCA04 and NCA07 are further away and shielded from view of the work due to existing noise barriers which results in the worst-case impacts being predicted to be 'Clearly Audible'. Residential receivers on the second-row and beyond are predicted to experience much lower worst-case daytime noise levels that are either generally 'Clearly Audible' or compliant with the NMLs.

When noise intensive equipment is not in use as part of '*W.03 – Utilities and earthworks – typical'*, the worst-case noise impacts are substantially reduced, with the majority of receivers being subject to noise levels that are compliant with the NMLs. The front-row residential receivers in NCA01 in this scenario are predicted to experience 'Clearly Audible' impacts when work is nearby. Residential receivers on the second-row and beyond are predicted to experience noise levels that are compliant with the NMLs.

During evening and night-time construction periods, 'Moderately intrusive' and 'Highly intrusive' noise impacts are expected during:

- *'W.02 – Utility work and earthworks – peak'*
- *'W.03 – Utility work and earthworks – typical'*
- *'W.05 – Bridge construction – typical'*
- *'W.10 – Widening and pavement work – OOHW tie-ins'.*

The expected peak worst-case night-time noise levels are predicted to be about 85 decibels at some front-row residential receivers in NCA01 due to noise intensive work during *'W.02 – Utility work and earthworks – peak'.* More distant receivers would generally having 'Moderately Intrusive' or 'Clearly Audible' worst-case impacts.

When noise intensive equipment is not being using as part of '*W.03 – Utilities and earthworks – typical'*, the impacts are substantially reduced, however, a small number of front-row receivers in NCA01 are predicted to still experience 'Highly Intrusive' or 'Moderately Intrusive' worst-case night-time noise levels.

Construction noise impacts at all receiver types

The worst construction noise impacts would be experienced by front-row receivers in NCA01 to the south of the M5 Motorway. Table 6-12 outlines the predicted worst-case noise impacts of the proposal during the work scenarios. Sleep disturbance impacts are expected at residential receivers where night-time work is likely.

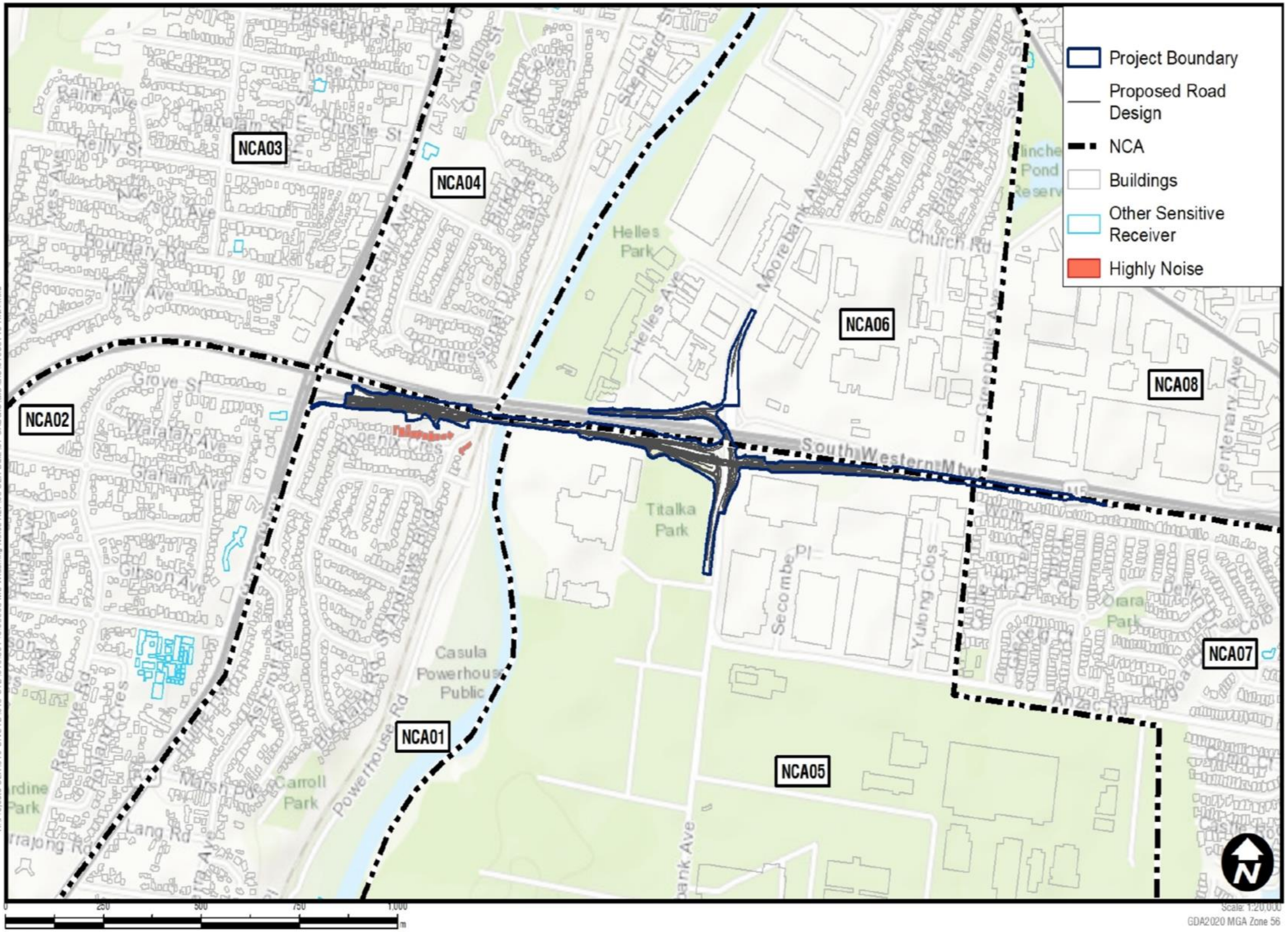
Table 6-12 Predicted worst-case noise impacts

Scenario		Predicted-worst case noise impacts
Daytime	'W.02 – Utility work and earthworks – peak'	Front-row residential receivers to the south of the M5 Motorway in NCA01 would experience 'Highly intrusive' or 'Moderately intrusive' noise impacts. Other receivers in NCA02, NCA04 and NCA07 would be shielded by existing noise barriers.
	'W.03 – Utilities and earthworks – typical'	When noise intensive equipment is not in use, front-row receivers in NCA01 would experience 'Clearly audible' noise impacts or be compliant with the NMLs.
Night-time	'W.02 – Utility work and earthworks – peak'	'Highly intrusive' noise impacts would be experienced in NCA01, with 'Moderately intrusive' noise impacts in NCA01, NCA02, NCA04 and NCA07.
	'W.03 – Utilities and earthworks – typical'	A small number of front-row NCA01 would experience 'Highly Intrusive' or 'Moderately Intrusive' worst-case night-time noise levels.
	'W.12 – Compounds – operation'	A small number of the nearest residential receivers in NCA01 and NCA04 are predicted to have 'Noticeable' impacts, with more distant receivers being below the NMLs.

Highly Noise Affected Residential Receivers

Residential receivers that are subject to noise levels of 75 dBA or greater are considered highly noise affected by the ICNG. This can occur when noisy work, such as work requiring a concrete saw, is close to residents.

Thirteen potentially front-row residential receivers in NCA01 are predicted to be highly noise affected during *'W.01 – Site establishment'* and *'W.02 – Utility work and earthworks – peak'* when noise intensive work is occurring nearby. These receivers are to the south of the M5 Motorway, as indicated in Figure **6-3**.



Source: Aurecon, TfNSW

Subject to detailed design

M5 Motorway Westbound Traffic Upgrade **Review of Environmental Factors**

Figure 6-3 Highly Noise Affected Residential Receivers (from any work scenario)

Commercial/Industrial and 'Other sensitive' receivers

'Moderately intrusive' worst-case impacts are predicted at some of the closest commercial/industrial and 'other sensitive' receivers during *'W.01 – Site establishment'* and *'W.02 – Utility work and earthworks – peak'*. In other work scenarios, there would be 'clearly audible' impacts for some receivers. The predicted impacts include:

- Two childcare centres in Liverpool with an increase of between one to ten decibels during *'W.01 – Site establishment' and 'W.02 – Utility work and earthworks – peak'* (noise that is clearly audible)
- One hotel in Casula with an increase of greater than 20 decibels while it is in use during *'W.01 – Site establishment' and 'W.02 – Utility work and earthworks – peak'* (noise that is moderately intrusive)
- Commercial/industrial:
    - Twelve properties with an increase of between one to ten decibels during *'W.01 – Site establishment'* (noise that is clearly audible) and five properties with an increase between 11 – 20 decibels (noise that is moderately intrusive)
    - Fifteen properties with an increase of between one to ten decibels during *'W.02 – Utility work and earthworks – peak'* (noise that is clearly audible) and six properties with an increase between 11 – 20 decibels (noise that is moderately intrusive)
    - One property with an increase of between one to ten decibels *during 'W.03 – Utility work and earthworks –typical'* (noise that is clearly audible)
    - One property with an increase of between one to ten decibels *during 'W.06 – Underpass construction – peak'* (noise that is clearly audible)
    - Two properties with an increase of between one to ten decibels during '*W.08 – Widening and pavement work – peak'* (noise that is clearly audible)
    - Twelve properties with an increase of between one to ten decibels during '*W.10 – Widening and pavement work – OOHW tie-ins'* (noise that is clearly audible).

There are no NML exceedances predicted for commercial/industries or 'other sensitive' receivers in W.04, W.05, W.07, W.09, W.11, W.12, W.13 and W.14. Further detail on the locations of these properties can be found be Appendix C.

Construction vibration assessment

The construction vibration assessment has identified buildings within the CNVG minimum working distances for cosmetic damage and human response (refer to Figure 6-4). Front-row receivers in NCA01, NCA05, NCA06 and NCA07 are within the minimum working distances for cosmetic damage. Receivers within the minimum working distances for human comfort vibration assessment would likely experience vibration impacts when vibration intensive equipment is nearby.

The following heritage buildings or structures have been identified within the minimum working distances:

- Kitchener House (formerly 'Arpafeelie')
- "Yulong" playing field entrance gates.

Refer to Section 6.8 for further details on the non-Aboriginal heritage impacts of the proposal.

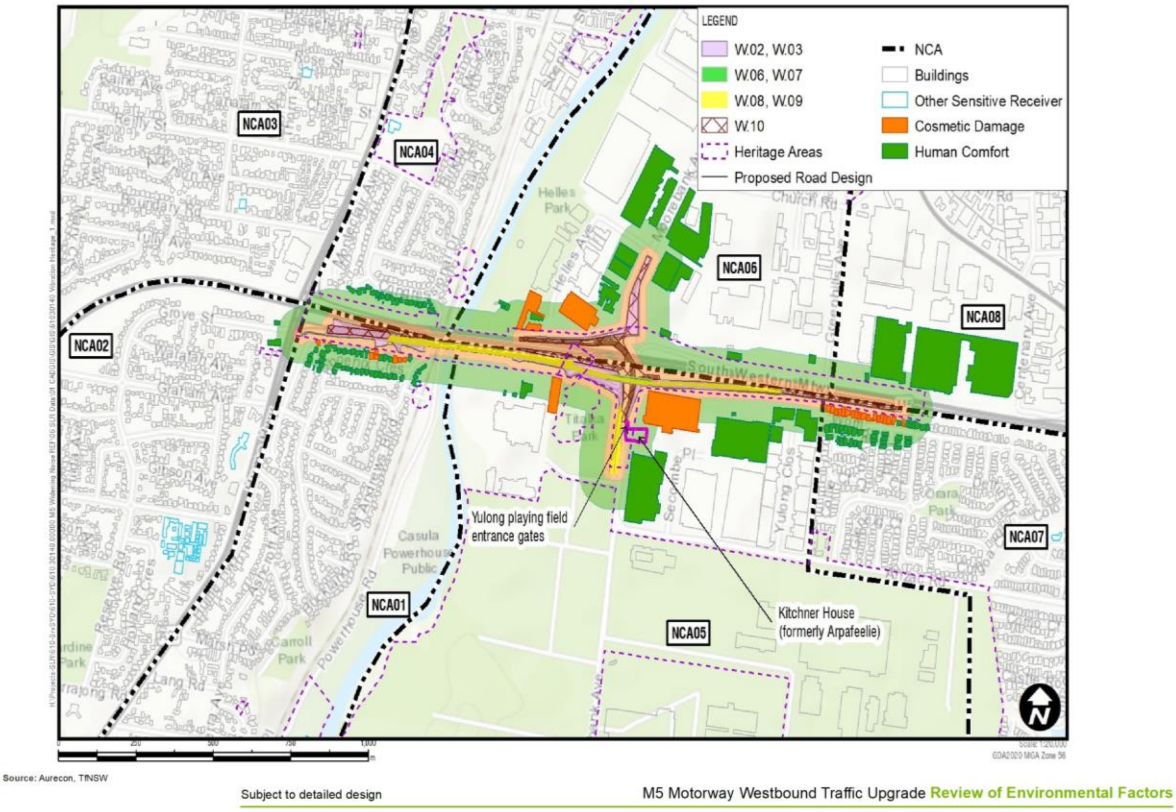


Figure 6-4 Construction vibration assessment

Construction traffic

Construction traffic may temporarily increase road traffic noise levels at receivers close to haulage routes (refer to Section 3.3.7). Daily vehicle movements would average:

- 45 heavy vehicle movements, with a maximum of 100 movements
- 100 light vehicle movements, with a maximum of 200 movements.

Noise impacts would be greater and more noticeable when construction traffic uses local roads due to lower existing traffic volumes on these roads. In comparison, noise impacts would be minimal for construction traffic travelling along existing busy roads within the proposal area, including the M5 Motorway or Hume Highway.

A number of smaller local roads would be used during the daytime to access the various construction areas during certain stages of the proposal including:

- An unsealed path east of Yulong Close
- Helles Avenue
- Yulong Close
- Secombe Place
- Lakewood Crescent
- Pensacola Place.

Existing traffic volumes would be relatively low on these local roads, meaning noticeable increases in road traffic noise (ie an increase of greater than 2.0 dB from existing levels) may occur at receivers where existing traffic noise exposure is low. Road traffic noise levels from construction traffic on these roads are predicted to below the 55 dBA base criteria for local roads (refer to Table **6-13**).

Table 6-13 Construction traffic noise assessment – local roads

Location	Vehicle type	Number of vehicle movements		Typical daytime hourly volume[1]		Daytime noise level (dBA)			Consider additional mitigation
		Average per day	Peak per day	Morning peak	Spread over rest of day	>2.0 dB increase[2]	Base criteria	Predicted level ($LA_{eq(1hr)}$)[3]	
Unsealed road/path east of Yulong Close	Heavy	10	20	2		Yes	55	51	No
	Light	20	40	15	5				
Yulong Close	Heavy	5	10	0.5	5	Yes	55	50	No
	Light	10	20	15	5				
Secombe Place	Heavy	10	20	2		Yes	55	51	No
	Light	20	40	15	5				
Lakewood Crescent	Heavy	10	20	2		Yes	55	51	No
	Light	20	40	15	5				
Pensacola Place	Heavy	5	10	<1		Yes	55	50	No
	Light	10	20	15	5				
Helles Avenue	Heavy	10	20	2		Yes	55	52	No
	Light	20	40	15	5				

Note 1: Construction traffic on local roads expected to be limited to daytime periods only

Note 2: Existing volumes on located roads are currently unknown. The assessment assumes existing volumes are negligible and greater than 2.0 dB increase due to construction traffic are likely

Note 3: The predicted noise levels assume receiver facades are around 10 metres from traffic on local roads and posted speeds are 50 km/h. Existing boundary fencing would reduce noise levels further. No allowance has been made for existing fencing in calculation.

Operation

Residential receivers

The proposal would not substantially change the operational road traffic noise levels in the study area, with a change of within one decibel expected for most receivers. Figure 6-5 shows the predicted operational noise levels with the proposal in the 2026 night-time scenario. The residential receivers near the proposal already experience relatively high existing road traffic noise levels, which exceed the NCG criteria. Some front-row receivers in NCA01 would experience reduced noise levels due to the proposal.

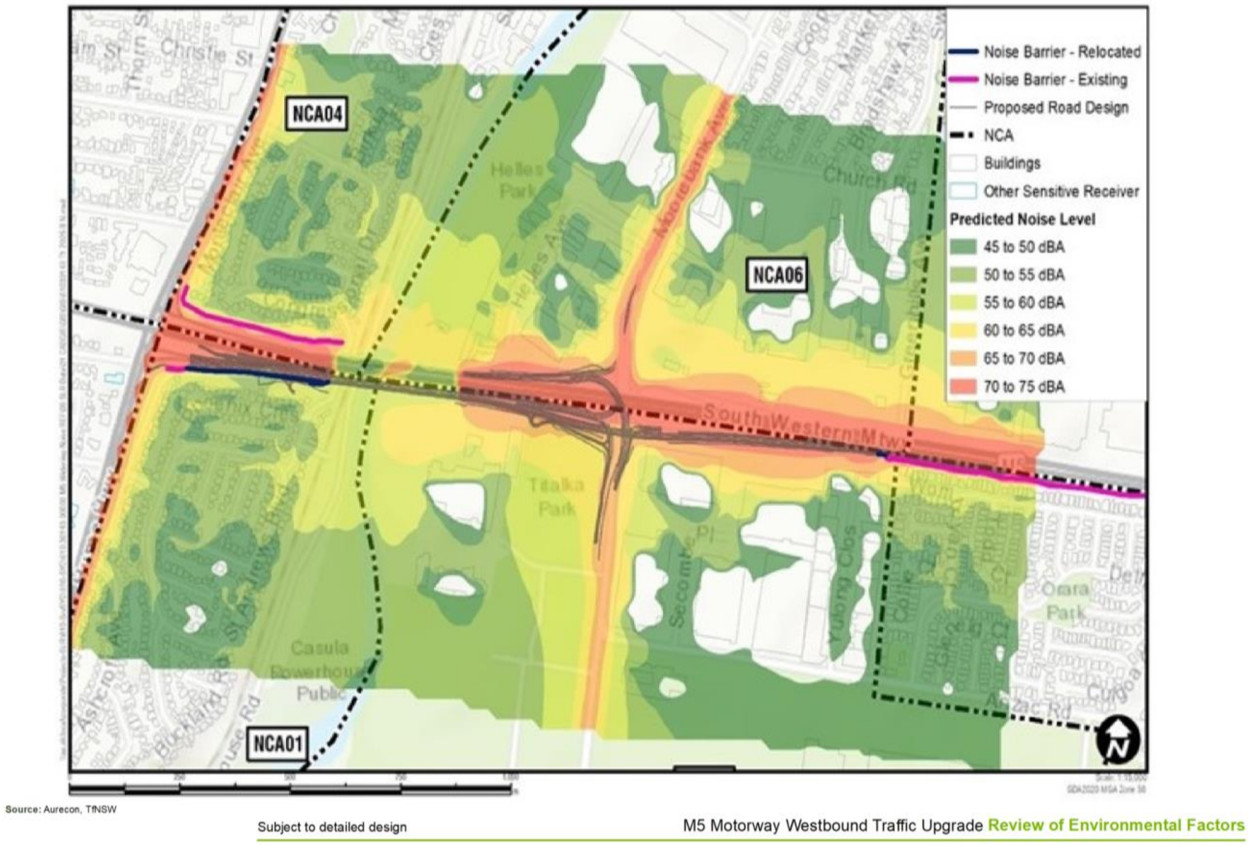


Figure 6-5 Predicted operational noise levels with the proposal (night-time, 2026)

The proposal would result in:

- No residential receivers experiencing increases in road traffic noise of greater than two decibels
- 81 residential receivers experiencing noise levels above the NCG cumulative limit criteria along the M5 Motorway in NCA01, NCA04 and NCA07 (refer to 6.2.3)
- 76 residential receivers experiencing acute noise levels.

The predicted exceedances at residential receivers are due to existing high traffic noise levels and are summarised in Table 6-14. NCA02 and NCA03 are outside the operational assessment study area, while NCA05 and NCA08 do not have residential receivers and so are not included in this table.

Table 6-14 Predicted Road Traffic Noise Levels at Most Affected Residential Receivers in each NCA

NCA	Predicted Noise Level (dBA)[1]								Number of Triggered Buildings[2]			
	At Opening (2026)				Future Design (2036)							
	No Build (without project)		Build (with project)		No Build (without project)		Build (with project)					
	Day	Night	Day	Night	Day	Night	Day	Night	Trigger 1>2.0 dB	Trigger 2 Cumulative	Trigger 3 Acute	Total
NCA01	72	67	69	64	72	67	69	64	-	20	19	20
NCA04	74	69	74	69	74	69	74	69	-	34	31	34
NCA06	76	72	77	72	76	72	77	72	-	-	-	-
NCA07	71	66	71	66	71	65	71	66	-	27	26	27
											Total	**81**

‘Other Sensitive’ Receivers

Noise levels for other sensitive receivers are not predicted to exceed the operational road traffic noise criteria.

Receivers eligible for consideration of ‘additional noise mitigation’

A total of 81 sensitive receiver buildings are predicted to have exceedances of the NCG operational road traffic criteria. As such, these receivers are eligible for consideration of ‘additional noise mitigation’. These receivers are all residential receivers and their locations are shown in Figure 6-6.

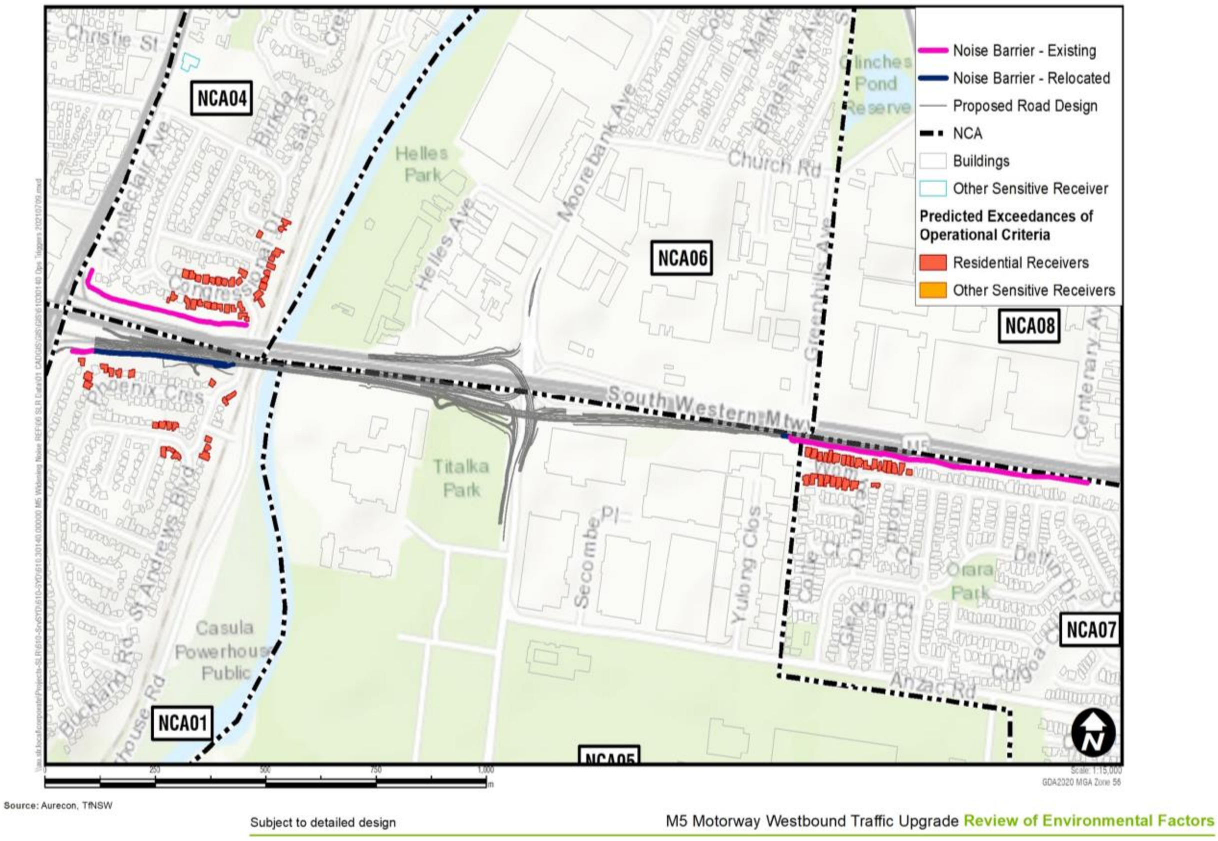


Figure 6-6 Receivers eligible for consideration of additional mitigation

Maximum Road Traffic Noise Levels

Background road traffic noise levels were presented in Section 6.1.2 of this REF. As the proposal would widen and realign some roads, the proposal may result in changes to maximum noise level events in the study area due to vehicles being closer to sensitive receivers. These changes are described in Table 6-15.

Table 6-15 Predicted change in maximum noise levels

NCA	Worst-case Change (dB)	Description of change to sensitive receivers
NCA01	2	Negligible change in maximum noise levels is predicted at most of the nearest receivers in this NCA. Increases of up to 2 decibels are predicted at isolated receivers where the line-of-sight to traffic changes due to the widening and

NCA	Worst-case Change (dB)	Description of change to sensitive receivers
		relocated barrier. A negligible change in maximum noise levels is predicted at the other sensitive receivers in this NCA which are further from the road corridor.
NCA02	-	This NCA has no sensitive receivers within the operational study area.
NCA03	-	This NCA has no sensitive receivers within the operational study area.
NCA04	0	Negligible change in maximum noise levels is predicted at sensitive receivers in this NCA.
NCA05	0	Negligible change in maximum noise levels is predicted at sensitive receivers in this NCA.
NCA06	0	Negligible change in maximum noise levels is predicted at sensitive receivers in this NCA.
NCA07	1	Maximum noise levels at residences closest to the new lane are predicted to increase by up to 1 decibel due to the new lane being around five metres closer than the existing lanes. Negligible change in maximum noise levels is predicted at the other sensitive receivers in this NCA which are further from the road corridor.
NCA08	0	Negligible change in maximum noise levels is predicted at sensitive receivers in this NCA.

6.1.5 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 33 in Section 7.1.2 of the noise and vibration assessment, included in Appendix C. Table 6-17 outlines the proposal specific construction mitigation measures to be implemented.

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 6-16 are to be considered. These would be further investigated during detailed design. Table 6-17 outlines the proposal specific mitigation measures to be implemented.

Table 6-16 Operational 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 considered feasible where there are four or more closely spaced receivers that exceed the operational road traffic noise criteria. The proposal includes low noise pavement on parts of the proposed new ramps off the M5 Motorway. Other parts of the proposal would have concrete and dense graded asphalt road surfaces. To achieve noise benefits of replacing these surfaces, the M5 Motorway would require resurfacing, which is unlikely to be feasible on the main carriageway where no work is proposed and is out of scope for this proposal. Low noise pavements would be considered further during detailed design.
In-corridor mitigation (noise barriers)	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	Noise barriers are a feasible mitigation measure for the proposal and have been incorporated in the proposal design (refer to Section 3.2.4).

Mitigation option	Description	Feasibility
	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.	
At-property mitigation (architectural treatment)	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 Transport for NSW *At-Receiver Noise Treatment Guideline*. The guideline details the approach for specifying feasible and reasonable at-property treatments for Transport for NSW road projects.	At-property architectural treatments are considered feasible for properties identified as being eligible for at-property noise mitigation. Receivers that are identified as being eligible for at-property noise mitigation would be identified and offered treatment.

Mitigation measures

Table 6-17 describes the proposed safeguards and management measures that would be implemented by the proposal to mitigate any impacts to noise and vibration impacts.

Table 6-17 Noise and vibration safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	A Noise and Vibration Management Plan (NVMP) would be prepared and implemented as part of the CEMP. The NVMP would generally follow the approach in the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) and identify: • Nearby sensitive receivers • All potential significant noise	Construction Contractor	Detailed design / Pre-construction	Section 4.6 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	and vibration generating activities associated with the activity • Description of work, construction equipment and hours the work would be completed • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Transport for NSW, 2014) • Criteria for the proposal and relevant licence and approval conditions • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Details on how respite would be			

Impact	Environmental safeguards	Responsibility	Timing	Reference
	applied where ongoing high impacts are seen at certain receivers • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.			
Noise and vibration	All sensitive receivers (eg residential properties and schools) likely to be affected by construction noise and vibration would be notified at least seven days prior to the commencement of noise and vibration intensive activities. The notification would provide details of: • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information	Construction Contractor	Detailed design / pre-construction	Additional safeguard
Construction noise and vibration assessments	Location and activity specific noise and vibration impact assessments would be carried out prior to (as a minimum) activities: • With the potential to result in noise	Construction Contractor	Pre-construction/ construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	- levels above 75 dBA at any receiver - Required outside standard construction hours and likely to result in noise levels greater than the relevant Noise Management Levels - With the potential to exceed relevant criteria for vibration. The assessments would 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.			
Construction noise exceedances	Where noise intensive equipment is to be used near sensitive receivers, the work would be scheduled during standard construction hours, where possible. If it is not possible to restrict the work to the daytime, then they would be completed as early as possible in each work shift, where possible. Appropriate respite would also be provided to affected receivers in	Construction Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	accordance with the CNVG.			
Compounds with long term work	Hoarding, or other shielding structures, would be used where receivers are impacted near compounds or fixed work areas with long durations. To provide effective noise mitigation, the barriers would break line-of-sight from the nearest receivers to the work and be of solid construction with minimal gaps.	Construction Contractor	Construction	Additional safeguard
Monitoring	Monitoring would be carried out at the start of noise and/or vibration intensive activities to confirm that actual levels are consistent with the predictions and that appropriate mitigation measures from the CNVG have been implemented.	Construction Contractor	Construction	Additional safeguard
Construction traffic	The potential impacts from construction traffic would be reviewed at a later stage when more information is available.	Construction Contractor	Pre-construction / Construction	Additional safeguard
Vibration work within minimum working distance	Where work is within the minimum working distances and considered likely to exceed the cosmetic damage criteria: • Different construction methods with lower source vibration levels would be	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	investigated and implemented, where feasible • Attended vibration measurements would be carried out at the start of the work to determine actual vibration levels at the item. Work would be ceased if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria.			
Vibration work within minimum working distance	The potential human comfort impacts and requirement for vibration intensive work would be reviewed as the proposal progresses.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
Vibration work within minimum working distance	Building condition surveys would 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.	Construction Contractor	Pre-construction / Construction	Additional safeguard

6.2 Traffic and transport

This section describes the potential traffic and transport impacts associated with the proposal. This section is informed by the traffic and transport assessment (Aurecon, 2022), which is provided in Appendix D.

6.2.1 Methodology

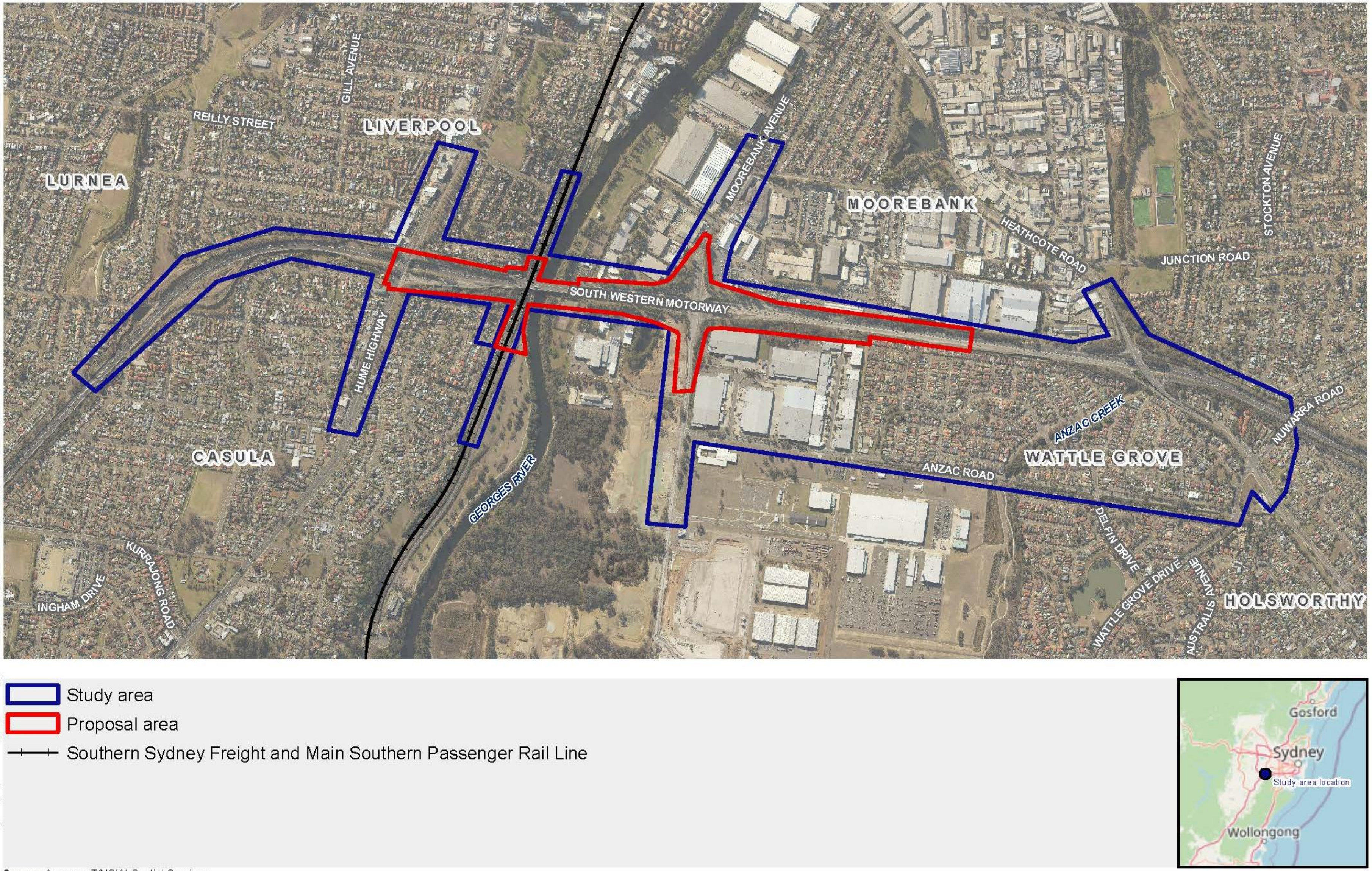
The traffic and transport assessment is based on a desktop review of collected and modelled data. The study area in the assessment has been adopted as the boundary of the traffic modelling for the proposal, and focuses on the segment of the M5 Motorway from east of the Heathcote Road Interchange to west of the Hume Highway Interchange (refer to Figure **6-7**).

The methodology for this traffic and transport assessment involved:

- Review of existing and future conditions of the transport network within and surrounding the proposal
- Developing a model for the concept design: A VISSIM model was developed based on existing conditions
- Modelling the traffic performance at key interchanges as well as basic, merge, weaving and diverge freeway segments for the following scenarios:
    - Base year (2018)
    - 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'
- Assessing the impacts of the proposal on traffic and transport during construction and operation
- Recommending mitigation measures to minimise potential traffic or transport impacts from the proposal.

The study area for this assessment includes the M5 Motorway from east of the Heathcote Road interchange to west of the Hume Highway interchange (refer to Figure **6-7**) and also includes the nearby intersections of:

- Heathcote Road, Nuwarra Road and Wattle Grove Drive
- Wattle Grove Drive and Anzac Road
- Moorebank Avenue and Anzac Road.



Source: Aurecon, TfNSW, Spatial Services

Scale 1:18,500 @A4

0 250 500m

Projection: GDA 1994 MGA Zone 56

M5 Motorway Westbound Traffic Upgrade

Figure 6-7 Study area for the traffic and transport impact assessment

6.2.2 Existing environment

Road network

The M5 Motorway is a classified State road that extends from General Holmes Drive at Kyeemagh to the Hume Motorway at Prestons and forms part of the Sydney Orbital Network. This section of the M5 Motorway generally has three to four lanes in each direction separated by a concrete median barrier and a speed limit of 100 kilometres per hour. Major intersections along this section of the M5 Motorway are at the Hume Highway, Moorebank Avenue and Heathcote Road. This section of the M5 Motorway also passes over the Georges River via the Georges River bridges, which have four traffic lanes in each direction. Other key roads within the study area include the Hume Highway, Heathcote Road, Anzac Road, Wattle Grove Drive, Nuwarra Road and Bapaume Road.

Key intersections

Key intersections within the study area include:

- M5 Motorway / Hume Highway – a signalised intersection
- M5 Motorway / Moorebank Avenue – a signalised intersection
- M5 Motorway / Heathcote Road – a signalised intersection
- Heathcore Road / Nuwarra Drive / Wattle Grove Drive – a signalised intersection with slip lanes
- Wattle Grove Drive / Anzac Road – a four-way roundabout
- Moorebank Avenue / Anzac Road – a signalised T-intersection with a slip lane
- Moorebank Avenue / Bapaume Road – an unsignalised T-intersection.

Traffic observations

During the PM peak, the westbound section of the M5 Motorway between Moorebank Avenue and Hume Highway experiences congestion as a result of weaving traffic. This results in slow travel speeds and queues that extend back to the Georges River at Hammondville. This suggests that the corridor is already operating close to capacity.

Intersection performance

Level of service (LoS) is the standard measure used to assess the operational performance of intersections, with LoS criteria defined in Table 6-18.

Existing intersection LoS for key intersections along the M5 Motorway were modelled using traffic count data for the AM and PM peak periods (refer to Table 6-19 and Table 6-20).

Table 6-18 Road level of service (LOS) criteria

LOS	Average Delay per Vehicle (sec/veh)	Traffic signals, Roundabout
A	<14	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity

LOS	Average Delay per Vehicle (sec/veh)	Traffic signals, Roundabout
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts requires other control mode
F	>70	Unsatisfactory with excessive queuing

Table 6-19 shows the traffic performance of the three key interchanges within the study area as per the base case model results for the 2018 AM peak. The LoS for the M5 Motorway / Hume Highway and M5 Motorway / Moorebank Avenue intersections was ‘B’, indicating that these intersections were operating well, with acceptable delays and spare capacity. However, the M5 Motorway / Heathcote Road intersection was running at an unsatisfactory LoS with excessive queuing (LoS F). This is due to congestion on the M5 Motorway eastbound and westbound off-ramps and Heathcote Road’s through and right turn lanes.

Table 6-19 Existing intersection performance for 2018 AM peak

Intersection	Average delay (sec)	LOS
M5 Motorway / Hume Highway	26	B
M5 Motorway / Moorebank Avenue	21	B
M5 Motorway / Heathcote Road	80	F

Table 6-20 shows the traffic performance of the three key interchanges within the study area as per the base case model results for the 2018 PM peak. The LoS for the M5 Motorway / Hume Highway intersection was ‘C’ indicating a satisfactory delay; however, the M5 Motorway / Moorebank Avenue and M5 Motorway / Heathcote Road intersections are running at capacity (LoS E). The M5 Motorway / Moorebank Avenue congestion is caused by heavy right turn traffic from the north approach. The M5 Motorway / Heathcote Road intersection congestion is caused by congestion in the PM peak on the M5 Motorway eastbound and westbound off-ramps and Heathcote Road’s through and right turn lanes.

Table 6-20 Existing intersection performance for 2018 PM peak

Intersection	Average delay (sec)	LOS
M5 Motorway / Hume Highway	31	C
M5 Motorway / Moorebank Avenue	69	E
M5 Motorway / Heathcote Road	61	E

The LoS modelling for the M5 Motorway / Heathcote Road intersection reflects the base year scenario and did not include traffic signal optimisation, which may improve congestion.

Freeway performance

The M5 Motorway at the proposal area can be classified as a freeway. Three types of movements are found on freeways besides the basic freeway segment including weaving, merge and diverge segments.

Freeway performance criteria

Basic freeway segments do not require any additional movements such as merging, diverging and weaving. The LoS for this movement is described in Table 6-21.

Table 6-21 LOS criteria for basic freeway segments

LOS	Density (passenger cars/mile/lane)	Density (passenger cars/km/lane)
A	≤ 11	≤ 6.83
B	Between 11 and 18	Between 6.83 and 11.18
C	Between 18 and 26	Between 11.18 and 16.15
D	Between 26 and 35	Between 16.15 and 21.75
E	Between 35 and 45	Between 21.75 and 27.96
F	Demand exceeds capacity or density over 45	Demand exceeds capacity or density over 27.96

Freeway weaving segments are movements where two or more traffic streams travelling in the same general direction cross paths along a significant length of freeway without the help of traffic control devices. The LoS for this movement is described in Table 6-22.

Table 6-22 LOS criteria for freeway weaving segments

LOS	Density (passenger cars/mile/lane)	Density (passenger cars/km/lane)
A	Between 0 and 10	Between 0 and 6.21
B	Between 10 and 20	Between 6.21 and 12.42
C	Between 20 and 28	Between 12.42 and 17.39
D	Between 28 and 35	Between 17.39 and 21.75
E	Between 35 and 43	Between 21.75 and 26.71
F	Demand exceeds capacity or density over 43	Demand exceeds capacity or density over 26.71

This traffic movement requires the most changes with two or more traffic streams combining to form a simple traffic stream (merge) or a single traffic stream divides to form two or more separate traffic streams (diverge). The LoS for this movement is described in Table 6-23.

Table 6-23 LOS criteria for freeway merge and diverge segments

LOS	Density (passenger cars/mile/lane)	Density (passenger cars/km/lane)
A	≤ 10	≤ 6.21
B	Between 10 and 20	Between 6.21 and 12.42
C	Between 20 and 28	Between 12.42 and 17.39
D	Between 28 and 35	Between 17.39 and 21.75

LOS	Density (passenger cars/mile/lane)	Density (passenger cars/km/lane)
E	≥ 35	≥ 21.75
F	Demand exceeds capacity	Demand exceeds capacity

Between Moorebank Avenue and Hume Highway

High volumes of crossing traffic were identified along the M5 Motorway between Moorebank Avenue and Hume Highway in the 2018 AM and PM peaks. During the AM peak period, the crossing traffic volumes were greatest eastbound, with the traffic volumes from ramp to the M5 Motorway about 1,000 vehicles per hour and from the M5 Motorway to ramp about 1,260 vehicles per hour. During the PM peak period, the crossing traffic volumes were greatest westbound, with the traffic volumes from ramp to the M5 Motorway about 1,260 vehicles per hour and from the M5 Motorway to ramp about 1,000 vehicles per hour.

The traffic performance for westbound freeway segments was:

- LoS C (operating acceptably) over all highway sections during the AM peak
- LoS F (operating with congestion) in almost all lanes of the basic, weaving, merge and diverge freeway segments during the PM peak.

The traffic performance for eastbound freeway segments was:

- LoS D or LoS E (operating near, or in some cases, at capacity) during the AM peak
- LoS D or better (operating acceptably, although near capacity) during the PM peak.

Between Heathcote Road and Moorebank Avenue

Moderate volumes of crossing traffic were identified along the M5 Motorway between Heathcote Road and Moorebank Avenue in the 2018 AM and PM peaks. The traffic volumes were similar for eastbound and westbound.

The traffic performance for westbound freeway segments was:

- Mostly LoS C or better (operating acceptably) over all highway sections during the AM peak, with some lanes at LoS D and approaching capacity
- Mostly LoS F (operating with congestion) in almost all lanes of all freeway segments during the PM peak.

The traffic performance for eastbound freeway segments was:

- Mostly LoS D or better (operating acceptably, although near capacity in some segments), apart from some outer lanes operating over capacity (LoS F) during the AM peak
- Mostly LoS C or better (operating acceptably), apart from some lanes operating over capacity (LoS F) during the PM peak.

Freight access and routes

There are many roads near the proposal area which are approved B-Double routes for vehicles up to 26 metres length, including the M5 Motorway, Hume Highway, Moorebank Avenue, Heathcote Road and sections of Anzac Road between Moorebank Avenue and Yulong Close.

Road safety

Road safety data was analysed for the section of the M5 Motorway within the study area, as well as intersections up to 50 metres from the M5 Motorway (including

Heathcote Road, Moorebank Avenue and Hume Highway). There were 224 crashes reported between January 2014 and December 2018, comprising:

- 136 crashes involved a casualty
- No fatal crashes
- 21 serious injuries
- 37 moderate
- 45 minor
- 59 non-casualty
- 6 uncategorised.

The locations of crashes within the proposal area are shown in Figure 3-20 of the traffic and transport assessment (refer to Appendix D).

Modes of travel

The primary mode of travel within the Liverpool LGA is by vehicle, with this accounting for 77 per cent of movements. Public transport is used the least for travel. This is illustrated in Figure 6-8.

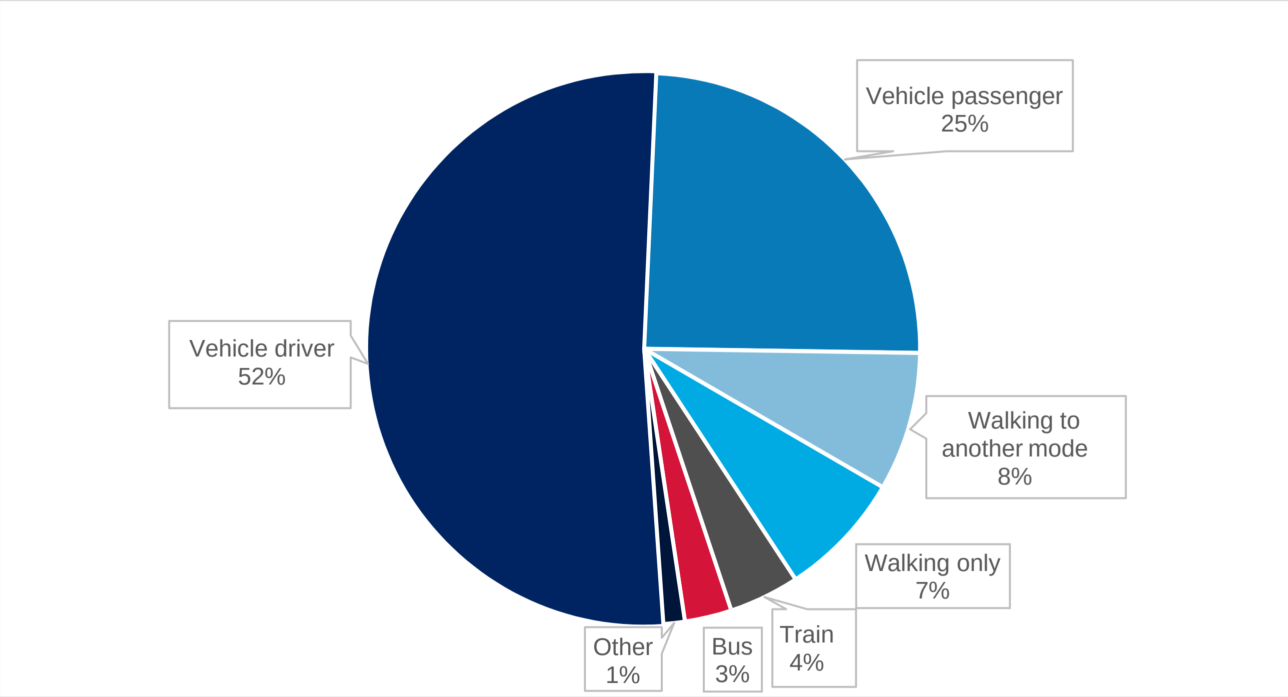


Figure 6-8 Travel by mode, Liverpool LGA in 2018/19

Public transport

The Georges River bridge within the proposal area crosses over the rail corridor that is serviced by several rail lines including:

- T2 Inner West & Leppington and T5 Cumberland rail lines – which are commuter passenger services
- Southern Sydney Freight Line – which is a freight only line managed by the Australian Rail Track Corporation (ARTC).

The closest train stations are Casula station, about 1.3 kilometres south of the proposal area, and Liverpool station, about 1.7 kilometres north of the proposal area.

There are several bus routes that run through the proposal area including 851, 852, 855, 856, 857, 870, 871 and 872 that are all operated by Interline Bus Services. There are also three routes that are operated by Transdev NSW including bus route 901, 902 and 902X. There are no bus stops on the M5 Motorway within the proposal area; however, there are bus stops located nearby along the Hume Highway, Moorebank Avenue and Heathcote Road.

Active transport

Although there is a network of bike paths located around the proposal area, there are major barriers to movement including the rail line in the west, the Hume Highway, the M5 Motorway, Cabramatta Creek, the Georges River, the M7 Motorway and Hoxton Park Road. There is currently an off-road cycleway broken into sections along the M5 Motorway from the Hume Highway to Georges River bridge, as well as a section of Moorebank Avenue near the intersection with the M5 Motorway. This means there are gaps in the path and cyclists cannot continue the whole way on a separated path.

The area is well serviced by footpaths and shared paths, with existing pathways located along the Hume Highway, southbound lanes of Moorebank Avenue and Heathcote Road, Lakewood Crescent and Powerhouse Road. Local roads around the proposal area also offer areas for pedestrians to walk. However, there are no formal pedestrian crossings on Moorebank Avenue north of the M5 Motorway. There is also no signalised crossings at the M5 Motorway and Moorebank Avenue interchange.

6.2.3 Potential impacts

Construction

Traffic movements

The proposal would generate light and heavy vehicle movements on the road network surrounding the proposal associated with delivery or removal of construction materials and equipment and construction worker movements to and from the construction zones.

An average of 45 heavy vehicles and 100 light vehicles per day are expected, with up to 135 heavy vehicles and 200 light vehicles expected during peak construction on the surrounding road network. The construction traffic for delivery or removal of construction materials and equipment would generally be staged throughout the day, with a slight peak in construction traffic volumes during the morning period. The construction workers would arrive and leave site at the start and end of each shift. In addition, oversized vehicles would occasionally be required to travel to and from the construction zones, which would likely occur during night-time periods to minimise traffic impacts.

The proposal area is well serviced by roads suitable for heavy vehicles, including the M5 Motorway, Hume Highway, Moorebank Avenue, Heathcote Road and sections of Anzac Road. The additional volume of vehicles would be relatively small compared to the existing traffic volumes of vehicles on the surrounding major road network.

However, the construction traffic may be particularly noticeable and result in traffic impacts on the short sections of local roads used to access the construction zones and main ancillary facility, which is proposed to be located directly south of Area 4 within vacant land to the east of Georges River. This is because a large proportion of the construction vehicles for the proposal would travel to and from the main ancillary facility each day as it would be used for site offices, staff amenities, parking, delivery and storage of materials, equipment and structural elements as well as for fabrication and assembly of bridge elements. This ancillary facility would be accessed via the ABB

Australia facility to the east using Bapaume Road in Moorebank, which is a local road managed by Liverpool City Council. Another access point would be via the unnamed access track on the northern side of the proposal area accessible via Helles Avenue in Moorebank to the east of the Georges River.

To minimise potential traffic impacts associated with use of the proposed ancillary facility and local roads during construction of the proposal, several management and mitigation measures would be implemented. This would include consultation with nearby property owners (including ABB Australia), minimising use of local roads where practical, preparing a road dilapidation report and controlling construction traffic in accordance with a Traffic Management Plan.

Parking

Parking in residential areas of Casula and Liverpool may be affected during construction of the new bridge and the new exit ramp. This would be due to the temporary removal of parking spaces for heavy vehicles and cranes.

Construction workers would be encouraged to park in parking areas within the proposed ancillary facility and share vehicles when travelling to construction areas to limit potential parking impacts in surrounding local roads.

Construction staging

As detailed in Section 3.3, six construction areas have been defined, with up to five stages in which work would be completed. The assumed access arrangements and a summary of impacts are summarised in Table 6-24.

Table 6-24 Construction staging impacts

Construction area	Construction access point	Impact
1	Stages 0, 1 and 3: via Greenhills Avenue and Secombe Place Stage 2: via M5 Motorway (entry only), Greenhills Avenue and Secombe Place	Stages 0 to 3 may result in a reduction of the speed limit to 80 kilometres per hour on the M5 Motorway, potentially resulting in a minor increase in travel time. However, this section often experiences congestion during peak periods and operates at speeds below the posted limit of 100 kilometres per hour. Stage 3 work would be limited to overnight asphalting work, which would avoid peak traffic periods and so minor traffic impacts are expected.
2	Stage 0: Night work with no access during peak periods Stages 1 and 3: off Moorebank Avenue on the western side and via Secombe Place on the eastern side	Temporary road layout modifications on the M5 Motorway and Moorebank Avenue would be required impacting on travel time and potentially increase congestion. Delays and queuing along Moorebank Avenue would impact local traffic along

Construction area	Construction access point	Impact
	Stage 2: off Moorebank Avenue on the western side and via Secombe Place on the eastern side and access to the west via Bapaume Road Stages 4 and 5: via Secombe Place on the east	Cambridge Avenue and Moorebank Avenue. The closure of the footpath on both sides of Moorebank Avenue would impact pedestrians in the area. Alternative routes would be identified as part of the Traffic Management Plan.
3	Stages 0,1 and 2: Potential access via Bapaume Road Stage 3: Potential access via Bapaume Road and via the on ramp Stage 4: Open new ramp and underpass	No expected impact to traffic.
4	All stages: Via Helles Avenue, Bapaume Road and Powerhouse Road	Temporary partial closures of Lakewood Crescent and Powerhouse Road may be required for safety. These would be for up to three weeks at a time, and a detour route required during closures. The barge on the Georges River used for construction of the bridge may impact users of the river as access may be restricted along the river. The barge would be in the river for about nine months, however, would not obstruct passage for the whole duration.
5	All stages: via the Hume Highway westbound off-ramps	Lakewood Crescent would likely be required for heavy vehicle movements. The use of local residential streets for construction access may result in traffic and road safety impacts.
6	Stages 0, 1 and 2: via eastbound off-ramp, Helles Avenue and Moorebank Avenue Stage 3: Night work, with no access during peak periods	During Stage 2, only one right turn lane on the eastbound off ramp to Moorebank Avenue would be open. This may cause vehicles to queue beyond the existing eastbound off ramp into the M5 Motorway eastbound kerb lane. Further modelling is required during detailed design to determine whether traffic signal

Construction area	Construction access point	Impact
		phasing and timing can accommodate the traffic during this phase. If these impacts cannot be minimised, Stage 2 work may need to be carried out through night-time only.

Property access

Private property access would generally be maintained during construction. Consultation would be carried out with ABB Australia due to their location to the construction areas 3 and 4 and the proposed ancillary facility, to minimise potential disturbance of their operations.

Public and active transport

There would be minimal impact to public transport as there are no bus stops located within the proposal area. However, bus routes that pass along areas under construction may experience minor temporary traffic delays. There would be up to three rail possessions a year required, and these would occur during scheduled Sydney Trains and ARTC shutdowns.

There may be temporary impacts on pedestrian access including:

- Extended closure of the footpath along Moorebank Avenue on the south side
- Closures of the shared path and footpath in Casula along Lakewood Crescent and Powerhouse Road
- Disruptions / closures of the on-road bicycle lane along the south side of the M5 Motorway from the eastern boundary of the proposal to Moorebank Avenue.

Cyclists travelling west on the M5 Motorway may be impacted by the need for a short-term closure of the existing cycle path upstream of the existing Georges River bridge toward Casula, or along the Georges River.

Traffic management strategies would be implemented to appropriately manage changes during construction, including alternate access, detours, and/or controlling pedestrian and heavy vehicle construction movements using traffic controllers or temporary signals.

Maritime

The construction of the new bridge over the Georges River would temporarily impact passage for boats and other marine vessels due to the use of a crane barge. The barge would be in place in the river for about nine months, however due to the moveable nature of the barge access would not be restricted for the whole duration. Construction work would result in partial or full closures of the river, which would restrict access and result in impacts to fishing and recreational boats and marine vessels and users of the NSW Barefoot Water Ski Club. Transport for NSW would consult with this club to minimise impacts to scheduled events held by the club.

Operation

Weaving volumes and traffic performance

During operation, the proposal would address the existing weaving issue on the M5 Motorway westbound between the Moorebank Avenue and Hume Highway interchanges through construction of a new service road.

Analysis of the VISSIM model has been conducted for the AM and PM peak periods in 2026 and 2036, for the scenarios with and without the proposal. Table 6-25 outlines the traffic impacts expected in these scenarios in both 2026 and 2036. The impacts are expected to be the same in 2026 and 2036.

Table 6-25 Traffic impacts on weaving volumes in both 2026 and 2036 with and without the proposal

Location	Period	Without the proposal	With the proposal
Between Moorebank Avenue and Hume Highway	AM peak	The weaving issue would remain with a high volume of traffic eastbound and a moderate volume of traffic westbound. This would result in a continued safety issue and risk of crashes as outlined in Section 2.1	The proposal would improve the safety of the section of the M5 Motorway as it would remove the existing weaving section.
	PM peak	The weaving issue would remain with a high volume of weaving traffic eastbound and westbound. This would result in a continued safety issue and risk of crashes as outlined in Section 2.1.	The proposal would improve the safety of the section of the M5 Motorway as it would remove the existing weaving section.
Between Heathcote Road and Moorebank Avenue	AM peak	The weaving issue would remain with a moderate volume of weaving traffic eastbound and westbound. This would result in a continued safety issue and risk of crashes as outlined in Section 2.1.	Along the westbound, there would be a decrease in about 22 per cent of vehicles needing to change lanes. This would improve safety, with a smaller risk of crashes, and result in a decrease in volume of weaving traffic on the ramp to the M5 Motorway.
	PM peak	The weaving issue would remain with a moderate volume of weaving traffic eastbound and westbound. This would result in a continued safety issue and risk of crashes as outlined in Section 2.1.	Along the westbound, there would be a decrease in about 22 per cent of vehicles needing to change lanes. This would improve safety, with a smaller risk of crashes, and result in a decrease in volume of

Location	Period	Without the proposal	With the proposal
			weaving traffic on the ramp to the M5 Motorway.

Freeway segment performance

The proposal would remove the existing diverge segment between Moorebank Avenue and the Hume Highway, with construction of the new road between the interchanges, as illustrated in Figure 6-9.

Figure 6-9 Freeway segment locations between Moorebank Avenue and Hume Highway

The change in performance for these sections is described in Table 6-26.

Table 6-26 Freeway segment performance with the proposal

Location	Period	Change in performance
Between Moorebank Avenue and Hume Highway – Westbound	AM peak	Without the proposal all freeway segments would result in a LoS C to D. With the proposal the road would experience good performance with acceptable delays (LoS B and C). The new road would operate at a LoS B.
	PM peak	Without the proposal all freeway segments would result in LoS F, indicating that the road would experience congestion. The proposal would improve this section of the M5 Motorway, with all segments operating at LoS D or better, apart from one lane on segment 4 (diverge) which may operate at a LoS E.
Between Moorebank Avenue and Hume Highway – Eastbound	AM peak	Without the proposal the road would result in unacceptable operation (LoS E or F). The proposal would result in an overall improvement of traffic, with lower densities and higher speeds. Segment 4 (diverge), as well as isolated lanes on other segments, may however operate at LoS E.

Location	Period	Change in performance
	PM peak	Operation of the proposal would not result in any significant changes.
Heathcote Road and Moorebank Avenue – Westbound	AM peak	Overall improved performance with lower densities and higher speeds.
	PM peak	The proposal would result in an overall improvement over this section of the M5 Motorway, with all segments operating at LoS D or better, apart from one lane on segment 11 (basic) which may operate at a LoS E.
Heathcote Road and Moorebank Avenue – Eastbound	AM peak	Operation of the proposal would not result in any significant changes.
	PM peak	Operation of the proposal would not result in any significant changes.

The proposal would improve the performance of the freeway segments between Heathcote Road and Moorebank Avenue. This change is illustrated in Figure 6-10.

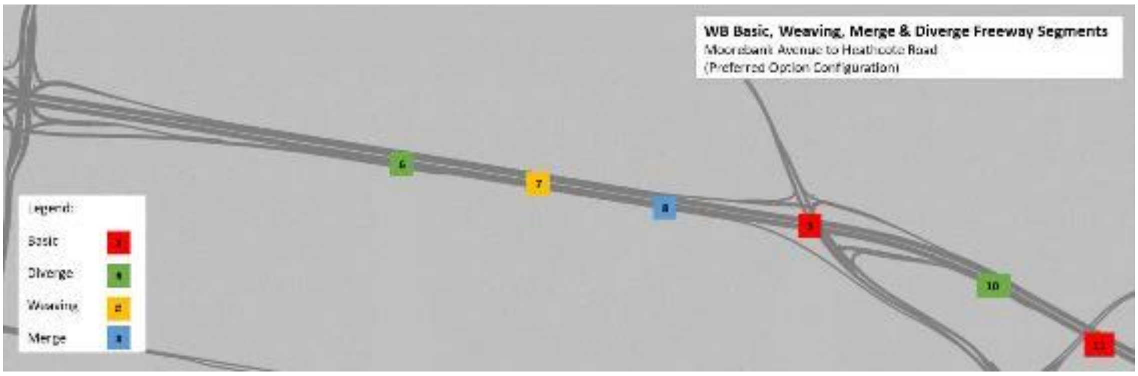


Figure 6-10 Freeway segment between Heathcote Road and Moorebank Avenue

Intersection performance

Without the proposal, overall interchange performance would worsen for all interchanges over time. However, the operation of the proposal would lead to improvement in performance of the M5 Motorway / Hume Highway and M5 Motorway / Moorebank Avenue intersections during the PM peak in 2036 as outlined in Table 6-27. There is not expected to be a substantial change during the morning peak at all intersections or at Heathcote Road for both AM and PM peak.

Table 6-27 Intersection performance with the proposal

Intersection	Scenario	Change in performance
Hume Highway	PM peak 2026	Improving from LoS C (41s delay) to LoS C (30s delay)
	PM peak 2036	Improving from LoS D (52s delay) to LoS C (32s delay)
Moorebank Avenue	PM peak 2026	Improving from LoS F (71s delay) to LoS C (32s delay)
	PM peak 2036	Improving from LoS F (74s delay) to LoS C (39s delay)

Road safety

The existing weaving issue would be addressed with less weaving traffic volumes, as the proposed design disconnects the existing Hume Highway ramps. The upgrade would create a longer merge lane by about 160 metres for vehicles entering the M5 Motorway from Moorebank Avenue, and result in more opportunities to change lanes and a less dense road environment.

Without the proposal, the existing weaving issue would become worse, with the Moorebank Logistics Park becoming operational, creating a substantially larger volume of heavy vehicles entering from Moorebank Avenue. The proposal would improve the safety of the Moorebank Avenue and M5 Motorway intersection by providing westbound traffic from Moorebank Avenue entering the M5 Motorway a longer section of road to change lanes.

Public and active transport

The proposal would have minimal impacts on public transport as bus routes and access to bus stops are expected to be maintained. However, the proposal may improve the reliability of bus services using the associated roads due to reduced congestion and improved safety.

The proposal would result in improved safety for cyclists and pedestrians. A new shared user path would be installed on the southern side of the M5 Motorway across the new bridge. This would mean cyclists can travel along a separate path the whole way to the Hume Highway. Cyclists wanting to travel westbound on the M5 Motorway would exit the M5 Motorway at the Moorebank Avenue underpass and travel to the M5 Motorway / Moorebank Avenue intersection to re-join the M5 Motorway on the existing entry ramp. There would also be a new shared path from Moorebank Avenue northbound, connecting to the western side of the Georges River.

6.2.4 Safeguards and management measures

Table 6-28 describes the proposed safeguards and management measures that would be implemented by the proposal to mitigate any impacts to traffic and transport.

Table 6-28 Traffic and transport safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would be prepared in accordance with the Roads and Maritime *Traffic Control at Work Sites Manual* (RTA, 2010) and *QA Specification G10 Control of Traffic* (Roads and Maritime, 2008). The TMP would include: • 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	Construction Contractor	Detailed design/pre-construction	Section 4.8 of QA G36 Environment Protection

Impact	Environmental safeguards	Responsibility	Timing	Reference
	inform the local community of impacts on the local road network including between Campbelltown and Liverpool LGAs • 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.			
Construction site access	Construction site access would be designed and implemented in consideration of:	Construction Contractor	Detailed design/ construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Road design guidelines and turning paths for heavy vehicles • Appropriate sight distances 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 • Provision of deceleration lanes at accesses next to highly trafficked roads • Minimising the size of heavy vehicles that would use local roads to access construction zones (particularly at Area 5).			
Traffic impacts	Consultation would be carried out with the NSW Barefoot Water Ski Club to	Transport for NSW / Construction Contractor	Pre-construction / construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	confirm temporary closures of the Georges River during construction.			
Traffic impacts	For construction area 6, during stage 2 work further traffic modelling would 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.	Construction Contractor	Detailed design	Additional safeguard
Impact on rail operations	If any potential impact on rail operations is identified, Transport for NSW would consult with Sydney Trains and ARTC, as required, and obtain any necessary permits or licences.	Transport for NSW / Construction Contractor	Pre-construction	Additional safeguard
Impact on bus stops or routes	If any potential direct impacts on bus stops or routes are identified, Transport for NSW would consult with the relevant bus operator (Interline Bus Services or Transdev) to identify alternate arrangements.	Transport for NSW / Construction Contractor	Pre-construction	Additional safeguard
Damage to local roads	A Road Dilapidation Report would be prepared by a suitably qualified person for local roads proposed to be used by heavy vehicles,	Construction Contractor	Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	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 would be remediated / rectified by the Construction Contractor to be similar to the existing road condition or compensation would be paid to the relevant road authority.			
Impacts on cycling	Community consultation would be carried out to understand the travel patterns of cyclists and inform the cyclists of any alternate access arrangements.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard
Temporary access changes	Detours during temporary access changes would be implemented with directional signage along alternate routes. Signage along the M5 Motorway and the associated on-ramps would be provided to advise pedestrians and cyclists of any path closures.	Construction Contractor	Construction	Additional safeguard
Traffic management measures	Any temporary traffic diversions, clearways and road closures would be implemented in accordance with Transport	Construction Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Management Centre (TMC) requirements.			
Property access	Property access would be maintained where feasible and reasonable and property owners (including ABB Australia) would be consulted before starting any work that may temporarily restrict or control access.	Construction Contractor	Construction	Additional safeguard
Local road or shared path closures	Liverpool City Council would be consulted prior to any local road or shared path closures to identify suitable mitigation measures such as detour routes.	Construction Contractor	Construction	Additional safeguard
Parking	Off-road parking for construction vehicles would be provided within the ancillary facility and construction areas.	Construction Contractor	Parking	Additional safeguard
Cumulative traffic impacts	Transport for NSW and the Construction Contractor would coordinate with the project team for nearby road projects (including the Moorebank Avenue Realignment) and the Transport Management Centre with regard to the proposed timing of any road and lane closures and identify alternate routes or additional safeguards and management measures, as required.	Transport for NSW / Construction Contractor	Cumulative traffic impacts	Additional safeguard

6.3 Hydrology and flooding

This section describes the potential hydrology and flooding impacts associated with the proposal. This section is informed by the hydrology and flooding assessment (Aurecon, 2022) which is provided in Appendix E.

6.3.1 Methodology

The study area in the hydrology and flooding assessment comprises a section of the Georges River catchment. The assessment included:

- Reviewing flood study and hydrologic and hydraulic models (TUFLOW) previously carried out by BMT in 2020
- Updating the models to incorporate the proposal design including:
  - Incorporating design changes such as the proposed road and new bridge
  - Existing conditions (baseline) model, which incorporated the Moorebank Link rail bridge upstream of the study area
- Running the updated model for a range of design events including five per cent, two per cent, one per cent and 0.05 per cent Annual Exceedance Probability (AEP) design events and Probable Maximum Flood (PMF).

6.3.2 Existing environment

The proposal area is within the Georges River catchment, which is located in south west Sydney. The river runs from Appin, south of Campbelltown, to its coastal outlet Botany Bay. The land surrounding the proposal is mainly developed, with industrial and commercial buildings on the northern side of the proposal area on the eastern side of the Georges River and high density residential buildings on the western side. Development on the southern side of the proposal area is high-density residential buildings on the western side of the Georges River and low-density industrial and commercial buildings on the eastern side.

Existing flood behaviour results show peak flood levels of up to 10.4 metres during one per cent AEP design event, and 12.4 metres during the PMF, upstream of the existing bridge. Flow velocities of about 3.5 metres per second during one per cent AEP design event, and 4.5 metres per second during PMF.

In a one per cent AEP design event (ie there is a one per cent chance of the event happening in a year), a minor localised flood event from the eastern bank of the Georges River about 300 metres upstream of the bridges is expected. No flooding of the existing M5 Motorway is predicted; however, minor flooding is predicted in the PMF event. The existing bridge is not predicted to flood in either event, including the PMF event.

6.3.3 Potential impacts

Construction

Construction area four, construction work of the bridge over the Georges River, and the location of the proposed ancillary facility may be prone to flooding in the five per cent AEP (ie a flood event once every 20 years).

Flood events during construction could inundate these areas and result in loss and/or damage of plant, equipment and construction materials. As these areas are located within flow paths, they also have the potential to impact flooding conditions by altering flow depths, velocities or flow paths. Portable buildings and large unsecured construction objects have the greatest potential to affect flooding. They can be carried away by deep flood waters and worsen flood conditions by blocking bridges, culverts and flood control structures downstream.

The barge used to construct the new bridge may pose a risk during flood events. In response to forecast flood events, the barge would be moved along the Georges River to a safer location. This would minimise the risk of damage to the barge and the foreshore environment.

These impacts would be temporary and construction activities would be designed to accommodate local flood risk during detailed design and construction.

Operation

There would be no significant changes in the flood behaviour of the Georges River due to the proposal. The proposal has been designed for one per cent AEP flood event, meaning there would be a one per cent chance of it happening in a year.

The area located on the eastern floodplain of the river, south of the proposed road embankment and west of Moorebank Avenue within Titalka Park, is predicted to have an increase of 20 millimetres in peak flood levels under the one per cent AEP flood event. This is due to a three-metre-deep depression, meaning during the one per cent AEP flood waters would break out from the main Georges River channel and flow into this depression where the floodwaters pond. The depression would experience an inflow of 200 millimetres. This flood event is illustrated in Figure **6**-**11**. The impacted land is currently zoned as IN1 – General Industrial, and is currently not permitted to become built type developments due to its topography. Future use would be limited by these existing constraints.

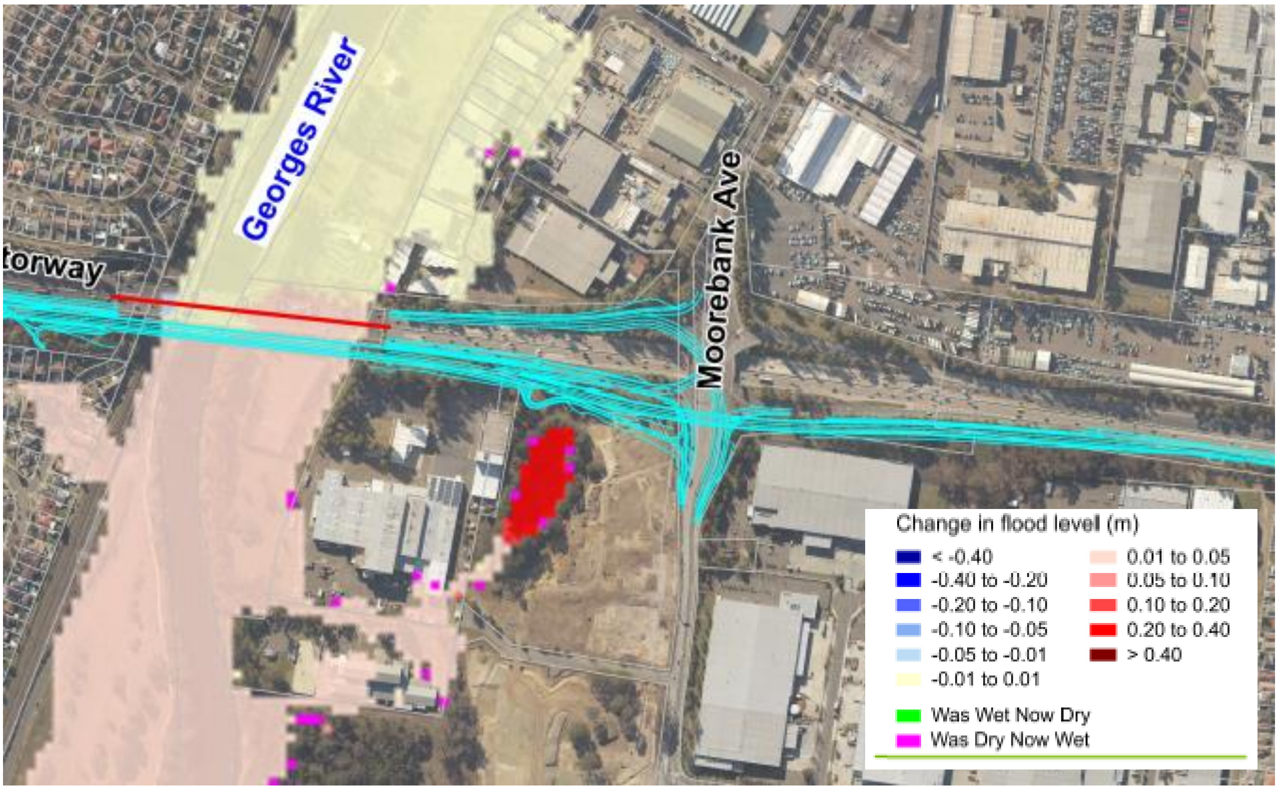


Figure 6-11 The proposal in a one per cent AEP design event

Seven residential properties (to the west of the Georges River) and two commercial properties (to the east of the Georges River) were identified to be within the one per cent AEP zone of flooding. The potential impacts on the buildings within these properties cannot be fully assessed in the absence of a detailed building floor level survey. However, the predicted affluxes of up to 20 millimetres are not expected to impose significant risk to the buildings due to the following:

- These properties are predicted to have substantial inundation of up to about one metre in the existing environment and that the predicted increases in the inundation depth of up to 20mm is considered minimal.
- The flow velocities in the existing environment are low (less than 0.2m/s) and that no increase in flow velocities is predicted as a result of the proposal.
- No changes to the flood hazard classification is predicted as a result of the proposal.

A section of Powerhouse Road and the railway corridor (to the south of the bridge and west of the Georges River) is predicted to have an increased peak flood level of less than 20 millimetres as a result of the proposal in the five per cent, two per cent and one per cent AEP design events and the PMF. However, no significant increases in the peak flow velocities are expected in these sections. Therefore, minimal impact on the existing road and the rail is expected. These flood levels and associated properties are illustrated Figure **6-11**.

The M5 Motorway is not predicted to be inundated in the design events up to and including a one per cent AEP design event. However, minor inundation and overtopping of the M5 Motorway is predicted in the PMF event. There would be increases in peak flood levels of up to 20 millimetres upstream of the proposed bridge in the flood events up to and including the PMF.

Climate change impacts

Climate change impacts have been assessed with the worst-case scenarios predicating an increase in rainfall of nine per cent by 2050 and about 20 per cent by 2090. An allowance for sea level rise of 0.4 metres in 2050 and 0.9 metres in 2100 were also considered.

These two climate change scenarios were run for the one per cent AEP design event with results indicating the following:

- Scenario 1 (year 2050): climate change is expected to result in increases in peak water levels of up to about 30 centimetres upstream of the proposed bridge. The proposed bridge is not expected to become submerged, however the M5 Motorway is predicated to become inundated
- Scenario 2 (year 2090 to 2100): climate change is expected to result in increases in peak water levels of up to about 50 centimetres upstream of the proposed bridge. The proposed bridge is not expected to become submerged, however the M5 Motorway is predicated to become inundated.

6.3.4 Safeguards and management measures

Table 6-29 describes the proposed safeguards and management measures that would be implemented to manage the potential hydrology and flooding impacts from the proposal.

Table 6-29 Hydrology and flooding safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Flooding	A building floor level survey would be conducted for properties impacted by up to 20 millimetre increase in flood level peak to allow a more detailed assessment during detailed design.	Transport for NSW	Detailed design	Additional safeguard
Flooding	A survey of a limited section of the Powerhouse Road and rail corridor (where the precited flood	Transport for NSW	Detailed design	Additional Safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	overtopping in one per cent AEP design event occurs) would be conducted during detailed design. This would allow more detailed assessment of the flooding impacts in these areas.			
Flooding	A flood warning and evacuation plan would be developed as part of the Construction Environmental Management Plan. This would include details on the prediction of floods of five per cent AEP or greater severity and provide safeguards to allow the safe evacuation of personnel during flood events.	Construction Contractor	Pre-construction / Construction	Additional safeguard
Flooding	Facilities used by personnel during working hours such as semi-permanent offices would be positioned outside the five per cent AEP flood extent.	Construction Contractor	Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Flooding	During flood events, the barge used for bridge construction would be moved to a safer location along the river.	Contractor	Construction	Additional safeguard

6.4 Surface water and groundwater

This section describes the potential surface water and groundwater impacts associated with the proposal. This section is informed by the surface water and groundwater assessment report (Aurecon, 2022), which is provided in Appendix F.

6.4.1 Methodology

The study area used in the surface water and groundwater investigation is a 500 metre buffer of the proposal area, including the Georges River upstream and downstream of the proposal. The assessment included:

- Desktop review of potential constraints and existing conditions including:
    - Climate and weather conditions
    - Local hydrology
    - Soil landscape
    - Groundwater bores/information
- A site investigation was carried out on 3 September 2020 to determine the existing conditions and support the desktop review
- An erosion hazard risk assessment was conducted in accordance with *PN 143P Erosion and Sedimentation Management Procedure* and *Managing Urban Stormwater: Soils and construction – Volume 1* (the Blue Book). This assessment informed the Preliminary Erosion and Sedimentation Assessment (PESA). The assessment was used to calculate the impacted catchment area to trigger a requirement for sediment basins
- Assessment of impacts during construction and operation of the proposal. The assessment used the following ratings:
    - **Low:** Potential adverse impact could result in a minimal decline in the resource in the study area during the life of the proposal. Probability of event occurring may be not anticipated
    - **Medium:** Potential adverse impact could result in a slight decline in the resource/quality of a resource in the study area during the life of the proposal. Probability of event occurring may be unlikely. Research, monitoring, and/or recovery initiatives would not normally be required

- High: Potential adverse impact could result in a decline in the resource resource/quality of a resource to lower-than-baseline/worse-than-baseline but stable levels in the study area. Probability of event occurring may be probable/possible. Regional management actions such as research, monitoring and/or recovery initiatives may be required

- Identification of safeguards and management measures to reduce the proposals impact on surface water and groundwater.

6.4.2 Existing environment

Climate

The Bankstown Airport Automatic Weather Station (AWS) weather gauge, which is about 6 kilometres from the site, was used to obtain rainfall data for the proposal area. The mean annual precipitation (MAP) is 900 millimetres, while the mean annual evaporation is 1,512 millimetres. Typically, wetter than average conditions are experienced from November to June and drier conditions from July to October. Evaporation rates are also consistently higher than precipitation rates. This is as illustrated in Figure 6-12.

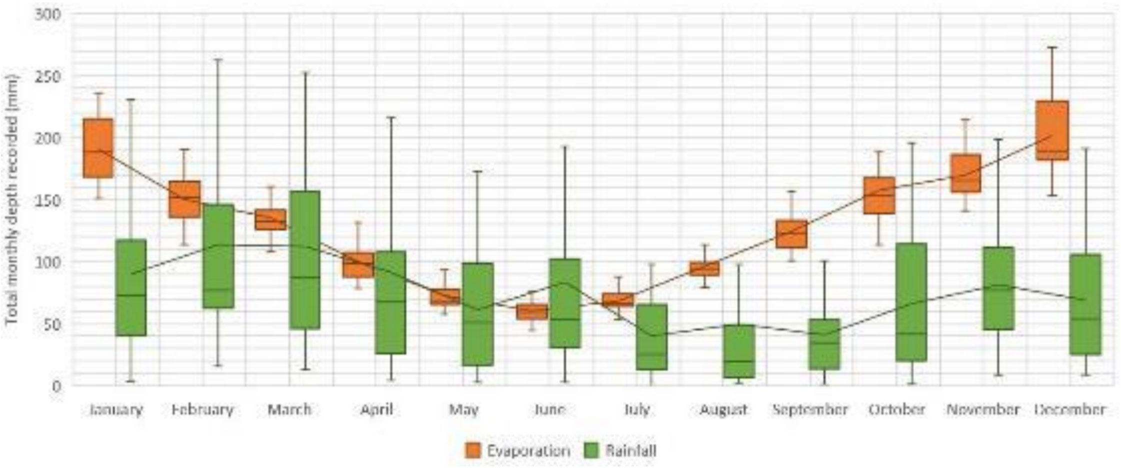


Figure 6-12 Precipitation and evaporation rates

Bankstown Airport AWS was also used to determine historical temperature at the proposal area. It indicates that there are warm to hot summers, with an average maximum of 29 degrees Celsius, and cooler winters with an average maximum of below 20 degrees Celsius and minimum of about six degrees Celsius, as illustrated in Figure 6-13.

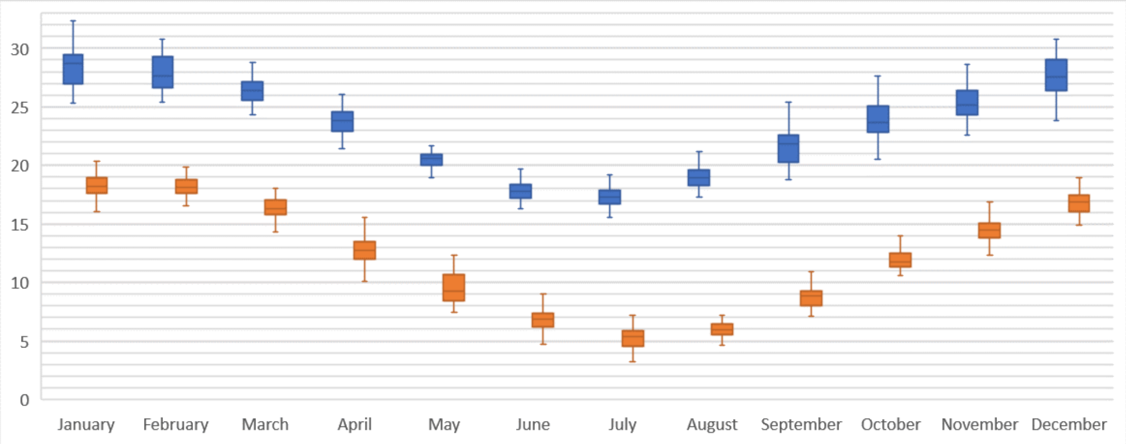


Figure 6-13 Temperature

Comparison of Figure 6-12 and Figure 6-13 reveal that there is correlation between the evaporation rate and temperature. Temperature projections indicate higher average temperatures, which may also result in higher evaporation rates.

Climate change

Long term climate patterns may be affected by climate change. Analysis of expected local climatic changes in the proposal area indicate a future increase in the intensity of extreme rainfall events. As a result, the runoff volume from the proposal area to receiving surface watercourses would increase. These changes are described in Table 6-26.

Table 6-30 Long term climate patterns

	Per cent change in near future (%) (2020-2039)			Per cent change in far future (%) (2060-2079)		
State planning region	Rainfall	Runoff	Recharge	Rainfall	Runoff	Recharge
Metropolitan Sydney	+0.4	+4.0	-5.0	+8.1	+17.6	+12.5

Soils

The proposal crosses the Blacktown and Berkshirte Park, Luddenham and Richmond soil landscapes (Chapman, et al., 2009). These soil landscapes have characteristics that may influence the interaction between surface water and groundwater impacts. These limitations include:

- Erodibility
- Erosion hazard
- Localised seasonal waterlogging
- Slope gradients
- Flood hazard.

There is a low probability of Acid Sulfate Soils (ASS) occurring on the western bank of the Georges River. There are Category 1 and Category 5 ASS located within the proposal area along the riverbed and adjacent to the river, respectively.

Soils are described in detail in Section 6.5.

Hydrological soil groups

There are two hydrological soil groups that have been mapped within the proposal area. These may affect surface water runoff and groundwater recharge. The groups that are present include group C and D, with group C more likely on the western side of the proposal and group D more likely on the eastern side of the proposal (refer to Figure **6-14**). Group C soils have a moderately high runoff potential when saturated, with water movement through the soil restricted. While group D soils have high runoff potential when saturated, with water movement up to very restricted.

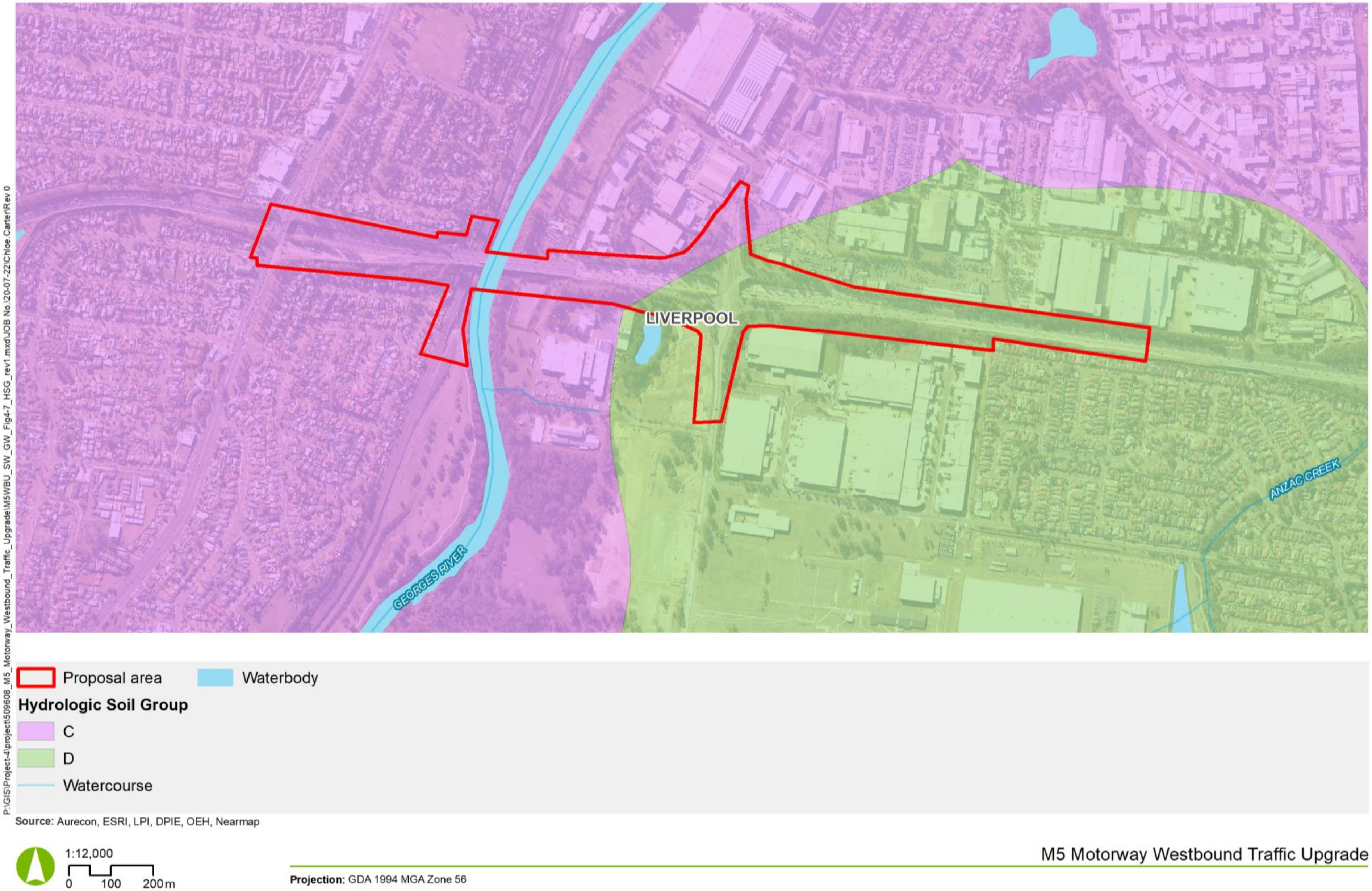


Figure 6-14 Hydrogeological landscapes

Catchment and surface water

The proposal is located within the Georges River catchment which drains 930 square kilometres of land. The Georges River extends about 60 kilometre south west of Sydney flowing northward for about half its length and then in an easterly direction from Liverpool to Botany Bay. The Georges River flows through urbanised and developed areas, and, therefore, has poor water quality conditions throughout the lower portion of the catchment. Surrounding land uses includes residential, industrial, agricultural, mining and Defence activities.

Waterways located near the proposal area include the Anzac Creek (640 metres east of the proposal), Georges River and an unnamed tributary (referred to as Titalka Park Drainage Channel for this assessment). At the proposal's crossing of the Georges River the river is about 45 metres wide and there are freshwater flows towards Liverpool Weir. Due to the location of the weir the river height is controlled in the proposal area.

Stormwater drainage

The Georges River flows in a northerly direction through the proposal area and is the main receiving waterway for discharge. There are a number of surrounding land uses that partially drain into the Georges River including:

- ABB Ltd site, about 50 metres south of the proposal (downstream)
- Industrial area in Moorebank 50 metres north of the proposal (upstream)
- Moorebank Business Park, 50 metres south of the proposal (upstream)
- Moorebank Logistics Park, 50 metres south of the proposal (upstream)
- Stormwater drainage direction is generally to the west.

There are two existing stormwater retention basins on the eastern side of the Georges River (shown in Figure **6-15**), comprising:

- M5 Motorway eastbound basin – located on the northern side of the motorway near Greenhills Avenue, Moorebank. This basin captures road runoff from the eastbound traffic lanes of the motorway, before discharging into the Georges River
- M5 Motorway westbound basin – located on the southern side of the motorway near Yulong Close, Moorebank. This basin captures road runoff from the westbound traffic lanes of the motorway. This basin is proposed to be relocated as part of the proposal (to beneath the new Georges River bridge, as shown in Figure 3-1). The flows previously received by the existing spill basin would be directed to the existing spill basin near Greenhills Avenue, Moorebank.

There is one retention basin located on the western side of the Georges River adjacent to Lakewood Crescent, which collects road runoff from the M5 Motorway draining towards the Georges River. The existing drainage points are illustrated in Figure **6-15**.

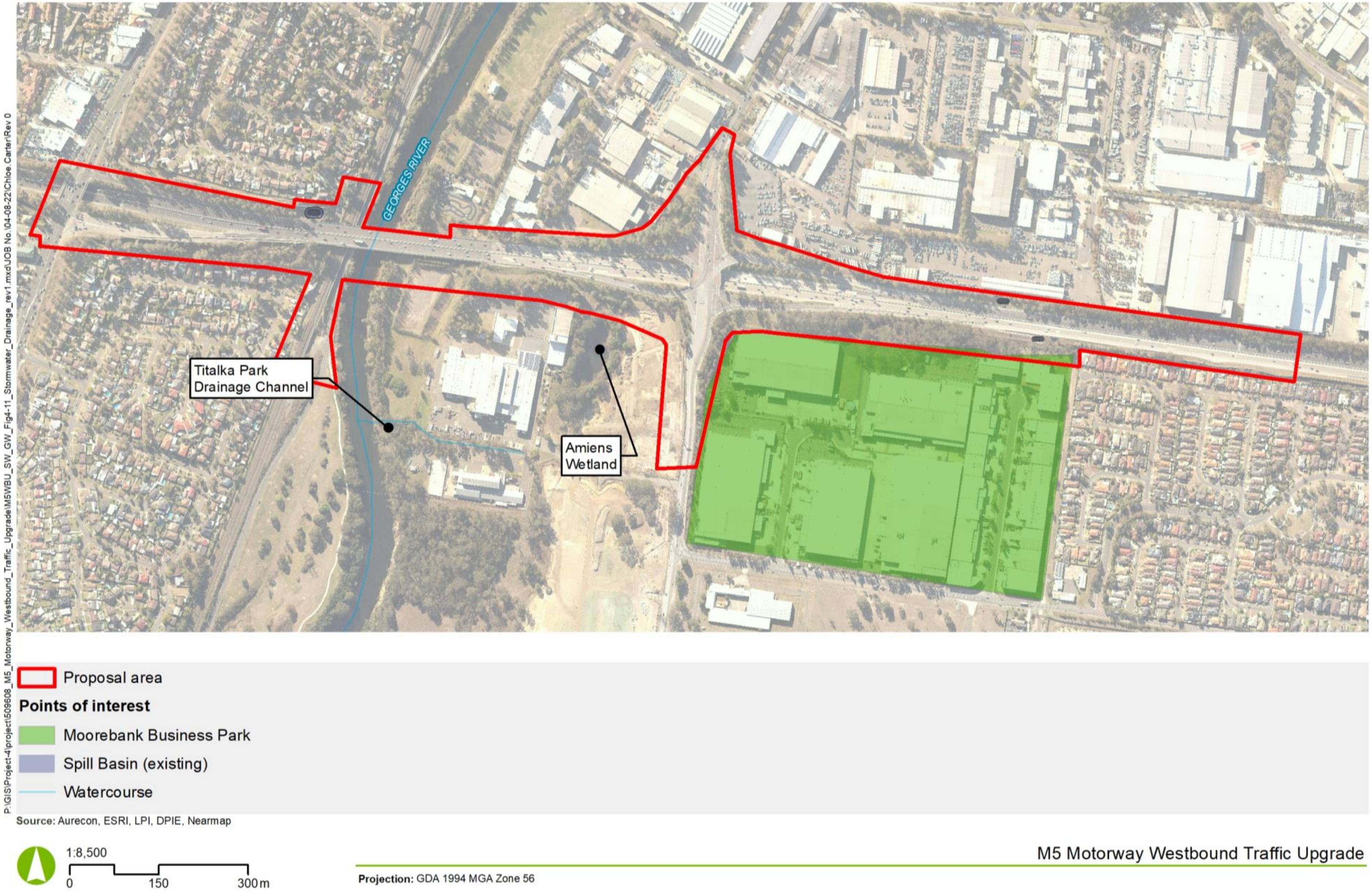


Figure 6-15 Existing stormwater drainage points

Wetlands

The Amiens wetland (Titalka Park Wetlands) is a small freshwater wetland on the Georges River floodplain located south west of the intersection of Moorebank Avenue and the M5 Motorway. There is an existing drainage line from the proposal area to the Amiens wetland, with stormwater drainage from south of the Moorebank Avenue intersection being detained by the wetland. Water is discharged from the Amiens wetland via a piped connection to the Georges River (Aurecon, 2022).

The wetland is fed by groundwater recharge, with overland flows received from the surrounding areas. The wetland provides a stormwater treatment function through the storage of stormwater and retention of nutrients, sediment and other pollutants.

Surface water quality

The Georges River is located within a sub-catchment classified as a ‘waterway affected by urban development’. Key environmental values relevant to the Georges River include:

- **Protection of Aquatic Ecosystems:** ecological condition of waterways and the riparian zone. Physical and chemical water quality stressors can cause degradation of aquatic ecosystems. For the purpose of this assessment, indicators include dissolved oxygen, metals, nutrients, pH, salinity and turbidity.
- **Protection of Visual Amenity:** aesthetic qualities of waters. For the purpose of this assessment, indicators include colour, odour and transparency.
- **Protection of primary and secondary contact recreation:** water quality for recreational activities, where primary contact recreation implies direct contact with the water via bodily immersion or submersion with a high potential for ingestion (eg swimming, diving and water skiing), and secondary contact recreation implies some direct contact with the water would be made but ingestion of water is unlikely (eg boating, fishing and wading).

Data from the surface water monitoring program for the Moorebank Logistics Park project, carried out between 2013 to 2016, shows that no major exceedances for metals were recorded. Other discrete exceedances have been recorded but none indicating unusual or long-term trends of concern (Parsons Brinkerhoff, 2016).

The Georges River Keeper monitoring data identified the Georges River as an overall B+ (or ‘Good’) grade; however, the water quality closest to the proposal area was lower with a C+ (or ‘Fair’) grade.

Groundwater

Based on previous investigations in the area, the local groundwater flow direction is considered to trend to the northwest towards the Georges River (Parsons Brinkerhoff, 2014). On a regional scale, groundwater flow is likely to be generally north-east following the flow direction of the Georges River.

Salinity in the alluvium is generally low but is typically higher in the Ashfield Shale (brackish) than the quaternary alluvium. Total dissolved solids (TDS) within the shales typically exceeds 3,000 milligrams per litre (mg/L), while in the Hawkesbury Sandstone, TDS is typically below 500 mg/L (Sydney Catchment Authority, 2007). The measured salinities for the Hawkesbury Sandstone are also high and are likely to be influenced by the overlying Ashfield Shale.

Previous groundwater investigations for the study area indicate that pH in the alluvial deposits ranges between 4.3 and 8.0 (HLA Envirosciences, 2003), while electrical conductivity (EC) ranges between 31 and 24,500 μS/cm. Groundwater investigations conducted by GHD in 2004 indicate that pH within a range of aquifers to the south of the proposal area is acidic, ranging between 4.76 and 5.83 (GHD, 2004).

Water quality measurements from monitoring wells installed in the Ashfield Shale and the Hawkesbury Sandstone indicated both fresh and salty water quality. The higher salinity in the sandstone is probably due to leakage of saline groundwater from the overlying shales (HLA Envirosciences, 2003).

A previous groundwater investigation carried out by Transport for NSW in September 2019 (JBS&G, 2019) identified that all Contaminants of Potential Concern (CoPC) were below applicable Limits of Reporting for human health criteria, except for some metals, BTEX, PAHs and per- and polyfluoroakly substances (PFAS) compounds. The investigation results are summarised below:

- All CoPC concentrations in groundwater were reported below the adopted freshwater ecosystem criteria, except for the following metals:
    - Copper with a concentration of 0.002 µg/L (criterion of 0.0014 µg)
    - Zinc with a concentration of 0.1 µg/L (criterion of 0.008 µg/L)
- Low concentrations of toluene, xylenes and the PAHs naphthalene and phenanthrene were reported above limits of reporting but below health and ecological criteria.
- Eight PFAS compounds were reported above the limit of reporting; however, all results were below adopted assessment criteria where available.

A search of Realtime Water NSW on the 18 November 2020 indicated there were 35 registered boreholes within one kilometre of the proposal, five of which are for water supply uses (four are specified for industrial purposes), four bores for irrigation (three currently in use) and one for recreational use.

Groundwater dependent ecosystems

A search of the Australian Government's Atlas of Groundwater Dependent Ecosystems was carried out on 16 November 2020. Several aquatic and terrestrial GDEs with potential reliance on subsurface groundwater were identified in the locality (refer to Figure **6-16**). No terrestrial GDEs were present within 500 metres (up-gradient) and 1,300 metres of the proposal area.

The Cumberland Riverflat Forest adjoining the Georges River was identified as having a high potential for groundwater interaction. This terrestrial GDE is located approximately 500 metres south of the proposal (upstream). The Georges River is also identified as having a high potential for groundwater interaction and this aquatic GDE passes through the proposal. No data on subterranean GDEs was available for the locality. Amiens Wetland is not identified as a GDE in the Atlas of Groundwater Dependant Ecosystems.

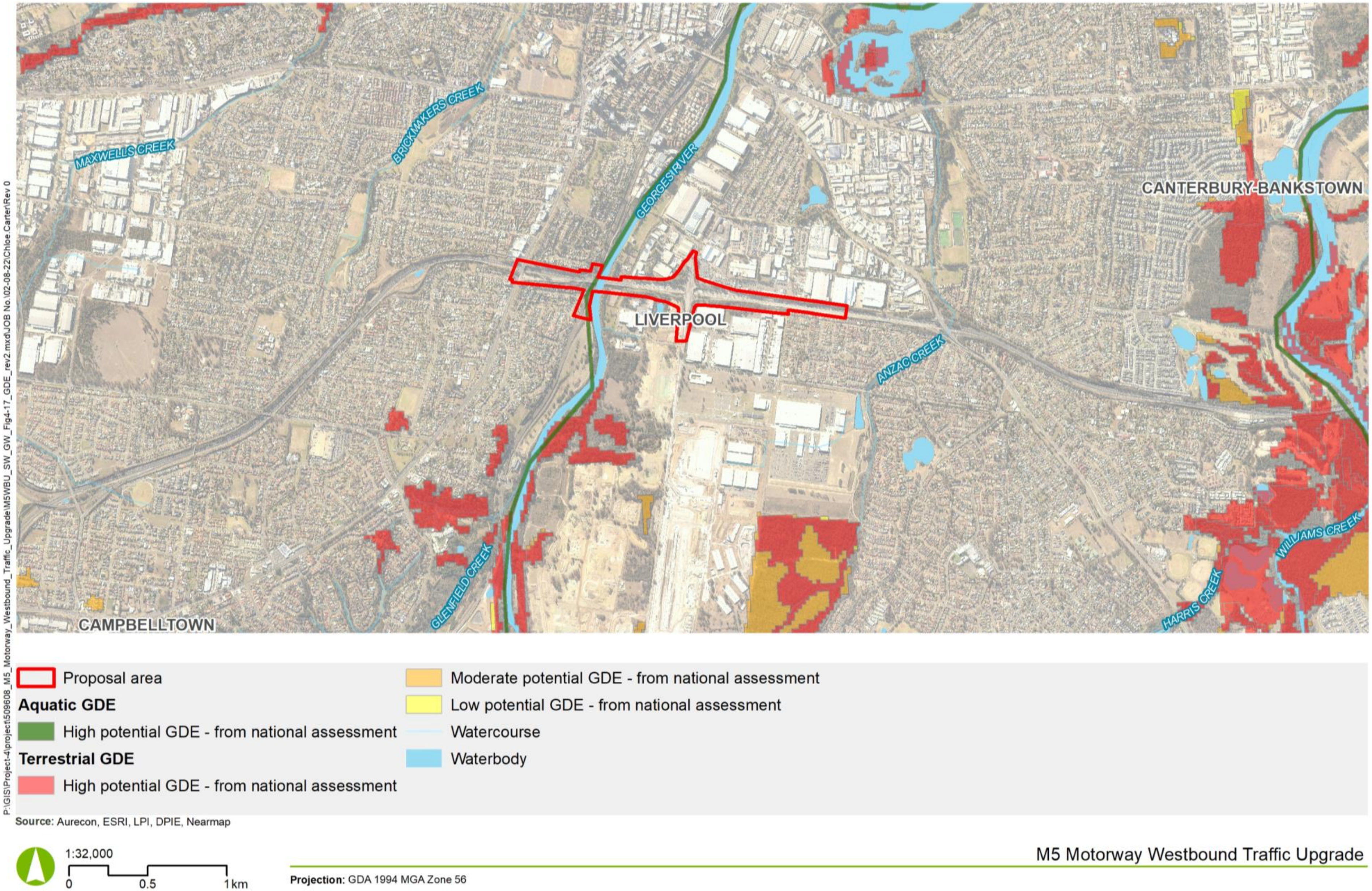


Figure 6-16 Groundwater dependant ecosystems (Bureau of Meteorology, n.d.)

6.4.3 Potential impacts

Construction

Erosion and sedimentation

The Preliminary Erosion and Sedimentation Assessment (PESA) considered the proposal to have a low erosion risk. The PESA was used to estimate the soil loss from the proposal area. The assessment estimated a soil loss of 69.1 tonnes/hectare/year and 100.2 tonnes/hectare/year for the east and west side of the proposal area respectively. Under the guidelines this would be considered a ‘low erosion risk’.

During construction, if the catchment areas of disturbed land are greater than 1.95 hectares on the western side and 2.82 hectares on the eastern side of the Georges River respectively, consideration for sedimentation basins or alternative control measures would be investigated. This analysis would be conducted in the detailed design stage of the proposal.

Surface water

Impacts to surface water would include erosion, scouring of natural waterways and sedimentation and contamination. The most direct impact to surface water would be the construction of the bridge across the Georges River, which may result in disturbance of the bed and bank of the watercourses, aquatic ecosystems and a key fish habitat. This has a potentially high impact to surface water quality.

Earthworks and vegetation removal would result in scouring and erosion of waterways due to lack of vegetation protection and increased volume and rate of channelised discharges to the environment. Vegetation removal would increase surface run-off to surrounding waterways, with the greatest impacts expected for the Titalka Park Drainage Channel during storm conditions. There would also be an increase in sedimentation in surrounding waterways.

The use of a barge to construct the new bridge would result in impacts on bed and banks of the Georges River. For example, the anchors required to secure the barge may result in localised habitat modification in the Georges River channel bed and temporary water quality impacts downstream until the work area is stabilised. A temporary wharf would be installed and the movement of the barge to and from the wharf has the potential to destabilise the bank of the river.

Spills and leaks from construction equipment and materials on the wharf and on the barge may also impact water quality downstream of the proposal. Potentially harmful chemicals and substances used during construction could be accidentally released into waterways during construction stages. This could result from activities such as maintenance work, refuelling and inappropriate storage or handling. Examples of such substances include fuels for machinery, lubricants, and construction materials, including concrete/cement.

Construction within Areas 4 and 5 and the ancillary facility present the highest risk. This is due to their proximity to either the Georges River and/or Titalka Park Drainage Channel. Other areas of concern are Areas 2 and 3 due to their proximity to Amiens wetland. During construction, overland flows may transport material that has spilled or leaked to the Amiens Wetland during high rainfall events and cause poor water quality events or contamination.

Construction activities

During enabling work and earthworks for the ancillary facility in the Helles Park former landfill, there is the potential for elevated contaminant concentrations to be released into the surface water through contaminated soils and groundwater. Work completed around the ABB site may also have the potential of releasing Polychlorinated biphenyls (PCBs) into the surrounding waterways through impacted soils. There is potential for surface water quality impacts from the operation of the ancillary facility through sedimentation and discharge of sediment-laden stormwater.

There is the potential for release of alkaline concrete wash water stored on waterfront land during construction. This would reduce the surface water quality. Waste materials, such as concrete, plasterboard, timber and contaminated soils spreading via surface run-off to site drainage pathways would also reduce the water quality.

Other impacts may result from stormwater sources, with drainage lines potentially being interfered with through construction activities such as excavation and earthworks and leaks and spills from construction work which have a low-moderate impact.

Impacts of the construction work on flooding are discussed in Section 6.3.3.

Water Quality Objectives

There is the potential to impact the following NSW Water Quality Objectives (WQO):

- Protection of aquatic ecosystems
- Protection of visual amenity
- Protection of primary and secondary contact recreation.

Activities that would have the potential to cause these impacts include erosion of soil, scouring and changes to the landscape, sediment-laden stormwater discharge and release and spills or leaks of construction material such as alkaline concrete wash water.

Groundwater

Potential groundwater impacts that are relevant to the construction phase of this proposal can be summarised as aquifer interference and groundwater contamination. There is the potential for interference with groundwater during construction activities such as piling and boring. This may result in dewatering/localised aquifer drawdown and flow disturbance. However, the impacts are considered low.

Potential groundwater contamination may result when construction activities intercept with the water table, including the piling activities for the construction of the bridge footings. Potentially harmful chemicals and substances could accidentally be released during construction and leach contaminants to groundwater through surface water transport. The interception of contaminants from the historical contaminated sites, such as the ABB site and the historical landfill, may occur and result in the leaching of contaminants into the groundwater from within the soils. The potential impacts of groundwater contamination are considered moderate.

Groundwater dependent ecosystems

Potential impacts on GDEs are linked to groundwater impacts of a proposal. Any aquifer interference and groundwater contamination impacts also have a potential to impact GDEs. However, due to the location of known GDEs the potential impacts are considered low as there are no other GDEs within the proposal area, other than Georges River itself.

Operation

The proposal would result in a larger area of hard stand area due to several design elements, including but not limited to:

- A new two-lane carriageway
- A new bridge structure
- Pedestrian and cycling paths
- Retaining wall and noise wall structures.

Surface water

Surface water impacts due to operation of the proposal include impacts to surface water quality and physical characteristics such as erosion and scouring. These impacts are considered to be low and should be managed satisfactorily by the proposed drainage and stormwater management for the proposal including upgrade of existing culverts and a stormwater retention basin. The new spill basin designs would be further investigated during detailed design.

The proposal is expected to result in a 29 per cent increase in impervious surfaces in the proposal area, which would result in an increase of stormwater runoff ultimately increasing the pollutant load of stormwater runoff into the drainage system. The key pollutants contained in road runoff include:

- Suspended solids as a result of pavement wear, atmospheric deposition and deposition from vehicles
- Microplastics from tyre wear
- Heavy metals bound to dust particles washed off pavement surface
- Oil and grease and other hydrocarbons deposited by vehicles (from everyday use as well as spills)
- Nutrients as a result of atmospheric deposition.

Stormwater from about 90 per cent of the increased impervious surfaces would be directed to one of the following spill basins (refer to Figure 3-1):

- Existing spill basin on the eastbound side of the M5 Motorway in Liverpool near Lakewood Crescent
- Existing spill basin near the Hume Highway intersection on the eastbound side of the M5 Motorway, on the western side of Georges River
- New spill basin would be installed under the new bridge over the eastern side of Georges River.

There would be a marginal increase in the pollutant load being released from the proposal area due to the increased pavement footprint. While this increased load would be managed through basins, during low frequency high magnitude storm events, the excess water would be discharged through the stormwater network to Georges River. However, due to the size of the catchment the impacts to the ecological condition of the wider Georges River catchment are low. Water quality treatment may be investigated further during detailed design.

Scouring and erosion of Titalka Park Drainage Channel and Georges River at the entry of stormwater discharges is a potential impact, due to higher rates of water flow because of the increased surface area of impervious surfaces.

New structures, including outlets, are subject to souring and erosion if not designed accordingly. Scour and erosion for outflow points as part of the drainage design would be mitigated through the design. Scour and erosion protection is incorporated to reduce any localised impacts.

Accidental spills of oils or other chemicals being transported could potentially lead to contaminants being released into either the spills basins described in the section above (which would not provide effective hydrocarbon contamination treatment, only onsite retention), Amiens Wetland, Titalka Park Drainage Channel, the Georges River or drainage lines, which could lead to poor water quality events within Georges River. It is not expected that this extent or magnitude of a spill would be significantly worse than on the existing carriageway, however it is acknowledged that an increase in traffic volume results in a proportionally greater risk of spills. Conversely, the upgrade would aim to ease congestion and improve safety for motorists travelling westbound on the M5 Motorway between Moorebank Avenue and the Hume Highway and the risk of spills as a result of incidents may become lower.

The risk of accidental spills, which would impact water quality and contamination of the spill basins and other watercourses, would be expected to remain the same or decrease compared to without the proposal.

Groundwater

Overall impacts to groundwater from the operation of the proposal are low and localised. The potential impacts may include aquifer interference in respect to flow due to the existence of the bridge footings. There is potential for continued leaking of landfill contaminated groundwater, however this would be further investigated during detailed design.

The local flow directions may be impacted by the existence of the bridge footings in Area 4 which would likely be interacting with the water table. Given the depth of the groundwater, it is expected that groundwater would interact with the proposed new piers. The installation depth of the new bridge piers has not been finalised as of the date of this report.

Potentially harmful chemicals and substances could accidentally be released as result of maintenance work, refuelling and inappropriate storage or handling. This could potentially lead to contamination of exposed soils and therefore leaching of contaminants to groundwater.

Groundwater dependent ecosystems

Impacts to GDEs due to operation of the proposal are low due to the location of known GDEs, as there are no other GDEs within the proposal area, other than Georges River itself. There are no anticipated impacts of the operation of the proposed upgrade of the road and bridge to GDEs in the area.

6.4.4 Safeguards and management measures

Table 6-31 describes the proposed safeguards and management measures that would be implemented to manage the potential surface water and groundwater impacts from the proposal. Other safeguards and management measures that would address surface water impacts are identified in sections 6.3 and 6.5.

Table 6-31 Surface water and groundwater safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil erosion and water pollution	A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction.	Construction Contractor	Detailed design / pre-construction	Section 2.1 of QA G38 Soil and Water Management
Soil erosion and water pollution	A site-specific Erosion and Sediment Control Plan/s would be prepared and implemented as part of the Soil and Water Management Plan. The Plan would 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.	Construction Contractor	Detailed design / Pre-construction	Section 2.1 of QA G38 Soil and Water Management
Accidental spill	A site-specific emergency spill plan would be developed and include spill management measures in accordance with the Transport for NSW *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan would address	Construction Contractor	Detailed design / Pre-construction	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).			
Soil erosion and water pollution	An assessment of the requirement for a temporary construction sediment basin would be conducted to inform the ESCP as part of the SWMP and CEMP. Investigation of alternative erosion and sedimentation control measures would be carried out in the event that spatial constraints restrict the implementation of basins.	Construction Contractor	Detailed design	Additional safeguard
Construction water quality assessment	A construction water quality monitoring plan would be prepared and implemented as part of the SWMP. The plan would be prepared in accordance with the Transport for NSW *Guideline for Construction Water Quality* and EPA publication *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW.*	Construction Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction within the waterway	Control measures and mitigation measures that relate to working within the waterways would be outlined in the SWMP and in particular an Environmental Work Method Statement (EWMS) would be completed. This includes measures to reduce potential for spills into the river. Construction work should take into consideration the *Guidelines for instream works on waterfront land* (DPI, 2012). Instream erosion and sedimentation controls would be considered in line with *Code of Practice – Minor work in NSW waterways* (RMS, 2014) to keep sedimentation within the work area. Water quality monitoring to be conducted during construction would include visual monitoring and monitoring of turbidity.	Construction Contractor	Detailed design / pre-construction / construction	Additional safeguard
Piling work of the bridge footings and excavation work to impact groundwater flow patterns	A Groundwater Management Plan (GMP) would be prepared to outline measures for interaction, dewatering and treatment of groundwater. The piling methodology should	Construction Contractor	Detailed design / pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	be chosen to reduce groundwater interface with groundwater flow. Piling activities should be closely monitored to ensure that contamination through leaks, spills or ambient groundwater does not accumulate within pile borings resulting in point source pollution with the potential to impact Groundwater Dependent Ecosystems (GDEs). Monitoring may include regular inspections of pile borings to monitor for any light non-aqueous phase liquids (LNAPL), oils, staining, or odours. Groundwater monitoring would be carried out. Groundwater impacts as a result of piling would be included in the GMP.			
Discharges	The discharges from any sediment basins would be assessed in line with the Guideline for Assessing the Impacts of Treated Water Discharge from Water Quality Treatment Controls (Transport for NSW, 2020). The results of such assessment would inform design of sediment basins to adhere to EPL	Construction Contractor	Detailed design / pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	discharge requirements.			
Construction across waterways leading to erosion or disturbance of the bed and banks	NSW DPE-Water Guidelines for watercourse crossings on waterfront land and NSW DPE-Water Guidelines for instream works on waterfront land guidelines would be adhered to for constructions across the Georges River.	Construction Contractor	Enabling work – Earthworks – Construction	Additional safeguard
Flooding of ancillary facilities	Ancillary facilities would be designed to accommodate local flood risk.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard
Disturbance of historical legacy contamination leading to water pollution	A contamination management plan would be prepared prior to the commencement of construction and implemented during construction by the Construction Contractor. Measures would be put in place to monitor the risk of contaminated water within the landfill site escaping into the underlying aquifer.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard
Aquifer interference from bridge footings	Design should consider impacts to groundwater during operation and piles be chosen to have the least amount of impact as possible on the aquifer.	Transport for NSW	Detailed design / Pre-construction	Additional safeguard
Discharge associated with wet weather stormflows	Design suitable stormwater infrastructure including pipes, culverts, pits, grass	Transport for NSW	Detailed design / Pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
leading to water pollution	swales and appropriately sized water quality basin (sediment basin) to manage stormwater runoff from the site during operation and reduce loads of suspended solids entering waterways.			

6.5 Soils and contamination

The potential impacts of the proposal on contamination are assessed in the *Preliminary Site Investigation and Landfill Gas Assessment* (Aurecon, 2022). A summary of this assessment is presented in this section, with the full report provided in Appendix G.

6.5.1 Methodology

A Preliminary Site Investigation (PSI) and Landfill Gas Assessment (LFG) was carried out for the proposal. To inform this report a desktop review of the following was completed:

- Past and current activities in the proposal area and other potential on-site/offsite sources of contamination
- Lot and deposited plans (DP) and land use zoning information
- Historical aerial photographs (about 10-year intervals from 1930s to 2010s)
- NSW EPA databases on the contaminated land record and NSW EPA's *Protection of the Environment Operations Act 1997* (POEO Act) licences for the site and Liverpool City Council LGA
- Geology, soil, topography and registered groundwater bore maps
- Acid sulfate soil (ASS) and salinity risk maps
- Department of Defence unexploded ordnance (UXO) risk mapping
- The NSW EPA priority per- and polyfluoroalkyl substances (PFAS) investigation risk sites within 10 kilometres of the proposal
- Results of the assessment activities carried out by LCC at the former Helles Park landfill and others in the proposal area
- The results of the Transport for NSW GI and the soil analytical results completed by Transport for NSW.

The following investigations were also completed:

- Installation of five groundwater monitoring wells (GMWs) in the Transport for NSW owned property below the current M5 Motorway bridges
- Measurement of LFG concentrations in the installed GMWs during two events with a pre-calibrated LFG gas meter

- A ground gas survey in the vicinity of the GMWs and on the adjacent Council owned landfill.

6.5.2 Existing environment

Topography

The elevation on the western side of Georges River ranges from 22 metres Australian Height Datum (m AHD) in the west to eight metres in the east, with a sharp drop towards the river. On the eastern side of Georges River, where the proposal is located, there is a small steep bank before elevation flattens out at about eight to 12 metres AHD, rising sharply to 18 metres AHD, before dropping to 15 metres AHD as it continues east.

Geology and soils

The geology of the area includes Alluvial floodplain deposits, Bringelly Shale, Minchinbury Sandstone, Ashfield Shale, and Alluvium.

Soil landscape of the area includes Berkshire Park to the east, Blacktown to the north, Luddenham to the west and Richmond to the south. The key characteristics of the landscapes are described in Table 6-32.

Table 6-32 Key characteristics of soil landscapes within the proposal (Chapman and Murphy 1989)

Soil landscape	Key characteristics
Berkshire Park	Undulating low rises. Limitations include high erodibility in very high winds, and is prone to localised seasonal waterlogging, localised floods, impermeable and low fertility.
Blacktown	Gently undulating rises with broad (rounded ridges and crests). Limitations include localised seasonal waterlogging, localised water erosion hazard, moderately reactive highly plastic subsoil with localised surface movement.
Richmond	Mainly flat alluvial plains. Limitations include localised flood hazards, localised water logging as well as localised water erosion hazard on terrace edges.

Acid sulfate soils

Acid sulfate soils (ASS) are soils and sediments containing iron sulfides (commonly pyrite) that, when disturbed and exposed to oxygen, generate sulfuric acid and toxic quantities of aluminium and other heavy metals. The sulfuric acid and heavy metals are produced in forms that can be readily released into the environment, with potential adverse effects on the natural and built environment and human health. The majority of ASS are formed by natural processes under specific environmental conditions. This generally limits their occurrence to low lying sections of coastal floodplains, rivers and creeks where surface elevations are less than about five metres AHD.

A review of the acid sulfate soils (ASS) information from the NSW OEH (eSPADE 2.0) and the Australian Resource Information System (ASRIS) indicated there is a low risk of ASS occurring within the proposal area. Within the Georges River there is a high probability of encountering ASS.

Salinity

A review of the Western Sydney Hydrogeological Landscapes Land Salinity Map available through the OEH, Department of Primary Industries and the Geological Survey of New South Wales indicates the proposal area is located within an area of moderate risk of saline soils.

Hydrology and drainage

The study area is highly urbanised and developed, having multiple artificial drainage and outlet sources. The Georges River runs through the centre of the proposal. Water discharge would drain into Georges River on the eastern bank due to the topography of the land, eventually releasing into Botany Bay.

Site history

Aerial imagery dated between 1930 and 2004 was reviewed to assess major changes to land use in the proposal area over time. Table 6-33 summarises the historical aerial photographs reviewed.

Table 6-33 Summary of historical aerial imagery for the M5 Motorway at Moorebank Georges River crossing

Year of image	Proposal land use	Surrounding land use
1930	West of Georges River is vacant land with a road and railway running north to south through the site. Small pocket of light vegetation east of Georges River. Central site appears to have some construction/infrastructure. East site is vacant lots with track/road access.	North – Eastern bank of Georges River is lightly vegetated. Vacant lots and roads with sparse residential buildings. East – Vacant lots with sparse vegetation and access tracks. South – image not available. West – the industrial train line is already established. Further west is cleared land with residential and agricultural land use noted.
1955	Increase of vegetation to the rest of the proposal. Small increase in residential buildings to the centre of the site.	North – slight increase in residential buildings. East – agricultural and residential land use. South – residential buildings and large industrial buildings. West – increase in residential buildings west of road.
1961	Increase in industrial activity north of the centre of the site.	North – significant increase in residential properties. Some industrial complexes established.

Year of image	Proposal land use	Surrounding land use
		East – no significant changes. South – increased number of industrial complexes. West – no significant changes.
1965	No significant changes are noted.	North – no significant changes. East – no significant changes. South – slight increased number of industrial complexes. Further south, image not available. West – no significant changes. Image further west not available.
1970	No significant changes are noted.	North – increase in industrial complexes. East – slight increase in industrial activity. South – directly south of central site, ABB Australia building established. West – further increase in residential properties.
1975	Clearing of vegetation east of the Georges River. Increase in industrial activity from ABB building.	North – increase in industrial complexes and residential buildings. East – further industrial lots established. South – slight increase in residential and industrial activity. West – large increase in residential properties along the western bank of Georges River.
1978	Residential buildings encroached onto the site west of the Georges River.	North – increase in industrial complexes and residential buildings. East – no significant changes. South – slight increase in residential and industrial activity. West – increase in residential properties along the western back of Georges River.
1984	M5 Motorway (bridge) construction commenced.	North – no significant changes. East – no significant changes. South – no significant changes.

Year of image	Proposal land use	Surrounding land use
		West – further development of residential properties.
1986	M5 Motorway (bridge) construction completed.	North – no significant changes. East – large car lot established north of M5 Motorway. South – no significant changes. West – no significant changes.
1991	No significant changes.	North – increase in industrial structures north of central site. East – further development of industrial complexes. South – No significant changes. West – No significant changes.
1994	Increase in road corridors to the west.	North – no significant changes. East – further residential buildings. South – increase in industrial complexes. West – no significant changes.
1998	Bridge intersection added to the west of the site. Clearing and activity east of the Georges River. Large car lot to the north-east of the site.	North – increase in residential and industrial buildings. East – significant increase in residential properties. South – no significant changes. West – no significant changes.
2004	Increase in road infrastructure.	North – further development of industrial complexes. East – no significant changes. South – no significant changes. West – no significant changes.

Contamination

A search of the NSW EPA Contaminated Sites Register and Record of Notices (under Sections 58 of the *Contaminated Land Management Act 1997*) was carried out to determine the presence of registered sites in the proposal area. One site was found at ABB Australia Pty Ltd about 250 metres east of the proposal area. The site was issued an Ongoing Maintenance Order notice, with PCB having been found in the soil on site.

A search of NSW EPA's public register under the POEO Act identified 31 sites within the vicinity of the proposal. The sites with licenses near the proposal are located immediately south of the M5 Motorway. Liverpool City Council are expected to list

Helles Park former landfill. Transport for NSW would follow any management plans as required by the listing.

Areas of potential environmental concern

A review of site history data and a site inspection determined that Helles Park former landfill and ABB Australia Pty Ltd have been identified as areas of potential environmental concern (APECs). These sites are summarised in Table 6-34.

Table 6-34 Areas of potential environmental concern

Area of Potential Environmental Concern	Associated COPCs	Area Description
Helles Park former landfill	ACM, TRH, BTEXN, PAH, heavy metals, PCBs, landfill gas (methane, carbon dioxide), PFAS, VHCs	Area directly north and south of the M5 Motorway Georges River bridge. The landfill footprint extends below the M5 motorway overpass.
ABB Australia Pty Ltd	PCBs	Site immediately adjacent to southern section of proposal area, upgradient of site.

There is also the potential for contaminated material to be encountered within the proposal area during construction of the road embankments and motorway ramps.

Landfill gas

Five gas monitoring wells (GMWs) were installed within the proposal area in December 2020. No methane was detected above the ground surface. The results of the LFG monitoring indicated methane concentrations over 70 per cent, $C0_2$ concentrations about 29 per cent and oxygen at 0 per cent. The measurements indicated the gas concentrations were in excess of 100 per cent of the lower explosive limit. This indicates there is the potential for an explosion at the site if the gas were to be released into the air.

6.5.3 Potential impacts

Construction

Construction activities would have the following potential impacts on soils and contamination:

- Soil erosion and loss of topsoil: This could result from removal of vegetation (clearing and grubbing) and disturbance of the ground surface during site preparation, earthwork, excavation and other construction activities. Earthmoving activities have the potential to expose loose soils and mobilise these materials
- Spills of contaminating materials: There would be potential for construction activities to result in contamination of soil and/or water due to leaks and spills of potentially contaminating materials. Spill containment would be used at ancillary sites to contain spills and spill response procedures would be followed. These impacts would generally be temporary. Safeguards and management measures which would be implemented to reduce these impacts are provided in Section 6.6.4.

- Encountering ASS through installation of the bridge piers on the riverbank, sheet piling along Powerhouse Road and for the wharf of the temporary barge.

The results of the LFG monitoring indicated methane concentrations over 70 per cent, $C0_2$ concentrations about 29 per cent and oxygen at 0 per cent. The measurements indicated the gas concentrations were in excess of 100 per cent of the lower explosive limit. This indicates there is the potential for an explosion at the site if the gas were to be released into the air.

The Helles Park former landfill and ABB Australia Pty Ltd were identified as areas of potential environmental concern. The overall risk of these sites in regard to human health and the environment has been modelled. This considers the pathways of contamination including direct contact, incidental ingestion, inhalation, stormwater/wastewater inflows to excavations, release of LFG or direct interaction with infrastructure. The use of the proposed ancillary facility at the Helles Park (former landfill) would be conditional on implementation of a remedial strategy that mitigates the potential risks to human health and the environment to make the site suitable as a construction compound and the proposed construction activities. This work should be conducted in advance to construction work commencing and site suitability should be confirmed through the appropriate regulatory process. The risks and the potential receptors are summarised in Table 6-35.

Table 6-35 Contamination construction impacts

Potential source	COPCs	Pathways	Receptor	Summary
Helles Park former landfill	**Soil:** ACM, TRH, PAHs, heavy metals, PCBs, VOCs, waste materials **Groundwater:** TRH, PAHs, heavy metals, PCBs, VHCs, PFAS, acetone, carbon disulfide, ammonia **LFG:** methane, carbon dioxide	• Direct contact with contaminated soils • Incidental ingestion of soils or groundwater • Inhalation of contaminated dusts, vapours or LFG • Stormwater/wastewater inflows to excavations • Release of LFG • Direct interaction with infrastructure	• Construction workers • Incidental users of the site • New infrastructure • Georges River (during construction)	• The potential human receptors include only incidental users of the site. The site is not expected to have incidental recreational users • Groundwater is impacted with elevated concentrations of ammonia in some locations. Ammonia impacted groundwater may interact with the existing bridge piers as well as the proposed new piers • Establishment of ancillary facilities in the area of the former Helles Park landfill may result in gasses accumulating in enclosed spaces. This could lead to explosion or asphyxiation risks • Asbestos Containing Material has been detected in the area of the proposed ancillary facility and could pose the potential risks to workers accessing this site if not managed appropriately • During construction, mitigation measures would be required to

Potential source	COPCs	Pathways	Receptor	Summary
				minimise the potential for uncontrolled release of impacted environmental media to the Georges River.
ABB Australia Pty Ltd	PCBs	• Direct contact with contaminated soils • Incidental ingestion of soils	• Construction workers • Public during construction • Georges River (during construction)	The ABB site is a site regulated under the CLM Act with identified PCB impacts in soil. PCBs have been detected in soil samples collected along the proposal alignment. During construction, mitigation measures would be required to minimise the potential for uncontrolled release of PCB impacted soil to the Georges River

Operation

There would be potential for indirect impacts on soils as a result of run-off and drainage. These potential impacts would be managed by revegetating exposed soils and operational water quality measures.

There is potential for disturbed or dewatered ASS to generate aggressive soil and groundwater conditions that may increase degradation of concrete and corrosion of steel for bridge piers located on the riverbank. Disturbance of ASS during construction may cause short term leaching of acidic waters and dissolved heavy metals during operation. This would reduce and dissipate as groundwater conditions equilibrate.

Existing groundwater is impacted with elevated concentrations of ammonia in some locations. Given the depth of the groundwater, it is expected that ammonia impacted groundwater is interacting with the existing bridge piers and is expected to also interact with the proposed new piers. This would be further investigated during detailed design.

6.5.4 Safeguards and management measures

Table 6-36 describes the proposed safeguards and management measures that would be implemented to manage the potential soils and contamination impacts from the proposal.

Table 6-36 Safeguards and management measures for soils and contamination

Impact	Environmental safeguards	Responsibility	Timing	Reference
Contaminated land	A Contaminated Land Management Plan would be prepared in accordance with the Guideline for the Management of Contamination (Transport for NSW, 2013) and implemented as part of the CEMP. The plan would include, but not be limited to: • 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.	Construction Contractor	Detailed design / Pre-construction	Section 4.2 of QA *G36 Environment Protection*
Contaminated land	If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. All other work that may impact on the contaminated area would cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or	Construction Contractor	Detailed design / Pre-construction	Section 4.2 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.			
Accidental spill	A site specific emergency spill plan would be developed, and include spill management measures in accordance with the Transport for NSW *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan would address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Construction Contractor	Detailed design / Pre-construction	Section 4.3 of QA *G36 Environment Protection*
Gas monitoring	An Environmental Management Plan (EMP) would be prepared to manage the risks from methane and CO_2 during construction. The EMP would form a part of the overall Construction and Environmental Management Plan and focus on potential risks from the identified methane and carbon dioxide. The EMP would be reviewed by Transport for NSW to ensure it is adequate to address the potential risks. Active removal of methane and carbon dioxide could be considered prior to commencing construction activities. Demountable designs would consider the presence of these gases.	Construction Contractor	Pre-construction / construction	Additional safeguard
Contaminated land	If not already remediated by Council, ACM identified in the southern portion of Helles Park would be remediated prior to establishing the ancillary facilities on this property.	Construction Contractor	Pre-construction	Additional safeguard
Ancillary facility	The design of temporary offices would consider the presence of LFG in the southern portion of Helles Park if it is not addressed prior to establishing the site offices. In accordance with Appendix 5 of the NSW EPA's Assessment and Management of Hazardous Ground Gases: Contaminated Land Guidelines 2020, (NSW EPA,	Construction Contractor	Pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	2020), these design measures may include an installation of a gas membrane, allowing passive ventilation below the temporary offices, installation of active ventilation below the buildings, application of a positive pressure in the structures and / or internal gas monitoring. The exact mitigation approaches would be further evaluated when the nature and design of the ancillary facilities is finalised.			
Contaminated land	The EPA would be notified in writing at least two days before work commences that would exhume waste from a landfill site or former landfill site (located on the eastern side of the Georges River), in accordance with the requirements of Clause 110A of the Protection of the Environment Operations (Waste) Regulation 2014.	Transport for NSW / Construction Contractor	Pre-construction / construction	Additional safeguard
Contaminated land	If the Helles Park former landfill site were to become an EPA regulated site, work at the site would need to adhere to the sites Voluntary Management Proposal (VMP) as developed by the responsible party.	Construction Contractor	Construction	Additional safeguard
Contaminated land	Additional sampling would be carried out in the proposal area prior to construction to further characterise wastes likely to be encountered on site and the potential hazards and risks associated with handling and disposing of these materials.	Construction Contractor	Pre-construction / construction	Additional safeguard
Acid Sulfate Soils	An Acid Sulfate Soils Management Plan (ASSMP) would be prepared with reference to "*Guidelines for the Management of Acid Sulphate Materials: Acid Sulphate Soils, Acid Sulphate Rock and Monosulphidic Black Ooze*" (RTA, 2005).	Construction Contractor	Pre-construction / construction	Additional safeguard

Other safeguards and management measures that would address soil and contamination impacts are identified in section 6.4.

6.6 Biodiversity

This section describes the potential biodiversity impacts associated with the proposal. This section is informed by the *Biodiversity Assessment Report* (Aurecon and Niche, 2022) and the *Aquatic Ecology Assessment – M5 Motorway Upgrade* (Niche, 2022) which are provided in Appendix H.

6.6.1 Methodology

Biodiversity Assessment Report

Study area

The study area used in the biodiversity investigation includes the proposal area (which includes the area of vegetation clearance) and an indirect impact area which is considered to be about a 100 metre buffer.

The BAR identified that the study area has been historically cleared prior to 1943, with progressive clearing continuing up until the early 1980s. Revegetation (such as planting of tubestock) and natural rehabilitation across portions of the study area has occurred since, but for the most part, the study area is dominated heavily by urban and industrial land on either side of the road. comprises of previously cleared or modified habitats typical of developed urban corridors, including planted and degraded remnant native vegetation.

The study area also contains a portion of land (about 0.23 hectares) that has a biobanking agreement on it.

Desktop assessment

A desktop assessment was carried out to identify threatened flora and fauna species, population and ecological communities, Commonwealth listed migratory species or areas of outstanding biodiversity value, that have been previously recorded or predicted to occur within a ten kilometre buffer around the study area.

The databases searches included:

- NSW OEH – BioNet species sightings search and vegetation classification (DPE, 2020)
- NSW OEH – State Vegetation Type Map (SVTM)
- NSW OEH – SEED dataset
- NSW Department of Primary Industries (DPI) and Fisheries – Fisheries Spatial Data Portal
- NSW Department of Primary Industries (DPI) and Fisheries – DPI's database for aquatic threatened ecological communities (TECs)
- Department of Agriculture, Water and Environment (DAWE) – Protected Matters Search Tool (PMST)
- BOM Atlas of GDEs.

Relevant biodiversity reports were also reviewed as part of the background research, along with historic aerial imagery from 1943, 1984, and 1986 which show that the study area has been historically cleared.

Field survey

A field survey was carried out by ecologists on the 28 to 29 October 2020, and on the 30 to 31 May 2022 to undertake the following within the proposal area:

- Validation of vegetation across the study area using a combination of BAM plots and rapid data points. The vegetation was assigned to a best fit Plant Community Type (PCT) and attributed a condition class.
- Threatened flora traverses across the proposal area.
- Transects and plots targeting all threatened flora and fauna with particular focus on
  - Active searches for Cumberland Plain Land Snails
  - SAT plots for Koala scats.
- General traverses across the proposal area to assist with a general threatened flora and fauna habitat assessment.
- Hollow-bearing tree survey
- Microbat habitat assessment, with a focus on the bridge and culverts within the proposal area.

The above surveys were completed in in consideration of the following relevant guidelines:

- Biodiversity Assessment Methodology (DPE 2020)
- Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011)
- Draft NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC, 2004).

The field survey combined with a habitat assessment (ie background research, presence of habitat, results of field surveys and professional experience) provided sufficient data to determine the likelihood of occurrence of each threatened species, population and community (threatened biodiversity) in the study area.

Aquatic Ecology Assessment

The aquatic ecology assessment assesses the potential impact of the proposal on aquatic biodiversity. Surface water impacts with ‘medium to high’ ratings in the Surface Water and Groundwater Technical Assessment Working Paper (Aurecon, 2022) were assessed for aquatic ecology impacts. The following low rated impact was assessed because it was directly related to a key threatening process listed under the FM Act: ‘*Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams.’*

Threatened species of moderate to high likelihood of occurring were assessed for impact under NSW *Fisheries Management Act 1991* (FM Act) and EPBC Act guidelines.

The assessment was based on desktop review and did not consist of field surveys.

The database searches carried out included:

- NSW Department of Primary Industries (DPI) and Fisheries – Fisheries Spatial Data Portal
- DAWE PMST (DAWE, 2021)
- NSW Department of Planning, Industry and Environment (DPE) BioNet, Atlas of NSW Wildlife (DPIE, 2021).

The literature reviewed included:

- Surface Water and Groundwater Technical Assessment Working Paper (Aurecon, 2022)
- Previous monitoring reports and/or studies in the Georges River
- Key Fish Habitat mapping
- Threatened species profiles.

6.6.2 Existing environment

Plant community types

The vegetation in the study area has been historically cleared prior to 1943, with progressive clearing continuing up until the early 1980s. Revegetation (such as planting of tubestock) and natural rehabilitation across portions of the study area has occurred since, but for the most part, the study area is dominated heavily by urban and industrial land on either side of the road.

Three PCTs were recorded within the proposal area which have been summarised in Table 6-37 and illustrated in Figure 6-17.

Table 6-37 Plant community types in the proposal area

Plant community type (PCT)	Vegetation zone	Area	Listed as a Threatened Ecological Community	
			BC Act	EPBC Act
PCT 835 – Cumberland riverflat forest	Low condition	0.35 ha	Yes - River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest
PCT 835 – Cumberland riverflat forest	High condition	0.61 ha	Yes – River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest
PCT 849 – Cumberland shale plains woodland	Low condition	1.28 ha	Yes - Cumberland Plain Woodland in the Sydney Basin Bioregion	Not listed – condition does not meet the minimum condition thresholds
PCT 941 – Hinterland riverflat eucalypt forest	Low condition	0.96 ha	Yes - River-Flat Eucalypt Forest	Not listed – condition does not meet the minimum condition thresholds
PCT 941 – Hinterland riverflat eucalypt forest	Moderate condition	0.96 ha	Yes - River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest

Plant community type (PCT)	Vegetation zone	Area	Listed as a Threatened Ecological Community	
			BC Act	EPBC Act
Planted vegetation – does not neatly fit to a PCT given highly cleared nature of zone	Low	4.66 ha	Not listed	Not listed

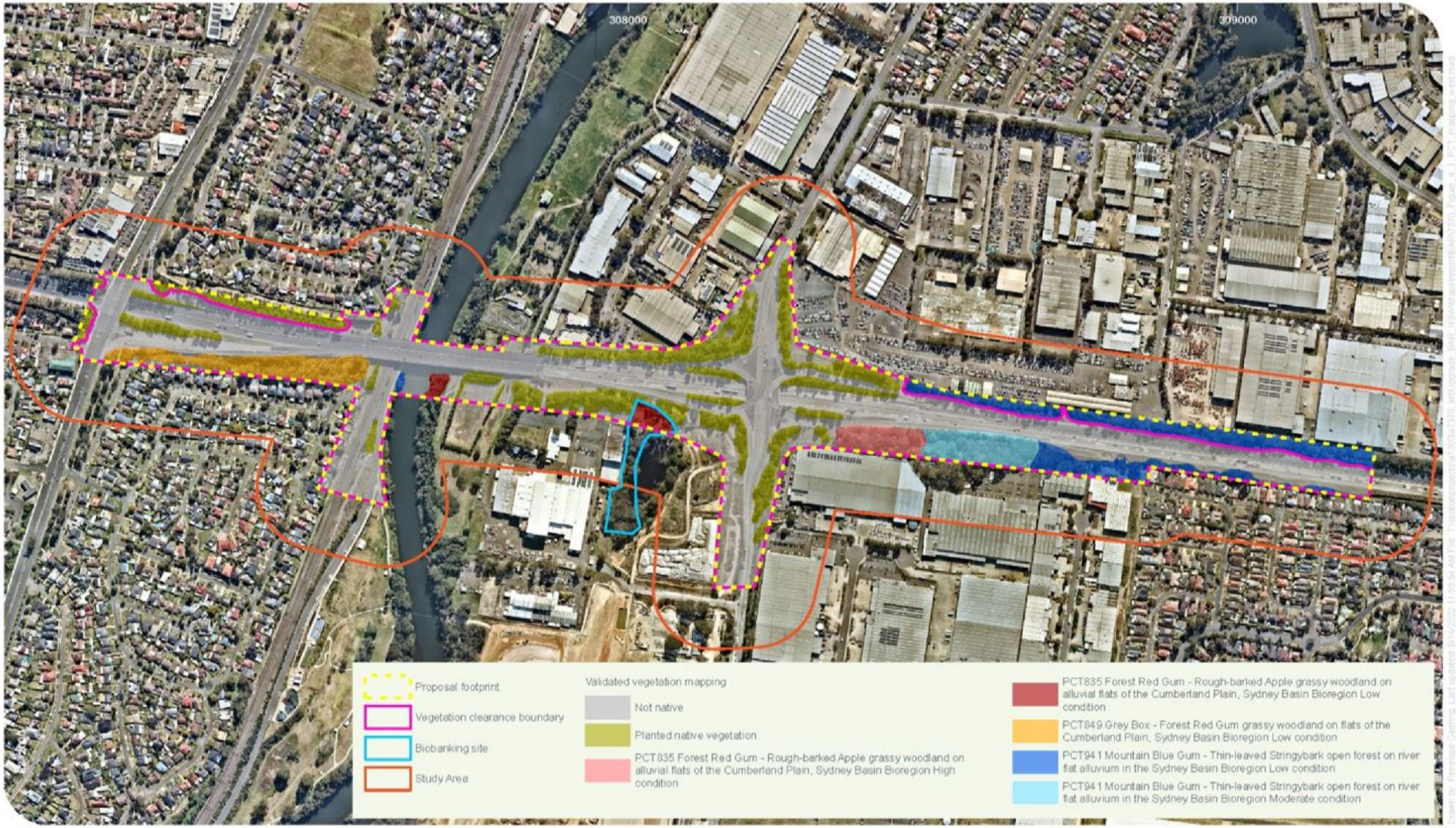
Threatened ecological communities

Two TECs are present in the proposal area associated with PCTs 835, 849 and 941 as indicated above in Table 6-38 and are illustrated in Figure 6-18

The two TECs identified are:

- Cumberland Plain Woodland in the Sydney Basin Bioregion listed as Critically Endangered under the BC Act and EPBC Act
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as Endangered under the BC Act and Critically Endangered under the EPBC Act.

For the most part, the TECs comprises of vegetation and structure that is a relatively lower condition state, due to the historic clearing that has taken place over the past 80 years.



Source: Aurecon, TfNSW

Subject to detailed design

M5 Motorway Westbound Traffic Upgrade **Review of Environmental Factors**

Figure 6-17 PCT mapping

Source: Aurecon, TfNSW

Subject to detailed design

M5 Motorway Westbound Traffic Upgrade **Review of Environmental Factors**

Figure 6-18 Threatened ecological communities

Threatened species

The desktop investigation identified 42 threatened species listed on the BC Act, and 60 threatened species listed on the EPBC Act that have habitat within ten kilometres of the proposal area.

Field surveys confirmed that many of the threatened flora and fauna were unlikely to be present due to the lack of the required habitat features and given the condition of the vegetation/habitat present.

Based on a likelihood of occurrence assessment, it was determined that there is a moderate or greater likelihood of 13 threatened fauna to occur within the proposal area (Table 6-38) however for the most part, these species may only forage in the proposal area.

Table 6-38 Threatened species likely to occur in the study area

Scientific name	Common name	BC Act status	EPBC Act status	Database	Potential occurrence
Artamus cyanopterus	Dusky Woodswallow	V	-	BioNet	Moderate
Daphoenositta chrysoptera	Varied Sittella	V	-	BioNet	Moderate
Glossopsitta pusilla	Little Lorikeet	V	-	BioNet	Moderate
Lathamus discolor	Swift Parrot	E1, 3	CE	BioNet, PMST	Moderate
Meridolum corneovirens	Cumberland Plain Land Snail	E1	-	BAM-C, BioNet	Moderate
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	BioNet	Moderate
Miniopterus australis	Little bent-winged bat	V	-	BioNet, PMST	Moderate
Miniopterus orianae oceanensis	Large bent-winged bat	V	-	BioNet	Moderate
Myotis macropus	Southern Myotis	V	-	BioNet	Moderate
Phascolarctos cinereus	Koala	V	V	BAM-C, BioNet, PMST	Moderate
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	BioNet, PMST	Moderate

Scientific name	Common name	BC Act status	EPBC Act status	Database	Potential occurrence
Saccolaiums flaviventris	Yellow-bellied sheathtail-bat	V	-	BioNet	Moderate
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	BioNet	Moderate
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	BioNet	Moderate

Note: CE – Critically Endangered, V – Vulnerable, E1 – endangered, 2 – Category 2 sensitive species, 3 – Category 3 sensitive species, M – Migratory

Aquatic habitats

The Georges River at the proposal is highly disturbed with increased nutrient loads and pollutants and introduced aquatic species. The catchment is one of Australia's most urbanised and developed catchments and this has led to poor water quality conditions throughout the lower portion of the catchment. Land use within the lower catchment varies, and includes residential, industrial, agricultural, mining and Defence activities.

The Georges River is mapped as 'Key Fish Habitat' and has a freshwater fish community listed as 'fair' (DPI 2021b). The waterway is categorised 'TYPE 1 – Highly sensitive key fish habitat' based on the presence of aquatic macrophytes and snags and 'CLASS 1 – Major key fish habitat' classification of waterways for fish passage.

The presence and abundance of fish species at the proposal area is impacted by the Liverpool weir 1.7 kilometres downstream and the urban catchment of the Georges River. As such, no key fish habitat estuarine vegetation (mangroves, saltmarsh, sea grasses) have been mapped in the area. The closest estuarine key fish habitat is 8.3 kilometres downstream and the Towra Point Nature Reserve Ramsar site in Botany Bay.

The Amiens wetland is a freshwater wetland on the Georges River which is near the proposal area, to the south-west of the M5 Motorway and Moorebank Avenue intersection. It is fed from groundwater recharge.

Five threatened aquatic species were identified with potential to occur in the Georges River catchment in the PMST search results. Three fish species were identified, including Black rock cod (*Epinephelus daemelii*), Macquarie perch (*Macquaria australasica)* and Australian Grayling (*Prototroctes maraena*). Two dragonfly species were identified, including Sydney Hawk dragonfly (*Austrocordulia leonardi*) and Adams emerald dragonfly (*Archaeophya adamsi*). The likelihood of all species occurring in the proposal area is unlikely, due to there either being no habitat, no previous records or no known or modelled distribution under DPIE mapping.

Common reed (*Phragmites australis*) and Cumbungi (*Typha sp.)* are common throughout the river system and are likely to occur in the proposal area.

The proposal area may also contain a small number of macroinvertebrates that are tolerant to pollution and prefer slow moving aquatic habitats. The stream health is expected to vary in the proposal area, impacting the stream condition.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater. There are mapped areas of high potential aquatic GDE in the Georges River within the proposal area, and high potential terrestrial GDE south of the proposal. Significant degradation to GDEs is not likely. Impacts related to GDEs would be managed during construction of the proposal.

Biodiversity and Conservation SEPP 2021

The proposal area is within the Central Coast Koala Management Area. There are 143 records of koalas within a ten kilometre radius of the proposal area with most of the Koala occurring towards the Campbelltown LGA and about 2 kilometres immediately to the south of the proposal area. The proposal area is relatively limited in terms of connectivity to the known population of Koalas within such areas given the surrounding urban, residential and industrial landscape.

6.6.3 Potential impacts

Construction

Removal of vegetation

The proposal would require clearing of up to 8.82 hectares of native vegetation. Most of the native vegetation (about 7.25 hectares) is of a relatively low condition state or consisted of planted native vegetation. This includes 4.66 hectares of planted native and exotic roadside vegetation. A summary of impacted native vegetation is provided in Table 6-39.

Table 6-39 Native vegetation requiring removal

Plant community type (PCT)	Vegetation zone	Threatened Ecological Community		Area to be directly impacted
		BC Act	EPBC Act	
PCT 835 – Cumberland riverflat forest	Low condition	Yes - River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest	0.35 ha
PCT 835 – Cumberland riverflat forest	High condition	Yes – River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest	0.61 ha
PCT 849 – Cumberland shale plains woodland	Low condition	Yes - Cumberland Plain Woodland in the Sydney Basin Bioregion	Not listed – condition does not meet the minimum condition thresholds	1.28 ha
PCT 941 – Hinterland riverflat eucalypt forest	Low condition	Yes - River-Flat Eucalypt Forest	Not listed – condition does not meet the minimum condition thresholds	0.96 ha

Plant community type (PCT)	Vegetation zone	Threatened Ecological Community		Area to be directly impacted
		BC Act	EPBC Act	
PCT 941 – Hinterland riverflat eucalypt forest	Moderate condition	Yes - River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest	0.96 ha
Planted vegetation - no best fit PCT	Low condition	Not listed	Not listed	4.66 ha

Removal of threatened flora

No threatened flora were identified within the proposal area at the time of field surveys or through the desktop assessment. Given that the majority of the study area was almost completely cleared of native vegetation for much of the 1900s and the extensive weed infestations and poor condition of remnant fringes along the Georges River, threatened flora are considered very unlikely to be impacted by the proposal.

Removal of threatened fauna habitat

Potential threatened fauna habitat is present within the proposal area, particularly in areas of high condition PCT 835 and moderate of PCT 941. For the most part however, the site lacked large native trees and hollow bearing trees.

5-Part Tests and/or EPBC Act Assessments of Significance were completed for threatened species that may have suitable habitat within the proposal area. Assessments were also completed for the Koala on a precautionary basis.

The assessments concluded that a significant impact to any threatened fauna species was unlikely.

Impact to existing BioBanking site

A total of about 0.23 hectares of PCT 835 occurs within the BioBanking site which would be directly impacted to support the proposal (Agreement 341). The PCT 835 within the BioBank site has been mapped in the BioBanking Agreement report as of a low condition class and was noted to contain significant woody weed infestations at the establishment of the agreement. This vegetation has regrown since clearing of the area prior to the 1940s.

As per the requirements of the BC Act, Transport for NSW would undertake the necessary processes to ensure that impact to the BioBank site are permitted and addressed prior to the impacts occurring.

Aquatic habitat

The proposal would require construction activities to be carried out over the Georges River. The greatest risk to the aquatic ecology within the proposal area is work which may cause sedimentation or contamination of the waterways and could have downstream impacts outside of the proposal area.

The impact of sedimentation on aquatic habitat would mainly occur during wet weather, be localised and for a short timeframe. The Georges River is dominated by fine sediments and so fine sediment deposition due to construction of the proposal would not significantly change the habitat at the bottom of the waterway.

Section 6.4.3 provides further details on potential surface and groundwater impacts during construction of the proposal.

There would be moderate to high impacts on aquatic habitats if contamination of nearby waterways during construction was to occur. This contamination may occur through the release of existing contaminated sediments, leachate from stockpiles, construction materials, or direct leakage from onsite chemicals. Refer to Section 6.5 for a summary of contamination impacts due to the proposal and recommended mitigation measures to minimise these potential impacts.

The construction work may also cause temporary displacement of aquatic fauna. The use of a barge on the Georges River to construct the new bridge would not block the river and would have minimal impacts to fish passage. However, if silt booms are used as management measure, there would be partial obstruction of fish, and they would need to be placed to avoid impact on the movement of fish along the Georges River.

Injury and mortality

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing is being carried out. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Fauna may become trapped in or may choose to shelter in machinery that is stored overnight. There is potential for these animals to become injured when the machinery is in use. A pre-clearance survey would be carried out to minimise potential impacts to fauna, with a qualified fauna spotter/catcher present during clearing activities.

Indirect impacts

Vegetation within the study area is distributed in narrow strips next to to roads and cleared areas, and is currently subject to significant edge effects, including vulnerability to weed infestation, disruption to ecosystem services (such as pollination), higher predation rates, and increased exposure to elements such as noise, wind and pollution. Vegetation removal and disturbance under the proposal is unlikely to have a substantial impact on these effects. Appropriate management would be carried out to minimise the spread of weeds, pests and pathogens within the construction area and from being brought in and out of the area.

Noise and vibration from construction activities may result in fauna temporarily avoiding habitats adjacent to the construction area. The magnitude of this impact would be substantial but due to the temporary nature would not lead to local extinctions or a significant reduction in biodiversity values within the study area.

Operation

Injury and mortality

During operation of the proposal there would a chance of fauna mortality through vehicle collision (ie roadkill), however, as the existing environment is highly urbanised the operation is not expected to significantly increase these impacts.

Habitat fragmentation

The connectivity value of the proposal area is relatively low given the site consists of thin strips of vegetation within a relatively urbanised environment immediately adjacent to a main road.

As such, significant impacts to wildlife connectivity are likely to be of low importance for the movement of species in the locality.

The proposal would require removal of the western edge of the PCT 941 patch. This is not expected to fragment this vegetation patch from the possible wildlife corridor to ANZAC Creek in the east however, the removal would increase the distance between vegetation along the M5 Motorway. Wider crossing distances may affect smaller aerial species and may result in increased vehicle strike for non-aerial species. Koala movements within the proposal area are unlikely to occur regularly since it contains poor quality habitat distant from the range of known populations.

Aquatic habitat

There would be long-term stormwater management and infrastructure impacts of the proposal on aquatic habitat and ecology. However, there would be no long-term downstream impacts due to operation of the proposal.

Discharge of water from sediment basins may occur during low frequency, high magnitude wet weather events. If this were to occur, water quality would decrease and there would be moderate impacts on the aquatic habitat within the proposal area.

The bridge footing would alter the flow and local hydraulic conditions within the Georges River. This would cause localised changes to the aquatic habitat, however, would have a negligible impact to the overall aquatic ecology within the proposal area.

Cumulative impacts

The proposal is adjacent to the nearby MLP project which is already in construction. This project will require the clearing of TECs and threatened fauna habitat, although 105 hectares of nearby environmental land will be conserved as part of the offset scheme. This area includes riparian vegetation along the Georges River adjacent to the project, and the nearby Wattle Grove vegetated area.

Increase in traffic numbers as a result of the proposal and the MLP is expected as a cumulative impact. The increase in traffic numbers, especially around Moorebank Avenue, has potential to increase vehicle strike of fauna species, however given the relatively poor connectivity of the proposal area to areas of significant habitat, such an impact is likely to be low.

Assessment of significance

A significant impact is unlikely to occur for any threatened species or communities.

Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.

6.6.4 Safeguards and management measures

Table 6-40 describes the proposed safeguards and management measures that would be implemented to manage the potential biodiversity impacts from the proposal.

Table 6-40 Biodiversity safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	A Flora and Fauna Management Plan would be prepared in accordance with Transport for NSW 's *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011) and implemented as part of the CEMP. It would include, but not be limited to: • 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 Landscape Guideline (RTA, 2008) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Procedures addressing relevant matters specified in the Policy and guidelines for fish habitat conservation and	Construction Contractor	Detailed design / Pre-construction	Section 4.8 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	management (DPI Fisheries, 2013) • Protocols to manage weeds and pathogens.			
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal would be investigated during detailed design and implemented where practicable and feasible.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard
Removal of native vegetation and habitat	Opportunities to further minimise native vegetation and threatened species habitat removal would be considered during detailed design.	Transport for NSW	Detailed design	Additional safeguard
Removal of native vegetation and habitat	Pre-clearing surveys would be carried out in accordance with *Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Pre-construction	Additional safeguard
Removal of native vegetation and habitat	Vegetation and habitat removal would be carried out in accordance with *Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
Removal of native vegetation	Native vegetation would be re-established in accordance with	Construction Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).			
Removal of native vegetation	The unexpected species find procedure is to be followed under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) if threatened ecological communities or species, not assessed in the biodiversity assessment, are identified in the proposal site.	Construction Contractor	Construction	Additional safeguard
Removal of threatened species habitat and habitat features	Targeted surveys would be carried out prior to construction for microbat species considered likely to occur within the study area. It is recommended these be carried out during the warmer nights (October to February). If species are found to occur, appropriate measures to minimise impacts would be developed. Including preparing a microbat management plan and incorporated into construction management plans.	Transport for NSW	Pre-construction	Additional safeguard
Removal of threatened species habitat and	Habitat would be replaced or re-instated in accordance with *Guide 5: Re-use of*	Construction Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
habitat features	*woody debris and bushrock* and *Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).			
Aquatic impacts	Aquatic habitat would be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	Construction Contractor	Construction	Additional safeguard
GDE	Interruptions to water flows associated with groundwater dependent ecosystems would be minimised through detailed design.	Transport for NSW	Detailed design	Additional safeguard
Changes to hydrology	Changes to existing surface water flows would be minimised through detailed design.	Transport for NSW	Detailed design	Additional safeguard
Edge effects on adjacent native vegetation and habitat	Exclusion zones would be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing*	Construction Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	biodiversity on RTA projects (RTA 2011).			
Injury and mortality of fauna	Fauna would be managed in accordance with *Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
Invasion and spread of weeds	Weed species would be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
Invasions and spread of pests	Pest species would be managed within the proposal site.	Construction Contractor	Construction	Additional safeguard
Invasion and spread of pathogens and disease	Pathogens would be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
Noise, light and vibration	Opportunities to reduce shading and artificial light impacts would be considered during detailed design. Microbat survey at the bridge location would identify if further vibration mitigation measures are required at specific locations of the bridge.	Transport for NSW	Detailed design	Additional safeguard

6.6.5 Biodiversity offsets

Under the current No Net Loss Guidelines (Transport for NSW, 2022) Transport for NSW implements biodiversity offsets, or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds.

The Biodiversity Assessment has provided an assessment against the No Net Loss Guidelines to quantify the offset requirement for the proposal. This assessment is summarised in Table 6-41.

Table 6-41 Assessment against offsetting thresholds

Veg. zone and Plant community type (PCT)	Condition	Threatened Ecological Community		Area to be directly impacted	Threshold triggered?
		BC Act	EPBC Act		
PCT 835 – Cumberland riverflat forest	Low condition	Yes - River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest	0.35 ha	Yes - Works involving clearing of an EPBC Act or BC Act listed critically endangered ecological communities (CEEC).
PCT 835 – Cumberland riverflat forest	High condition	Yes – River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest	0.61 ha	Yes - Works involving clearing of an EPBC Act or BC Act listed critically endangered ecological communities (CEEC).
PCT 849 – Cumberland shale plains woodland	Low condition	Yes - Cumberland Plain Woodland in the Sydney Basin Bioregion	Not listed – condition does not meet the minimum condition thresholds	1.28 ha	Yes - Works involving clearing of an EPBC Act or BC Act listed critically endangered ecological communities (CEEC).
PCT 941 – Hinterland riverflat eucalypt forest	Low condition	Yes - River-Flat Eucalypt Forest	Not listed – condition does not meet the minimum condition thresholds	0.96 ha	No – as clearing of an EEC ≥ 2 hectares in ‘moderate to good’ condition.
PCT 941 – Hinterland riverflat eucalypt forest	Moderate condition	Yes - River-Flat Eucalypt Forest	Yes - River-Flat Eucalypt Forest	0.96 ha	Yes - Works involving clearing of an EPBC Act or BC Act listed critically endangered

Veg. zone and Plant community type (PCT)	Condition	Threatened Ecological Community		Area to be directly impacted	Threshold triggered?
		BC Act	EPBC Act		
					ecological communities (CEEC).
Planted vegetation - no best fit PCT	Low condition	Not listed	Not listed	4.66 ha	Not applicable
Threatened flora	-	-	-	-	Not applicable as no threatened flora likely to occur.
Threatened fauna	-	-	-	-	Threatened fauna habitat is offset as per the above PCTs.

Preliminary offset calculations

Offsets for the PCTs assessed have been calculated using the formula provided in the BAM equation. This has determined that 73 BAM credits are required for the proposal. This is summarised in Table 6-42.The biodiversity credits would need to be retired to offset the impacts of the proposal.

Table 6-42 Offset calculations using BAM equation 1

Entity	Total offset (ecosystem credits rounded)
PCT 835 low	4
PCT 835 high	20
PCT 849 low	25
PCT 941 moderate	24
Total	73

Impacts to the BioBank site

The proposal requires clearing of 0.23 hectares of vegetation forming part of a BioBanking site (BioBanking Agreement 341) established to offset the impacts of the Moorebank Intermodal Terminal. Transport for NSW would discuss the impact and any associated additional offsets if required, with the relevant authorities.

6.7 Aboriginal cultural heritage

The potential impacts of the proposal on Aboriginal heritage are assessed in the Aboriginal and non-Aboriginal assessment report (Navin Officer, 2022). A summary of this assessment is presented in this section, with the full report provided in Appendix I.

6.7.1 Methodology

The Aboriginal and Non-Aboriginal Heritage Assessment was prepared for the proposal by Navin Officer (2022) in accordance with *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013* (Australia ICOMOS 2013) and the following heritage guidelines and procedures:

- Department of Environment, Climate Change and Water (DECCW). 2010a. 'Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales'.
- NSW Heritage Office. 2001. 'Assessing Heritage Significance'
- Heritage Branch, Department of Planning, 2009, 'Assessing Significance for Historical Archaeological Sites and "Relics"'.

This report fulfilled the requirements of Stage 2 of the 'Roads and Maritime Services procedure for Aboriginal cultural heritage consultation and investigation' (PACHCI) (Roads and Maritime Services 2011).

The assessment included the following:

- A literature review to locate any known Aboriginal sites within the proposal area

- Desktop assessment including searches on the Aboriginal Heritage Information Management System (AHIMS)
- Site investigations conducted on 30 September 2020 to verify the location and condition of registered Aboriginal sites. This visual assessment focused on known sites only
- Site investigation conducted on 11 July 2022 as part of the PACHCI Stage 2
- Significance and impact assessments to inform appropriate safeguards and management measures.

6.7.2 Existing environment

Landscape context

The proposal area is located on the low-lying Cumberland Plain in the Sydney Basin bioregion, on the central east coast of NSW. There are four soil landscapes mapped within the proposal area: Blacktown, Luddenham, Berkshire Park, and Richmond (Office of Environment and Heritage (OEH) 2020).

In areas with remnant native vegetation, there is potential for mature trees with evidence of Aboriginal cultural modifications (scarring and carving) to be present. Native vegetation within the proposal area has been extensively cleared. The proposal area is within the Georges River catchment and comprises low undulating bench and plateau topography overlooking the Georges River.

Archaeological heritage

Previous archaeological surveys and investigations have been conducted since 1992 identifying isolated artefacts, Potential Archaeological Deposits (PADs), artefact sites and scarred trees (with possible Aboriginal origin).

An extensive search of the AHIMS database carried out on 3 November 2021 found 52 Aboriginal sites that have previously been registered within an area centred on the proposal. Of these sites, nine have been recorded as destroyed and two as partially destroyed. These sites have been summarised in Table 6-43.

Aboriginal site AHIMS #45-5-4281 overlaps with the southern boundary of the proposal area near Powerhouse Road. This location was inspected during the site visit on the 11 July and noted to be partially impacted from development of a playground, dog park area, park infrastructure including shared pathways and installation of parking bays. The remainder of the area remains intact and is outside the proposal area.

One previously registered Aboriginal site is partly within to the proposal area; MA PAD1 [MA9] (AHIMS #45-5-4280). In 2017, Biosis undertook salvage excavations at MA9. Impacts to the site were authorised by the Minister’s Conditions of Approval for the Concept Proposal and Early Work (Stage 1) of the Moorebank Intermodal Terminal project (SSD 5066), under Part 5.1 of the EP&A Act (Biosis 2020:1). An Aboriginal site impact recording form was submitted to AHIMS following this work, indicating that the site was completely destroyed following authorised impacts. The status of this site as ‘destroyed’ was visually confirmed in a site inspection on 11th July. Therefore, this site no longer comprises a constraint on the proposal.

Table 6-43 Summary of Aboriginal sites from the AHIMS search

Aboriginal site feature	Number of sites
Artefact	34
Modified tree (carved or scarred)	6
Artefact; PAD	7
PAD	4
Shell	1
Total	52

6.7.3 Potential impacts

Construction

Based on the environmental context and the results of previous archaeological assessments, it is considered that evidence of past Aboriginal occupation would most likely be in the form of artefact sites (including isolated finds and open artefact scatters) or potential archaeological deposits.

Due to AHIMS site #45-5-4281 already being partially impacted from development and the majority of the site outside the proposal area, impacts to the site are not expected. The boundary of the site has been adjusted to reflect the historic disturbance. Temporary fencing around the southern perimeter of the proposal area during construction would be in place to avoid accidental damage

No Aboriginal objects were identified during the site inspection, and due to the disturbance from past land use, the area is unlikely to retain potential for intact subsurface Aboriginal deposits to be present. As a result, the Aboriginal archaeological potential of the remainder of the proposal area is considered to be low.

Operation

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

6.7.4 Safeguards and management measures

Table 6-44 describes the proposed safeguards and management measures that would be implemented to manage the potential Aboriginal heritage impacts from the proposal.

Table 6-44 Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) would be prepared in accordance with the *Procedure for Aboriginal cultural heritage consultation and*	Construction Contractor	Detailed design/pre-construction	Section 4.9 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	investigation (Roads and Maritime, 2012) and *Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) and implemented as part of the CEMP. It would provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The AHMP would be prepared in consultation with all relevant Aboriginal groups.			
Aboriginal heritage	*The Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) would be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Transport for NSW 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 would only re-commence once the requirements of that Procedure have been satisfied.	Construction Contractor	Detailed design / pre-construction	Section 4.9 of QA *G36 Environment Protection*
Aboriginal heritage	In the event of the discovery of Aboriginal objects, Heritage NSW should be notified in accordance with section 89(A) of the NPW Act.	Construction Contractor	Construction	Additional safeguards

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	If suspected Aboriginal object(s) outside the boundary of the destroyed Aboriginal site MA PAD1 (MA9) (AHIMS #45-5-4280) are encountered during the proposed works, any further excavation or ground disturbance in the area should cease and the find(s) managed in accordance with the Roads & Maritime Services' *Unexpected Heritage Items Procedure.*	Construction Contractor	Construction	Additional safeguards
Aboriginal heritage	AHIMS site #45-5-4281 should be protected through the installation of temporary fencing. The location of the site should be identified in the CEMP for the proposal.	Construction Contractor	Construction	Additional safeguards

6.8 Non-Aboriginal heritage

The potential impacts of the proposal on non-Aboriginal heritage are assessed in the Aboriginal and non-Aboriginal assessment report (Navin Officer, 2022). A summary of this assessment is presented in this section, with the full report provided in Appendix I.

6.8.1 Methodology

The Aboriginal and Non-Aboriginal Heritage Assessment was prepared for the proposal by Navin Officer (2020) in accordance with *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013* (Australia ICOMOS 2013) and the following heritage guidelines and procedures:

- NSW Heritage Office. 2001. 'Assessing Heritage Significance'
- Heritage Office, and Department of Urban Affairs and Planning. 2002. 'Statements of Heritage impacts'
- Heritage Branch, Department of Planning, 2009, 'Assessing Significance for Historical Archaeological Sites and "Relics"'.

The assessment included the following:

- A literature review to determine the presence of any known historical sites

- Desktop assessment including searches on the following heritage lists and registers:
    - Australian Heritage Database
    - NSW State Heritage Register (SHR)
    - Relevant state agency Section 170 Heritage and Conservation Registers
    - *Liverpool Local Environmental Plan 2008*, Schedule 5 Environmental heritage
    - NSW State Heritage Inventory (SHI)
    - Register of the National Estate
    - Register of the National Trust of Australia (NSW)
- Site investigations conducted on 30 September 2020 to verify the location and condition of listed heritage items This visual assessment focused on known sites only
- Significance and impact assessments to inform appropriate safeguards and management measures.

6.8.2 Existing environment

Historical context

A brief chronology of the proposal area is provided below:

- Pre 1840 – eastern part of the proposal area was formerly part of the Moorebank Estate, a property used for grain, sheep, cattle, hogs and horses
- 1840's – the grounds were left to the church where it later become Moore Theological College. The church leased out the land to a number of tenants for farming and other rural pursuits
- 1890's – Military use: During WWI, the Liverpool camp (north of the proposal area) was the main training area in NSW for all new recruits. WWII saw the expansion and intensification of military use in the Moorebank area
- 1951 – the Yulong playing field was opened for army sports matches
- 2017 – development of the Moorebank Logistics Park commenced.

Previous historical heritage studies

No previous historical heritage investigations have been completed for the proposal area. Three key studies were carried out in the vicinity that provide an indication of the nature and potential for historical resources that might be expected. These studies found assemblages of artefacts (such as Chinese porcelain and mochaware), and structural and depositional remains associated with the WWI Military Isolation Camp.

Heritage items

Two built heritage items, Kitchener House, (formerly 'Arpafeelie', refer Figure 6-19) and the railway viaduct over Woodbrook road (refer to Figure **6**-**20**), were identified on site. In addition, the entrance gates to the former "Yulong" playing field, located on the west side of Moorebank Avenue (refer to Figure 6-21), was identified as an item with potential heritage significance.

Kitchener House is located at 208 Moorebank Avenue, Moorebank (Lot 1001 DP 1050177). It is listed as *Liverpool Local Environmental Plan 2008* – Item #58. The structure is a single storey Federation Bungalow with tiled hipped roof and painted brickwork walls. The house is set back from the street frontage in a well maintained, landscaped garden. The proposal area extends up to about 26.5 metres into the front (western) part of the lot and includes the lawn, a number of trees and shrubs, and the paved footpath leading to the front of the house.

The statement of significance from the State Heritage Inventory listing sheet indicates Kitchener House is one of the best-preserved Federation Bungalows in the Liverpool area. It also states there is the potential to gain more information on the site from further architectural, archaeological and documentary research.

Figure 6-19 Kitchener House, view east from Moorebank Avenue

To the south of the M5 Motorway on the western side of Moorebank Avenue, the Woodbrook Road railway viaduct is listed on the Liverpool LEP and RailCorp section 170 register.

Figure 6-20 Woodbrook Road railway viaduct, view east-south from Woodbrook Road

To the south of the M5 Motorway, on the western side of Moorebank Avenue, the former entrance to Yulong Oval is marked by the original gateway, which has been retained in situ (refer to Figure 6-21). The entrance is wholly within the proposal area. The two main entry gates, linked by a central panel with the ‘YULONG’ in iron lettering, are flanked by connecting sandstone walls. The bronze plaque on the central panel reads ‘"YULONG" PLAYING FIELD OPENED BY LT. GEN. V.C. SECOMBE C.B.E. G.O.C. EASTERN COMMAND 2 DEC 51"’.

The heritage significance of the "Yulong" playing field entrance gates was assessed as there had not previously been a heritage significance assessment for this item. The gates mark the entrance of the former Yulong playing field at 2 Base Ordnance Depot, Moorebank, the forerunner of the Defence National Storage and Distribution Centre, which is historically significant. It is associated with Australian military forces prior to and during WWI and WWII and has been in operation since 1915. The gates survive as a record of the historical development of the depot and provide evidence of its layout in the second half of the 20th Century. The gates continue to provide a local landmark with aesthetic and streetscape value on Moorebank Road

Figure 6-21 Former entrance gates of Yulong playing field, view northeast from Moorebank Avenue

Historical archaeological potential

The potential for survival of historical archaeological remains within the proposal area has been assessed as nil to low. A significant portion of the proposal area is occupied by the existing alignment of the M5 Motorway and the Moorebank Avenue and M5 Motorway interchange, initially constructed in the 1980s. The construction of the M5 Motorway, including earthworks (for construction of the bridge embankment), and associated drainage (stormwater outlets and spill basin) is likely to have disturbed or removed much evidence within the proposal area related to the 19th Century farms and the Liverpool Camp to the east of the Georges River.

The summary of the historical archaeological potential results is outlined in Table 6-45. The intactness or likelihood of survival are divided into high, medium or low as detailed below:

- High – Potential archaeological remains associated with a particular historical phase or activity are likely to survive intact
- Medium – Potential archaeological remains associated with a particular historical phase or activity may survive but are likely to have been subject to some disturbance
- Low – Potential archaeological remains associated with a particular historical phase or activity are unlikely to survive.

Table 6-45 Summary of historical and archaeological potential

Phase	Site feature or activity	Potential archaeological remains	Intactness or likelihood of survival
Early European occupation and land use (1804 – early 20th Century)	Evidence of land clearing, cultivation, and grazing on the Moorebank and Collingwood Estates	Tree stumps, plant roots; plough marks or furrows; remains of subdividing fence lines such as postholes	**Low:** These activities are unlikely to have left substantial or significant features or deposits.
Early European occupation and land use (1804 – early 20th Century)	Evidence of tenant farms	Subsurface structural remains associated with former farmhouses and outbuildings (post holes, footings); underground services including pipes, wells, cesspits; rubbish pits; artefact scatters	**Low:** Subsequent land use (military occupation, MIT Precinct Early Work Stage 1, construction of M5 Motorway) is likely to have resulted in significant disturbance or removal of remains.
Early European occupation and land use (1804 – early 20th Century) **Military occupation and use (1890s – 2015)** **Industrial development and the Moorebank Intermodal Terminal (2016 – present)**	Kitchener House yard	Evidence of landscaping (garden beds, paths); plantings; services; isolated domestic artefacts	**Medium:** Subsequent land use (ongoing landscaping) is likely to have resulted in some disturbance or removal of remains.
Military occupation and use (1890s – 2015)	Liverpool Camp	Remains associated with temporary and fixed structures (tent support post holes, hut footings); latrines; rubbish pits and dumps; sporadic artefacts	**Low:** Subsequent land use (construction of M5 Motorway, water management infrastructure) is likely to have resulted in significant disturbance or

Phase	Site feature or activity	Potential archaeological remains	Intactness or likelihood of survival
		associated with troops attending training camps (personal items; tools); weaponry and ammunition (rifle cartridges, bullet casings). Remains associated with training or practice trenches, isolated artefacts	removal of remains. **Low-Medium**: Subsequent land use (construction of M5 Motorway, development of industrial complex) is likely to have resulted in some disturbance or removal of remains. Intactness of trench system and any associated artefacts likely to increase at depth.
The Liverpool Golf Links (1931 – 1971)	Evidence associated with landscaping, fencing of greens	Cut and fill associated with landscape modification and drainage; structural remains of fencing (postholes or remnant timber posts)	**Low:** Subsequent land use (construction of M5 Motorway) is likely to have resulted in significant disturbance or removal of remains

There is low potential for the survival of archaeological remains within most of the proposal area. If intact and legible, potential archaeological remains associated with the 19th Century farms would be of local significance and remains associated with the Liverpool Camp and military occupation would be of local and potentially state significance.

Potential archaeological remains associated with the yard of Kitchener House are likely to consist of remnant landscape features. However, the potential remains are unlikely to be able to provide information that other sources and sites are already able to supply. Therefore, these remains are unlikely to be of local or State significance and considered 'relics' under the Heritage Act.

6.8.3 Potential impacts

Construction

No potential impacts are anticipated to heritage items within the proposal area. The proposed work is located adjacent to Kitchener House (item #58), Woodbrook Road railway viaducts (item #12) and the former "Yulong" playing field entrance gates. The identified heritage curtilage of Kitchener House and physical curtilage of the entrance gates would not be impacted by the proposal. The Woodbrook Road railway viaducts would not be directly impacted by the proposal as they are separated from the M5

Motorway by the rail corridor and suburban development. Heritage items in the vicinity are also not anticipated to have any impacts as a result of the proposal. The distance between heritage items and the proposal is considered far enough to not warrant any anticipated potential impacts.

The proposed work is located partly within an area identified as having low-medium historical archaeological potential, associated with former earthworks (training or practice trenches). These earthworks relate to the military occupation and use of the proposal area. The depth and extent of introduced fill from training or practice trenches relative to the current ground surface is currently unknown. If construction requires earthworks below the disturbance and fill, this work may result in partial impact to historical archaeological features. Ground disturbance in this area should not commence until either an Excavation Permit Exception or Excavation Permit are issued. The Excavation Permit Exception under section 139(4) of the *Heritage Act 1977*, which would allow historical archaeological testing to be undertaken prior to construction. However, if relics were identified it would not allow for their removal or destruction. In that case an Excavation Permit under section 140 of the *Heritage Act 1977* would be applied for. This would allow any relics to be removed and would need to be supported by an Archaeological Research Design.

The proposal area is mostly located within the existing alignment of the M5 Motorway and the Moorebank Avenue/M5 Motorway interchange. Therefore, any historical evidence is likely to have been disturbed or removed.

Operation

Views to and from the non-Aboriginal heritage items from the road would not be affected. No change of use is proposed in the vicinity of these items. Therefore, operation impacts from the proposal are not expected.

6.8.4 Safeguards and management measures

Table 6-46 describes the proposed safeguards and management measures that would be implemented to manage the potential non-Aboriginal heritage impacts from the proposal.

Table 6-46 Non-Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	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.	Construction Contractor	Detailed design/pre-construction	Section 4.10 of QA *G36 Environment Protection*
Non-Aboriginal heritage	*The Standard Management Procedure – Unexpected Heritage Items* (Roads and	Construction Contractor	Detailed design/pre-construction	Section 4.10 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Maritime, 2015) would be followed in the event that 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.			
Non-Aboriginal heritage	Temporary fencing should be installed in front of the “Yulong” playing field entrance gates for the duration of the work to protect the physical curtilage and prevent accidental impacts from vehicles of mobile plant.	Construction Contractor	Construction	Additional safeguard
Non-Aboriginal heritage	Ground disturbance work would not commence in the area associated with former earthworks (training of practice trenches) until an Exception Notification under section 139(4) of the *Heritage Act 1977* or Excavation Permit under section 140 of the *Heritage Act 1977* is endorsed/issued by the Heritage Council.	Construction Contractor	Construction	Additional safeguard
Non-Aboriginal heritage	In the event of the discovery of relics of State significant, the Heritage Council of New South Wales should be notified in accordance with section 146 of the *Heritage Act 1977.*	Construction Contractor	Construction	Additional safeguard
Non-Aboriginal heritage	The location of the railway viaducts (Woodbrook Road item 12 LEP 2008) should be identified in the	Construction Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	CEMP and include information relating to significance and ensure the need for care to avoid vehicle damage is included in site inductions.			

6.9 Landscape character and visual impacts

This section describes the potential landscape character and visual impact associated with the proposal. This section is informed by the Landscape and Visual Impact Assessment (LCVIA) (KI, 2022) which is provided in Appendix J.

6.9.1 Methodology

The LCVIA was carried out in accordance with the *Practice Note: Guidelines for landscape character and visual impact assessment* (EIA-N04) (Transport for NSW, 2020).

The LCVIA assesses the potential impacts to landscape character and visual impacts of the proposal. It identifies the sensitivity of individual landscape character zones and viewpoints and the magnitude of change at each associated with the proposal. The impact is determined by assessing sensitivity and magnitude by using a matrix which is summarised in Table 6-47.

Table 6-47 Sensitivity and magnitude matrix

		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

The landscape character impact considers a combination of the area's built, natural and cultural character. Sensitivity refers to the degree to which a particular landscape type or receiver can absorb and accommodate change arising from a proposal. Magnitude describes the extent and scale of the effects of the development within the landscape.

Desktop studies and a site investigation were used to identify landscape character zones and representative viewpoints within the proposal area. The landscape character zones considered the natural environment (including consideration of human intervention and the shaping of the environment) and the interaction between place and community.

Viewpoints were chosen to represent vantage points with high numbers of viewers, such as major publicly accessible viewing areas rather than remote locations. Assessment tools used to investigate potential visual impacts included Google Earth in conjunction with plans and site photography. *Practice Note: Guidelines for landscape* *character and visual impact assessment* (EIA-N04) (Transport for NSW, 2020) was used to assess the likely changes to landscape composition such as the dominance of form, lines, colours and textures.

6.9.2 Existing environment

Regional context

The proposal is located within an urbanised area about 30 kilometres south west of the Central Business District (CBD). There are pockets of native bushland along the verges of the M5 Motorway. The Georges River intersects the proposal area. Land use is a mixture of residential, commercial, and industrial uses.

Network context

The M5 Motorway and Hume Highway are major state roads with high traffic volumes, and is a major freight route. Moorebank Avenue provides connection between various industrial estates and the M5 Motorway.

Pedestrian activity is limited, due to the dominance from cars/trucks. There is an existing on road cycleway along the M5 Motorway and the western foreshore of the Georges River.

Sensitive receivers

Visual sensitive receivers include residents, businesses, pedestrians, cyclists and motorists on the surrounding road network, and users of Georges River. The experience of these receivers would vary according to the duration, field of view and nature of exposure to the proposal. Residents would be the most sensitive to change because of their prolonged duration and heightened nature of exposure. Motorists would be least sensitive to change as they would be passing through.

Landscape character zones

The study area was separated into eight landscape character zones. Landscapes character zones are defined as having similar character. The landscape character zones are shown in Figure **6-22** and are described in Table 6-48.

Figure 6-22 Landscape character zones

Table 6-48 Landscape character zones

Landscape character zone	Land use and characteristics	Landscape view
LCZ 1 – Liverpool residential	This residential area is between the Hume highway and the Georges River and is located north of the M5 Motorway. The area is a highly modified urban environment that consists predominately of single and double storey homes set in a leafy and well-established neighbourhood. Sensitivity of this area is considered high. Its land use would be sensitive to change.	
LCZ 2 – Casula residential	This residential area is between the Hume Highway and the Main Southern Railway line. The area is a highly modified urban environment that consists of undulating, gently rolling land, with modern villas. The sensitivity of this area is considered high driven by its residential land use and sense of peaceful community.	

Landscape character zone	Land use and characteristics	Landscape view
LCZ 3 – Western foreshore	The area is located between the river and the railway line. A key feature of it includes a shared use path running along the foreshore. It includes parkland and foreshore greenery, with limited opportunities to go up to the water due to steep embankments and densely vegetated foreshore. Shared user path, a local road and the railway line define the built form elements. From within this zone, the bridge over the Georges River is a dominant element that defines the skyline. The sensitivity of this area is considered high. This zone is a popular recreational route for the community. The setting has scenic qualities contributing to this rating.	
LCZ 4 – Eastern foreshore	This zone comprises the eastern foreshore and is between the river and the industrial estates to the east. The eastern foreshore includes dense greenery running along the foreshore, with grassed and hard stand areas off the foreshore used for a variety of recreational activities. The Helles Park nature reserve, located to the north of the motorway corridor, houses a number of clubs and includes a number of activities such as barefoot water skiing, archery and remote control car racing. The sensitivity of this area is considered moderate. This zone provides for recreational space used by a limited number of community members. This, combined with the self-centered nature of its usage, limits the sensitivity.	

Landscape character zone	Land use and characteristics	Landscape view
LCZ 5 – Moorebank industrial west	This zone is a well-established industrial estate situated between Moorebank Avenue and the Georges River. Mature trees and some greenery with exotic vegetation are located along the streets. Double storey factory and large warehouse type buildings define the built form, including extensive hard stand areas. There are local streets with street lighting and some overhead powerlines. The sensitivity of this area is considered low. Its introverted character and land use contribute to this rating.	
LCZ 6 – Moorebank industrial east	This zone is located east of Moorebank Avenue and north of the M5 Motorway. There are factory style buildings and large warehouse, with hard stand areas and parking lots being dominant features. There are a lot of heavy vehicles present and local streets with street lighting and overheard powerlines. The sensitivity of this area is considered low. Its introverted character and land use contribute to this rating.	

Landscape character zone	Land use and characteristics	Landscape view
LCZ 7 – Moorebank industrial south	This zone is located east of Moorebank Avenue and south of the M5 Motorway. The area has large factory style buildings in the form of bulky warehouses. The western side of this zone occupies the larger buildings. The eastern side of this zone fronts the residential area of Wattle Grove and includes smaller industrial buildings two and three storeys in height. There is some vegetation present on the street. This zone also includes undeveloped land to the west of Moorebank Avenue. The sensitivity of this area is considered low. Its introverted character and land use contribute to this rating.	
LCZ 8 – Wattle Grove	This zone is located at the eastern end of the study area, in a residential zone of Wattle Grove with single storey brick facade residences with open front yards and manicured gardens. There are mature trees and vegetation along the streetscape. Some street lighting and pedestrian paths are present. The sensitivity of this area is considered high. Its land use would be sensitive to change.	

Viewpoints

Ten viewpoints were selected to represent receivers or sites that have potential to be visually impacted by the proposal. These viewpoints are listed in Table 6-49 and shown in Figure **6-23**.

Table 6-49 Proposal viewpoints

ID	Location	Receivers
1	Looking north from the pedestrian path along Lakewood Crescent looking towards the existing bridge	Residents
2	View from next to 9 Lakewood Crescent looking towards the existing bridge	Residents
3	View looking north along the shared user path next to Powerhouse Road	Recreational users
4	View looking from Casula Parklands towards the M5 Motorway with the bridge in the background	Recreational users
5	View from the M5 Motorway overlooking the Georges River	Motorists, pedestrians, cyclists
6	View looking east towards the eastbound Moorebank Avenue off-load ramp (including the mixed canopy vegetation along the verge)	Motorists
7	View looking west along the westbound Moorebank Avenue interchange on-load ramp	Motorists
8	View from Bapaume Road looking north towards the Moorebank Avenue interchange	Motorists, pedestrians, cyclists
9	View from the Moorebank Avenue interchange looking towards the southeast	Motorists
10	View looking along the westbound offload ramp of the Moorebank Avenue interchange	Motorists

Source: Aurecon, TfNSW

Subject to detailed design

M5 Motorway Westbound Traffic Upgrade Review of Environmental Factors

Figure 6-23 Map of proposal viewpoints

6.9.3 Potential impacts

Construction

General construction activities would result in temporary visual impacts on views in the vicinity. These include the movement and operation of construction vehicles and plant, the clearance of vegetation, excavations and earthworks, erection of temporary structures (such as fencing and lighting) and the establishment of ancillary construction facilities. The greatest impact would be to residential properties that overlook the construction site due to their prolonged exposure.

The potential impacts would be temporary during the construction period. The magnitude of impact would depend on the stage of construction and the location of the work along the alignment.

The proposal would have an overall minimal impact to the surrounding areas.

Operation

Landscape character zones

The proposal's impact to the eight identified landscape character zones would range from 'negligible' (five zones) to 'moderate' (LCZ3 – Western foreshore). Potential impacts on landscape character are summarised in Table 6-50.

The proposal would have a limited impact to the general surrounding areas of the proposal.

Table 6-50 Potential impacts on landscape character

Landscape character zone	Landscape character impact	Sensitivity	Magnitude	Impact
LCZ 1 – Liverpool residential	The proposal would have a minimal impact to the identity and sense of place of this zone. It should be noted however that the shared path link from Casula to Moorebank Avenue is considered a positive development for the urban connectivity of the area.	High	Negligible	Negligible
LCZ 2 – Casula residential	The proposal would have a minimal impact to the identity and sense of place of this zone. It should be noted however that the shared path link from Casula to Moorebank Avenue is considered a positive development for the urban connectivity of the area.	High	Negligible	Negligible
LCZ 3 – Western foreshore	The proposed new bridge would create a longer section of shared path beneath the bridge and impact the	High	Low	Moderate

Landscape character zone	Landscape character impact	Sensitivity	Magnitude	Impact
	foreshore, slightly reducing its amenity.			
LCZ 4 - Eastern foreshore	The proposed new bridge would create a longer section beneath the bridge and slightly deter from the character and identity of the club grounds. However, this impact is consider limited, hence the low rating.	Moderate	Low	Low to moderate
LCZ 5 – Moorebank industrial west	Although the proposal would have some effect on the green outlook for some properties, the overall effect on this zone is minimal and does not affect the identity and functioning of this area.	Low	Negligible	Negligible
LCZ 6 – Moorebank industrial east	The proposal would have no effect on the character and functioning of this area.	Low	Negligible	Negligible
LCZ 7 – Moorebank industrial south	The overall sense of place and identity would not be greatly impacted; accessibility to the area would be improved with the incorporation of a shared path and improved pedestrian amenities.	Low	Low	Low
LCZ 8 – Wattle Grove	The proposal would not impact this zone.	High	Negligible	Negligible

Visual impacts

The proposal's impact to the ten identified viewpoints would range from 'negligible' (two zones) to 'moderate to high' (viewpoint 3 and 5). Key receptors with the potential to be visually impacted and the potential visual impacts are summarised in Table 6-51.

The proposal would have a limited impact to the general surrounding areas of the proposal.

Table 6-51 Key visual receptors of the proposal

ID / Location	Description of impacts	Sensitivity	Magnitude	Impact	Proposed mitigation
1. Looking north from the pedestrian path along Lakewood Crescent looking towards the existing bridge	The proposal would increase the presence of the motorway bridges, yet the general visual amenity would greatly be retained. There is some loss of greenery, yet this is limited.	Moderate	Moderate	Moderate	Limited opportunity for visual mitigation. Ensure that safety screen elements are of a light colour to limit contrast with the sky backdrop.
2. View from next to 9 Lakewood Crescent looking towards the existing bridge	The perceived change is minimal due to the screening effect of existing vegetation which would be retained.	Moderate	Negligible	Negligible	No mitigation opportunity identified.
3. Looking north along the shared user path next to Powerhouse Road	The proposal would make the bridge crossing a more dominant element in the landscape. It should be noted, that the moderate to high rating is driven by the high sensitivity. The weathered steel girder would add interest by introducing colour to the structure.	High	Moderate	Moderate to high	Limited opportunity for visual mitigation. Ensure that safety screen elements are of a light colour to limit contrast with the sky backdrop. Ensure large scale vegetation is intermittently situated in front of the bridge to visually settle the structure in its setting.
4. Looking from Casula Parklands towards the M5 Motorway with the	The proposal would have a minimal impact to this viewshed due to the distance of the viewer to the proposal. In addition, vegetation partially	High	Negligible	Negligible	No mitigation opportunity identified.

ID / Location	Description of impacts	Sensitivity	Magnitude	Impact	Proposed mitigation
bridge in the background	screening the proposal contributes in mitigating the effect of the proposal.				
5. View from the M5 Motorway overlooking the Georges River	The scenic quality of the view would be reduced as the new bridge would be in the foreground. This would compromise the journey experience	Moderate	High	Moderate to high	No mitigation opportunity identified.
6. View looking east towards the eastbound Moorebank Avenue off-load ramp.	The loss of extensive vegetation and the re-establishment of new vegetation would contribute to this rating. The visual amenity of the viewscape would be compromised.	Low	High	Moderate	Ensure dense vegetation including shrubs and stands of trees provide for effective screening.
7. View looking west along the westbound Moorebank Avenue interchange on-load ramp.	The loss of some vegetation and the re-establishment of new vegetation would contribute to this rating. The visual amenity of the viewscape would be compromised, yet not to a detrimental effect.	Low	High	Moderate	Ensure dense vegetation including shrubs and stands of trees provide for effective screening.
8. View from Bapaume Road looking north towards the Moorebank	The proposal would not be very noticeable from the distance except for the loss of skyline vegetation. The re-introduction	Low	Low	Low	Ensure that stands of trees and dense shrubs are planted along batters.

ID / Location	Description of impacts	Sensitivity	Magnitude	Impact	Proposed mitigation
Avenue interchange.	of greenery would limit this effect.				
9. View from the Moorebank Avenue interchange looking towards the southeast.	The proposal would likely expose large scale industrial buildings, detracting from the streetscape. The marking of the interchange would be compromised.	Low	High	Moderate	Maximise large scale tree planting along the south eastern verge to provide for visual screening and re-establish the green character that the current interchange has.
10. View looking along the westbound off-load ramp of the Moorebank Avenue interchange.	The introduction of new paved areas and removal of screening vegetation would reinforce the dominance of the motorway setting. This is underpinned by the multi-exit offload ramps, increasing the visual prominence of the interchange.	Low	High	Moderate	Identify opportunities for interplanting of trees to maximise greenery.

6.9.4 Safeguards and management measures

Table 6-52 describes the proposed safeguards and management measures that would be implemented to manage the potential landscape character and visual impacts from the proposal.

Table 6-52 Landscape character and visual impacts safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impact	A Landscape and Urban Design Plan would be prepared to support the final detailed proposal design and implemented as part of the CEMP. The Landscape and Urban Design Plan would present an integrated urban design for the proposal, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan would include design treatments for: • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges and noise walls • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as seating, lighting, fencing and signs • Details of the staging of landscape work taking account of related	Construction Contractor	Detailed design / Pre-construction	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. The Landscape and Urban Design Plan would be prepared in accordance with relevant guidelines, including: • *Beyond the Pavement urban design policy, process and principles* (Roads and Maritime, 2014) • *Landscape Guideline* (RTA, 2008) • *Bridge Aesthetics* (Roads and Maritime 2012) • *Noise Wall Design Guidelines* (RTA, 2006) • *Shotcrete Design Guideline* (RTA, 2005).			
Landscape character and visual impact	Consider using safety screen elements that are of a light colour to limit contrast with the sky backdrop.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
Landscape character and visual impact	Consider opportunities to establish large scale vegetation intermittently situated in front of the bridge to visually settle the structure in its setting.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape character and visual impact	Consider opportunities to establish dense vegetation including shrubs and stands of trees to provide for effective screening.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
Landscape character and visual impact	Consider establishing stands of trees and dense shrubs along batters.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
Landscape character and visual impact	Maximise large scale tree planting along the south eastern verge to provide for visual screening and re-establish the green character that the current interchange has.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard

6.10 Socio-economic, property and land use

This section describes the potential socio-economic impacts associated with the proposal. This section is informed by the socio-economic impact assessment (SEIA) (Aurecon, 2022) which is provided in Appendix K.

6.10.1 Methodology

The SEIA was carried out in accordance with the ‘moderate’ level of assessment in the *Environmental Impact Assessment Practice Note – Socio-economic Assessment* (EIA-N05) (Transport for NSW, 2020a). The moderate level reflects the scale and magnitude of potential socio-economic impacts. The assessment includes:

- 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
- Description of the existing socio-economic environment of the study area to establish the baseline, including:
  - Review of local policies and strategies, including the Liverpool City Council Community Strategic Plan (CSP) (Our Home, Liverpool 2027) (Liverpool City Council, 2017)
  - 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 to the proposal, including recreation uses, educational facilities, places of worship, public transport and walking and cycling facilities
- Identification and assessment of the potential socio-economic impacts of the proposal’s construction and operation on property and land use, local amenity and community values, social infrastructure, business operations and access
- Measures to manage or mitigate potential impacts on the socio-economic environment and maximise potential benefits of the proposal.

A business survey was carried out over a three-month period between 7 December 2020 and 19 March 2021 (excluding holiday period). The aim of this survey was to understand how surrounding businesses interact with the M5 Motorway, including access, operational requirements and future operational needs. Businesses were chosen based on their proximity and use of the M5 Motorway, with questions focusing on:

- Basic business information
- Access
- Amenity
- The proposal: awareness of the proposal
- Future operations of existing businesses
- Any other comments related to business operation.

Three study areas are considered in this assessment:

- Proposal study area – 200 metres from the design, which considers direct impacts of the proposal
- Socio-economic study area – 400 metres from the design, which considers indirect impacts of the proposal
- Broader study area – considers indirect impacts of the proposal across the following Australian Bureau of Statistics areas:
    - Liverpool, Casula, Holsworthy-Wattle Grove (excludes Holsworthy Military Barracks) and Chipping Norton – Moorebank Statistical Area 2
    - In comparison with Liverpool LGA and Greater Sydney.

6.10.2 Existing environment

Population and demography

In 2016, the population of the broader study area was 82,286 people, about 40 per cent of the Liverpool LGA population. In summary the broader study area:

- Has a higher proportion of younger people with about 22 per cent of people aged 14 years or younger
- A high proportion of people born overseas with about 41 per cent, compared to about 37 per cent across Greater Sydney
- People with need for assistance is about 6 per cent. This is higher than across Greater Sydney
- The Liverpool City Council is expected to experience a substantial increase in population, with the area predicated to double in 2041 to about 441,500 people. This is higher than across Greater Sydney, which is expected to increase by half by 2041
- The average household size within the broader study area ranged between 2.8 to 3.2 people per household. This was relatively consistent with the average household size in the Liverpool LGA and Greater Sydney, which had an average of three people per household and 2.8 people per household respectively
- The higher proportion of residents living in family households in the broader study area and Liverpool LGA compared to Greater Sydney may be reflective of the availability of amenities and facilities that may be more attractive to families such as separate residential dwellings and a variety of educational/recreational facilities
- The number of households and implied dwellings in the Liverpool LGA is expected to substantially increase by 2041, predicted to be more than double the number of households in 2016. This is higher than the predicted households and implied dwellings in Greater Sydney, which are expected to increase by just over half. This may be a reflection of current growth and development in the Liverpool LGA, housing affordability and settlement patterns in the Liverpool LGA and south west Sydney area
- In 2016, the broader study area had a score between 882 to 1,076 based on the Socio-economic Indices of Areas (SEIFA). With Liverpool SA2 having the lowest score and Holsworthy-Wattle Grove having the highest score. The NSW average is 1,000. The lower score indicates the area may have households with low incomes

and less skilled occupations, while the higher score indicates households with higher income and skilled occupations.

Economy, industry and businesses

The key economic trends of the study area include:

- Unemployment was highest in the Liverpool LGA, at 7.5 per cent, compared to 6.9 per cent in the broader study area
- Liverpool LGA has a median household income of $1,550, which is consistent with the range in the broader study area of $1,088 to $2,123
- Employment in healthcare and social assistance was the top industry (15.4 per cent) in Liverpool. This can potentially be attributed to the location of Liverpool Hospital in Liverpool.

The proposal area is bordered by industrial areas, and precinct, with warehouses, storage and logistics businesses. A summary of the business survey results report is provided in Table 6-53.

Table 6-53 Summary of the Business Survey Report

Item	Comments
Concerns regarding traffic safety	Poor driver behaviour was noted as the main cause of incidents and delays along the M5 Motorway. The congestion on the M5 Motorway has flow on effects for the surrounding streets, making it hard for motorists turning onto main thoroughfares. Several businesses suggested a need for traffic management measures are intersections surrounding the M5 Motorway entry and exit ramps to improve safety.
Short term impacts with long term benefits	Businesses are concerned about traffic impacts during construction. However, over half also noted that the proposal would have positive impacts once operational. This is related to improved vehicle access, decrease in congestion and improved travel times.
Location of businesses in relation to the M5 Motorway	Businesses are highly dependent on their location in relation to the M5 Motorway. Their proximity provides greater accessibility for employees and deliveries.
Coordination with major developments	A key point of discussion from businesses was the need to coordinate the M5 Motorway proposal with other major developments in the area, including the MLP and large-scale warehouse developments.

Tourism industry

Liverpool City Council had almost 855,000 visitors in 2016, which accounted for almost three per cent of visitors to Greater Sydney. The following facilities are classified as key places to visit:

- Casula Powerhouse Arts Centre – a multi-disciplinary cultural facility that focuses on contributing to the diverse and growing community of south west Sydney. This is achieved through a range of activities including exhibitions, theatre, live music, dance and workshops

- Liverpool Regional Museum
- Army Engineer Museum
- Collingwood House
- Liverpool Pioneers Memorial Park.

Land use

The proposal is located within a highly developed urban environment. The proposal area is within the following land zones under the *Liverpool Local Environment Plan 2008:*

- SP2 – Infrastructure
- RE1 – Public recreation
- W1 – Natural Waterways
- E3 – Environmental Management
- R2 – Low density residential
- IN1 – General industrial.

The land zoning is shown in Figure **6-24**.

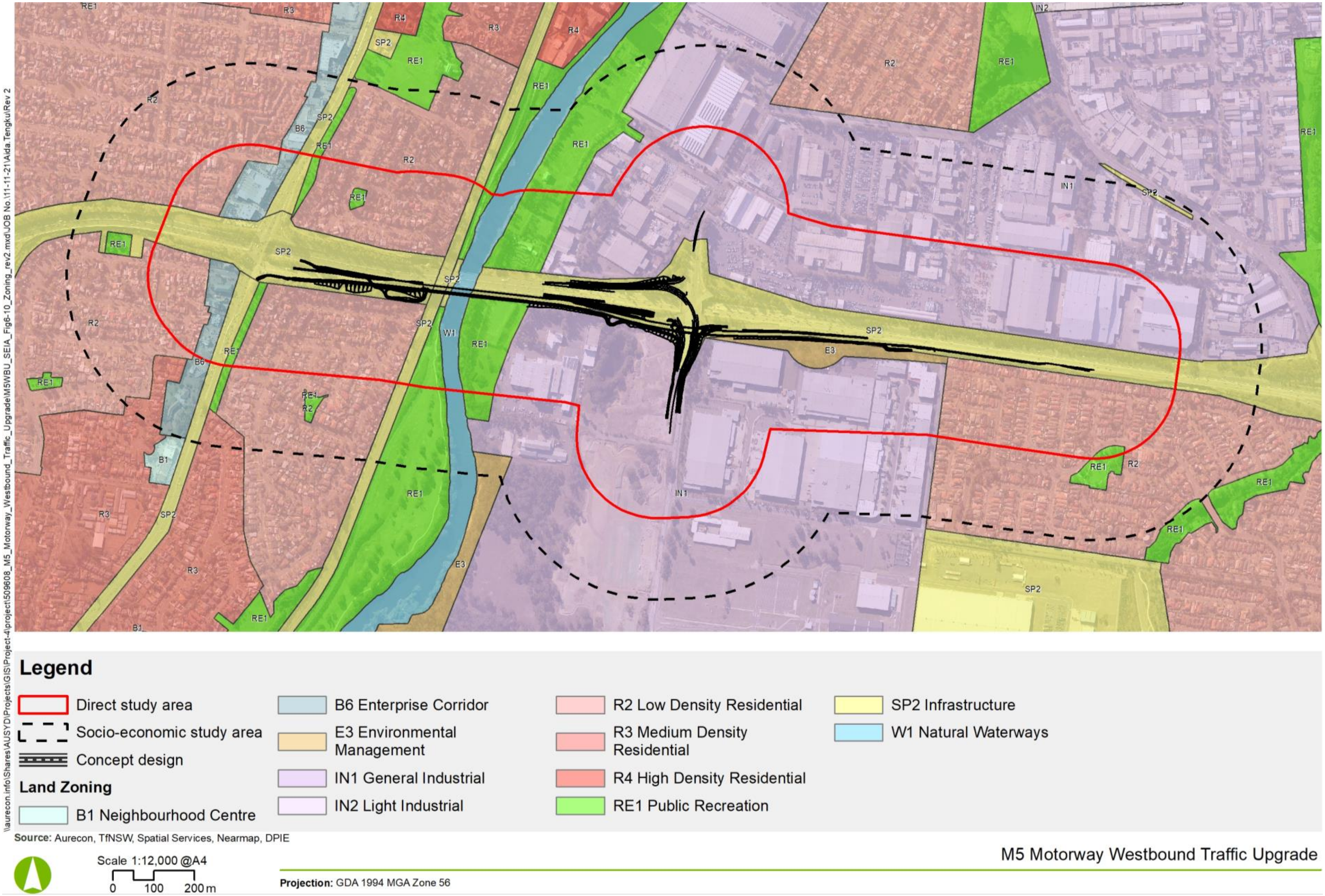


Figure 6-24 Land use zones

Major projects and development

The following two major projects in the socio-economic study area that are of relevance to the proposal:

- Moorebank Logistics Park (MLP): for the storage and dispatch of freight with the aim to relieve the increasing pressure on Port Botany. The proposal is located to the north of the MLP and would be accessed via Moorebank Avenue. Changes to the local road network south of the M5 Motorway along Moorebank Avenue are proposed to facilitate the construction and operation of the MLP
- Moorebank Avenue Realignment: to improve access for the MLP and for road users on Moorebank Avenue. The proposal is located to the north of the Moorebank Avenue Realignment.

Social infrastructure

The socio-economic study area has a broad range of facilities for the community including:

- Educational facilities including Selective and Opportunity Exam Training, Liverpool
- Childcare centre facilities including Little Kingdom Early Learning Centre, Liverpool, and Young Achievers Early Learning Centre, Liverpool
- Parks and reserves including Orara Park (Wattle Grove), St Andrews Park (Casula), Atlanta Park (Casula), Montclair Park (Liverpool), Hazel Bradshaw Park (Liverpool), Congressional Park, Liverpool, McGrath Park (Casula), Pensacola Park (Casula), Casula Parklands (Casula), Gimes Park (Casula), and Helles Park (Moorebank)
- Emergency services including Fire and Rescue NSW – Liverpool Fire Station, Liverpool (Liverpool Fire Station)
- Community facilities including the Nursing Group in Casula
- Recreational facilities including the John Grant International Raceway, Moorebank, and the Barefoot Water Ski Club, Moorebank and the Casula Powerhouse Arts Centre (Casula)
- Aged care facilities including Uniting Bernard Austin Lodge, Liverpool and Uniting Kankama, Liverpool.

An overview map of social infrastructure is shown in Figure 6-25.

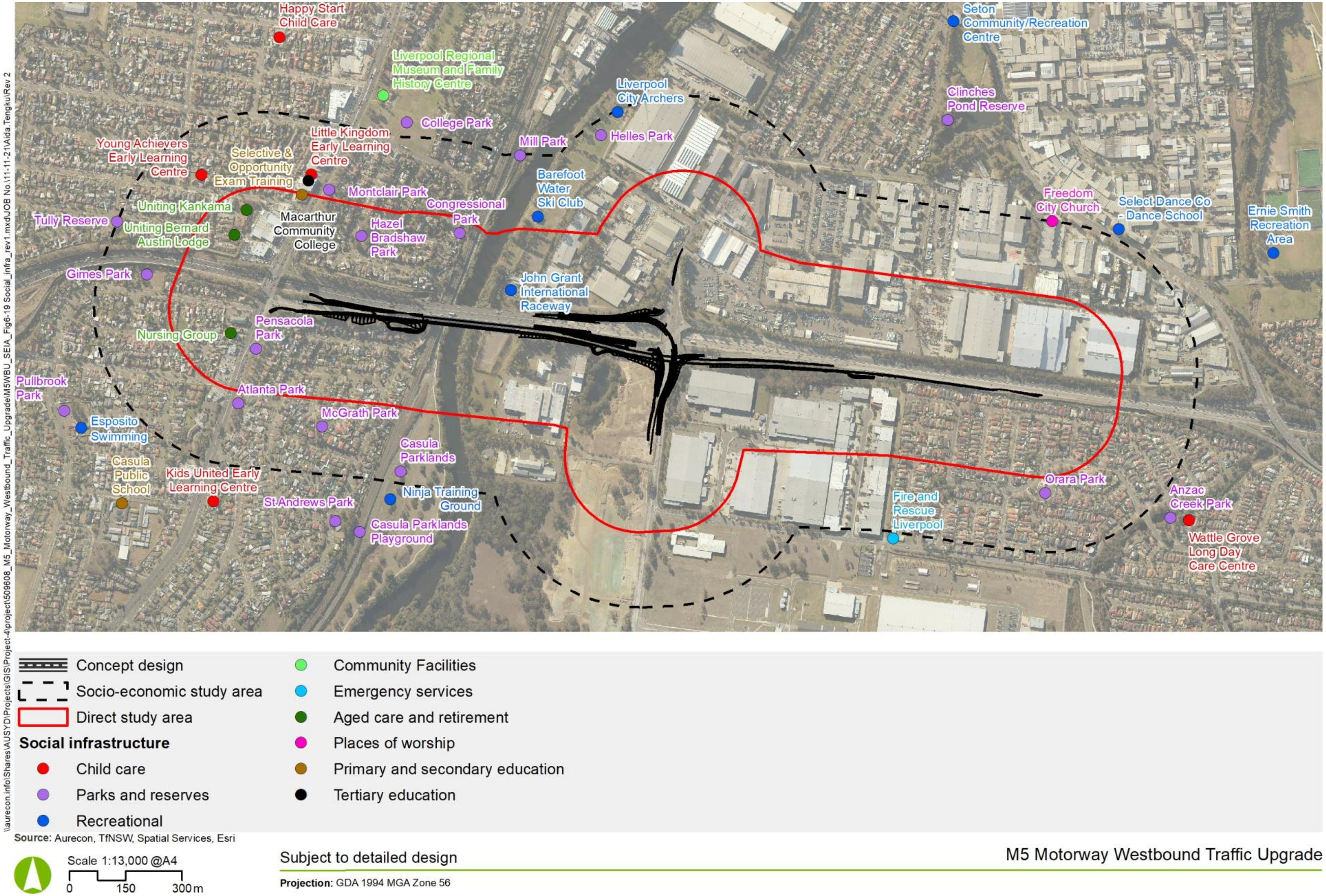


Figure 6-25 Social infrastructure surrounding the proposal

Community values

The Liverpool City Council has developed the Community Strategic Plan (CSP) 2017 to define the vision and priorities of the community and is designed to improve life for Liverpool's residents. It identified four directions:

- Creating connection – emphasising the importance of connections within Liverpool to create a harmonious community including celebrating diversity, providing access and equity for the community and creating a dynamic and inclusive environment
- Strengthening and protecting our environment – planning a high-quality, sustainable urban environment to create a great place to live, work and play
- Generating opportunity – underlines the need for Council to support economic growth, including employment and investment options. This direction includes the need to develop transport networks to create an accessible city
- Leading through collaboration – highlights the importance of a Council proactively leading the community, while continually engaging the community to ensure an aligned vision.

The CSP states that a high value is placed on diversity and inclusion, as well as connecting the community in regard to social connections and accessibility to social infrastructure and transport networks. Transport accessibility is identified as a challenge, and Liverpool City Council has committed to advocating and developing transport networks to create an accessible city.

6.10.3 Potential impacts

Construction

Property acquisition and adjustments

The construction of the proposal would require partial permanent acquisition of six areas between the eastern end of the proposal and the new bridge over the Georges River. No acquisition of physical business premises or residential properties is proposed. It is expected the proposal would be easily absorbed by most businesses who have indicated resilience to similar changes in the study area. The following partial acquisitions are proposed:

- Lot 21/DP1075884 – 2175m^2 to be acquired for the widening for the new exit ramp between Wattle Grove and Moorebank Avenue on the westbound side of the proposal
- Lot 100/DP1049508 – 4980m^2 to be acquired for the widening between Moorebank Avenue and the ABB property. This area would be used for the shared user path and earthwork
- Lot 2/DP547293 – 430m^2 – to be acquired for the widening in front of the ABB property on the westbound side of the proposal. This area would be used for the shared user path and earthwork
- Lot 2/DP32998 – 3130m^2 to be acquired for the widening in front of the ABB property. This area would be used for the shared user path and earthwork
- Lot 11/DP881265 – 2400m^2 to be used for the new bridge over the Georges River
- Lot 1/DP778777 – 132 m^2 to be used for upgrade on the Moorebank Avenue off ramp.

These areas are located along the southern side of the M5 Motorway with three businesses located directly south of the proposed acquisition. These include ABB Australia, Moorebank, Toyota Material Handling, Moorebank, and Amtek, Moorebank.

During construction, temporary leasing of property would be required for the proposed ancillary facility and construction access. This includes leasing arrangements in the following areas:

- About 22,000m^2 of Lot 11/DP881265 to be leased for the ancillary facility between the Georges River and ABB business property
- Three informal corridors to be used to access construction areas including:
    - The unnamed access track on the northern side of the M5 Motorway that connects to the proposed ancillary facility below the existing bridge over the Georges River. This is accessible via Helles Avenue in Moorebank
    - The gated pathway at the end of Yulong Close in Moorebank on the southern side of the M5 Motorway between the businesses of CDK Stone and Nulon
    - The utility corridor on the southern side of the M5 Motorway which forms the eastern border of the industrial area and western border of Wattle Grove.

Inter-property access arrangements would be required to access the proposed ancillary facility from the M5 Motorway. This would include access through Amtek and Toyota Materials Handling in the Goodman Industrial Estate, via Secombe Place. Access via the ABB property would also be required via Bapaume Road.

Consultation with landowners and businesses would be ongoing to establish necessary agreements and arrangements for leasing and access prior to construction. The sensitivity of stakeholders is considered low. The magnitude of both temporary and permanent changes during construction would be low, resulting in the significance of the impact being low.

Land use changes

Most of the construction for the proposal would occur on the southern side of the M5 Motorway, with a portion of the northern side of the motorway used at Moorebank Avenue. Construction activities would be temporary in nature and include earthwork and clearing, bridge construction, underpass construction, widening and pavement work and landscaping.

The installation of a crane barge would be located adjacent to the existing bridge on the Georges River. This would impact the ability for this section of the Georges River to be used for recreational activities as it would temporarily change from a recreationally used waterway to an active construction site. The barge would be in the river for about nine months, however, would not restrict access for this whole time given its moveable nature. The NSW Barefoot Water Ski Club hold events in the Georges River and would need to be consulted to manage the impact of any restricted access along the river.

The sensitivity of land occupiers, owners and the broader study area to changes in land use is negligible. The magnitude of the changes would be low resulting in the significance of the impact being negligible.

Access and connectivity

There would be temporary changes to existing traffic movements on the local road network, with alternative configurations required to maintain the flow of traffic. Changes would include the use of contraflow and traffic switching. These alternate arrangements can result in confusion and anxiety in road users, as well as result in delays and disruptions due to reduced lanes and slower movements.

The main mode of transport for nearby businesses is by car with the Business Survey indicating the high reliance businesses have on their location to the M5 Motorway for employee access and deliveries (Aurecon, 2021a). The 2016 ABC Census also indicated that the preferred method of travel to work was by car (ABS, 2016); therefore, the increased travel times would impact commuters.

North and south access below the bridge would be temporarily restricted during construction of the new bridge over the Georges River. People travelling north and south between Casula and Liverpool would be required to use the Hume Highway and would experience longer travel times. Temporary closure of Lakewood Crescent and Powerhouse Road would also be required during structural work and pier installation. These closures would be for up to three weeks at a time. This is expected to impact access to the Casula Powerhouse Museum as Powerhouse Road is the only access road. The pedestrian overpass at Casula Station would be used to access the museum, with the limited parking at the station likely to require parking in local streets. A detour to access the museum may be provided via Woodbrook Road, however this route would be height limited. Consultation would be carried out with Liverpool City Council and The Powerhouse Museum prior to the closures.

Property access

Property access would be maintained during construction; however, nearby businesses may experience delays in accessing properties. Parking arrangements, storage of materials and large vehicle movements may also result in changes to business operations to accommodate these movements. Property owners on Lakewood Crescent may also be temporarily impacted during construction of the bridge. This is due to the potential need for buffer zones and areas for plant and equipment.

During closures of Powerhouse Road heavy vehicles would not be able to access the Powerhouse Museum, unless under traffic management. Access would be maintained for light vehicles via a detour along Woodbrook Road

Construction traffic

Light and heavy vehicle movements would increase during construction with additional movements from workers and deliveries. The additional volume on the M5 Motorway and Moorebank Avenue is not expected to be impacted as they would be relatively small compared to the existing volumes on the road network.

However, traffic on local roads would temporarily increase and may result in localised traffic delays.

A construction Traffic Management Plan (TMP) would be prepared prior to construction to identify and mitigate traffic impacts. The local road closures would also need detour signage advising motorists of the temporary routes.

Parking

Parking in residential areas of Casula and Liverpool may be affected during construction of the new bridge and the new exit ramp. This would be due to the temporary removal of parking spaces for heavy vehicles and cranes.

Construction workers would be encouraged to park in parking areas within the proposed ancillary facility and share vehicles when travelling to construction areas, including on the western side of the Georges River, to limit potential parking impacts in surrounding local roads.

Public transport

There would be no impact on bus stops or routes during construction. There may be indirect impacts on the reliability of bus services along Moorebank Avenue and the Hume Highway due to potential traffic delays.

Where work is required near the railway corridor possession of the line may be required, resulting in potential disruptions to train services. Possessions would be during Sydney Trains and Australian Rail Track Corporation (ARTC) scheduled shut downs with requirements for any possessions, such as days and timeframes, discussed with Sydney Trains and Australian Rail Track Corporation (ARTC) to avoid and minimise impacts on train services.

Active transport

There would be temporary impacts on pedestrian access along Moorebank Avenue as access may be restricted to one side of Moorebank Avenue. This may increase pedestrians journey time and cause some difficulty for less mobile pedestrians. Temporary closures to the existing shared user path and cyclist shoulder along the M5 Motorway would be required during construction. As this would impact pedestrian and cyclist access detours and alternative routes would be provided.

These accessibility and connectivity impacts would be mitigated through the implementation of a Traffic Management Plan (TMP). Community consultation would also continue to be carried out to understand existing travel patterns of cyclists and inform the public of any impacts and alternative routes.

Marine transport

The construction of the new bridge would require a crane barge to be in the river for about nine months, resulting in temporary impacts to passage for boats and other marine vessels. Temporary partial and full closures of the Georges River at the proposal may be required during work on the new bridge. This would result in impacts to boats and people who use the NSW Barefoot Water Ski Club, who hold events in this area of the river. Transport for NSW would consult with the club to manage any impacts. The community would be notified of any restrictions during construction.

The sensitivity of users to changes in access and connectivity is moderate. The magnitude of the temporary changes during construction would be high, resulting in the significance of the impact being high-moderate.

Social infrastructure

Impacts to social infrastructure within the proposal area would affect visitors and users of the Georges River and foreshore. Community members using this infrastructure may experience temporary amenity impacts such as noise, air quality and visual impacts. These impacts would specifically be anticipated at the Barefoot Water Ski Club, Rifle Range Park, Helles Park, Mill Park and Casula Parklands, John Grant International Raceway and local parks.

The socio-economic study area would experience a range of different impacts including an increase in traffic volumes, different traffic arrangements and increased travel times and delays. These facilities include educational facilities, Liverpool Fire Station, Aged care facilities, and parks and reserves.

The overall sensitivity of the social infrastructure to construction impacts is moderate. The magnitude of impacts is moderate, resulting in a moderate level of significance.

Businesses and commercial operations

There are a range of businesses that may be impacted during construction of the proposal. These include:

- Businesses next to the M5 Motorway, north of the proposal in Moorebank, such as Amazon, Centenary Distribution Centre Real Estate Developer and Coates Hire
- Businesses next to the M5 Motorway, south of the proposal in Moorebank, such as ABB Australia and Amtek
- Businesses on the Hume Highway, including car dealerships and the Ibis Budget Hotel.

The Business Survey identified the potential increases in traffic volumes, increased travel times and disruption of vehicle access as businesses main concerns for construction. It is expected that the amenity impacts associated with the proposal would be easily absorbed by businesses.

The sensitivity of businesses during construction is moderate. The magnitude is moderate, resulting in the significance of the impact being moderate.

Community values and amenity

A reduction in amenity is likely through impacts to air quality, noise, visual and traffic. Noise impacts are expected for residents closest to the proposal in Wattle Grove and businesses on the northern side of the M5 Motorway in Helles Avenue. The increased noise has the potential to cause sleep disturbance in these residences. Visual impacts, such as lighting for nightwork and the inclusion of construction areas and plant, would impact those living within, visiting and travelling through including along the M5 Motorway, Hume Highway, Moorebank Avenue and the Georges River. In particular, the barge used for construction of the new bridge would obstruct views of the Georges River and surrounding area from parts of the foreshore.

Removal of vegetation along the Georges River would impact amenity and may contribute to concerns about air quality, with dust generation from vegetation removal work, as well as heavy vehicle movements.

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.

Cumulative construction impacts

The proposal would be located near the MLP and Moorebank Avenue Realignment project, meaning they are likely to contribute to cumulative impacts of the proposal. These impacts include:

- Traffic – additional pressure on road networks could lead to congestion, likely on Moorebank Avenue and Anzac Road in Moorebank. Traffic delays could occur with more light and heavy vehicles required
- Amenity – traffic noise, visual impacts and perceived air quality impacts. The community and stakeholders may experience consultation and construction fatigue, due to sequential projects in the area.

The sensitivity of the community to cumulative impacts is moderate. The magnitude of the impacts during construction is moderate, resulting in the level of significance being moderate.

Operation

Property acquisition and adjustments

Permanent acquisition of land adjacent to the westbound lanes of the M5 Motorway would bring the roadway closer to the buildings including businesses on the southern side of the proposal. Amtek in Moorebank is expected to experience the most impacts as it would be located closest to the new road. Lynch Group on the northern side of the proposal closest to the Moorebank Avenue intersection would also be impacted due to being closer to the road footprint. The acquisitions would not require any structures to be demolished and would be limited to strips of land that would not likely reduce the landowners current use of the property.

Sensitivity of receivers to permanent changes to property is low. The magnitude of these changes is low, resulting in the level of significance being low.

Land use changes

The proposal is not expected to result in any land use changes to properties surrounding the new and upgraded road infrastructure. The sensitivity of land occupiers and owners to permanent changes in land use is negligible. The magnitude of these changes is negligible, resulting in the level of significance being negligible.

Access and connectivity

The proposal would improve network efficiency and support the M5 Motorway as a key through-traffic connection for south west Sydney. Due to the reliance on private vehicles use for travel, this may improve and reduce travel times for commuters by enhancing connectivity for bus movements and reducing traffic congestion.

Pedestrian and cyclist facilities would be improved through the addition of a shared user path and cyclist shoulder. The shared user pathway would provide connections to Casula Parkland other shared user paths, helping to connect people to nature and open spaces. The cyclist lane would also provide a safer transport connection as it would better separate them from the main flow of high-speed moving vehicles.

The sensitivity of road users to permanent changes in access and connectivity is negligible. The magnitude is negligible and therefore the level of significance is negligible.

Social infrastructure

The proposal is expected to have an indirect positive impact as reduced congestion and the active transport options would result in better access to social infrastructure facilities. In particular, the shared user pathway would provide access to Casula Parklands.

The proposal would not significantly change the noise environment, therefore there would be negligible impacts to amenity for areas and facilities closest to the proposal, including the Georges River and foreshore, the Barefoot Water Ski Club, Casula Parklands and John Grant International Raceway.

The sensitivity of people using social infrastructure during operation of the proposal is negligible. The magnitude of the operation of the proposal is negligible resulting in a negligible impact level of significance.

Businesses and commercial operations

The improved access between the MLP and the State road network would support the expected increase in freight and businesses vehicles, and result in safer access with removal of the weaving issue. Businesses surrounding the M5 Motorway may also benefit through improved efficiency of the road network, with a decrease in congestion and improved travel times. The Business Survey Results Report identified that 64 per cent of businesses expect that once the proposal is operational it would provide positive outcomes (Aurecon, 2021).

Community values and amenity

Amenity of the area is expected to be impacted beneficially and adversely as a result of the proposal. This includes visual and noise impacts. The proposal would involve removal of vegetation resulting in adverse visual impacts. The impacts are expected to occur closest to the Georges River and foreshore, and Yulong Close. However, as the proposal area is a highly developed and urban environment, these impacts are expected to be absorbed easily by the existing environment. Noise impacts from the M5 Motorway are expected to be manageable with the adjustment of existing noise walls and at-property treatment where they exceed relevant guidelines. .

The Business Survey Results Report indicated that poor driver behaviour and safety is a key concern for business within the proposal area (Aurecon 2021). The proposal would improve the road safety and eliminate the existing weaving issue. This is expected to improve liveability through providing a more efficient road network and active transport facilities, connecting people with places via separated traffic arrangements.

Sensitivity of the community on amenity and community values is moderate. The magnitude of the operation of the proposal is expected to be low, resulting in the level of significance being moderate-low.

6.10.4 Safeguards and management measures

Table 6-54 describes the proposed safeguards and management measures that would be implemented to manage the potential socio-economic impacts from the proposal.

Table 6-54 Socio-economic safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Community consultation	A Communication Plan (CP) would be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP would include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • Contact name and number for complaints. The CP would be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008).	Transport for NSW / Construction Contractor	Pre-construction	Standard safeguard
Property impacts	Transport for NSW would continue to consult with affected property owners and land occupiers until the completion of the proposal. Discussions, including the nature and	Transport for NSW	Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	timing of construction work, would be required to identify relevant mitigation measures for noise, traffic and visual impacts.			
Changes in access	Temporary and permanent changes in access would be discussed with impacted land occupiers prior to commencement of construction and during construction activities should arrangements change. Temporary changes in access to social infrastructure facilities including the Casula Parklands and Georges River foreshore areas would be notified via signage and notification. Transport for NSW would confirm any realignment of street access or inter-property access under the proposal, in consultation with property owners.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard
Social infrastructure	Access to social infrastructure facilities including parks and reserves would be maintained during construction, with safety measures in place for noise and amenity impacts. Key facilities that would be consulted include the John Grant International Raceway, Liverpool City Council (Casula Parklands) and the Barefoot Water Ski Club. Should any active pathways or routes require closure during construction, Transport for	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	NSW would consult with Council and the community.			
Planning for construction pressures due to cumulative impacts	Transport for NSW and their contractor would consult with the Liverpool City Council, other project teams and the community throughout the construction period to reduce cumulative impacts during construction.	Transport for NSW / Construction Contractor	Pre-construction	Additional safeguard
Planning for construction pressures – events	Transport for NSW would work with the Liverpool City Council through the construction period to minimise impacts during events, such as the Barefoot Water Ski Club Championships to minimise any adverse impacts on the road network and surrounding areas.	Transport for NSW	Pre-construction	Additional safeguard
Visual impacts – lighting	During periods that require nightwork, lighting would be focused on the construction areas to avoid light spill and disturbance to surrounding properties and road users.	Construction Contractor	Construction	Additional safeguard
Cumulative impacts	Consultation with other projects including MLP and Moorebank Avenue Realignment would be carried out to reduce cumulative impacts to the community including traffic and amenity impacts.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard

6.11 Other impacts

6.11.1 Existing environment and potential impacts

Table **6-55** describes the other potential impacts that may occur from constructing and operating the proposal.

Table 6-55 Other environmental aspects

Environmental factor	Existing environment	Potential impacts
Air quality	The air quality in the region is typically “Good” by national standards (DPE, 2021). Local air quality is influenced by emissions and odours from vehicles, aircraft at Bankstown Airport, locomotives on the Southern Sydney Freight Line and local industry.	During construction, the following activities would potentially generate air emissions and dust or odour which would impact air quality: • Clearing of vegetation • Construction demolition • Stripping, stockpiling and managing of topsoil • Earthworks, excavation and road pavement work • Road preparation and pavement work • Transport and handling of soil • Use of construction vehicles, machinery, and plant • Release of landfill gasses • Spray painting of the road for line marking. These air quality impacts have potential to impact surrounding residential receivers and construction workers. However, impacts would be localised and largely be dependent on daily weather conditions including wind direction and strength. During operation, air quality impacts would be minimal, as the proposal would provide negligible increases in traffic compared to the existing environment. A TRAQ assessment

Environmental factor	Existing environment	Potential impacts
		was carried out to assess the air quality impacts from vehicular emissions on surrounding sensitive receptors, with modelling performed for projected 2026 and 2036 traffic flows with and without the proposal. Annual average and maximum daily $PM_{2.5}$ concentrations and annual average and maximum daily PM_{10} concentrations are predicted to exceed the relevant current ambient air quality criteria at the nearest sensitive receptor locations for the proposal from Moorebank Avenue to Hume highway only. However, these predicted exceedances are minimal, with an increase of 1.6 per cent in 2026 and 1.8 per cent in 2036 and are driven mainly by the existing background concentrations. The increases in the predicted cumulative annual average concentrations at 10 metres from the kerbside as a result of the proposal are minimal.
Waste and resource use	Existing waste volumes within the proposal area is minor and limited to roadside litter, illegal dumping and other waste material associated with roadside maintenance. Directly adjacent to the proposal area waste would be in greater volumes from industry. The resource management hierarchy principles in order of priority as outlined in the *Waste Avoidance and Resource Recovery Act 2001* would be applied to the proposal, these are: • Avoidance of unnecessary resource consumption • Resource recovery (including reuse, reprocessing, recycling and energy recovery) • Disposal. By adopting the above principles, Transport for NSW encourages the most efficient use of resources and	During construction, the proposal would require a number of resources including road base, concrete, steel and landscaping materials. Details of the materials and estimated volumes are provided in Section 3.3. Waste generated during construction would be mostly located at compound sites. Waste sources may include: • Residual road and building materials including concrete, asphalt and aggregate • Packing materials including pallets, crates, plastics • Domestic garbage including food waste and general site waste and litter • Wastewater from facilities, vehicle wash down and dust suppression • Residual chemical including oils, lubricants, waste fuels and batteries

Environmental factor	Existing environment	Potential impacts
	reduces cost and environmental harm in accordance with the principles of ecologically sustainable development.	• Green waste including timber, vegetation and weeds • Hazardous waste including oils, lubricants, waste fuels and batteries and potentially contaminated material exhumed from the Helles Park former landfill site. Inappropriately managed waste has the potential to result in impacts to air quality, human health, water quality and visual impacts. The proposal would require several sections of cut and fill for the construction of the bridge, underpass and the adjacent ramp construction areas. Earthworks involved in the proposal would result in a total of about 34,200 cubic metres of cut material and about 28,000 cubic metres of fill material. Significant quantities of spoil are not expected. 6,500 cubic metres of non-contaminated spoil (other than topsoil) is expected to be disposed offsite. Area of moisture affected silt or clay materials may occur in localised areas associated with drainage depressions, natural springs and in the vicinity of water bodies. These materials as well as the following materials would be considered unsuitable for reuse: • Highly organic material • Clay and silt of very soft, soft and firm consistency • Uncompacted or poorly compacted fill • Contaminated soils. During operation, waste sources would not change from the existing environment, including: • Roadside litter • Waste material associated with road maintenance

Environmental factor	Existing environment	Potential impacts
		• Illegal dumping. Waste would be reused and recycled on site where possible; however, additional or contaminated material would be classified and disposed of at a licensed waste facility in accordance with *EPA Waste Classification Guidelines* (EPA, 2014).

6.11.2 Safeguards and management measures

Table 6-56 describes the proposed safeguards and management measures that would be implemented to manage the potential other environmental impacts described in Section 6.11.1.

Table 6-56 Safeguards and management measures for other environmental impacts

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality	An Air Quality Management Plan (AQMP) would be prepared and implemented as part of the CEMP. The AQMP would include, but not be limited to: • Potential sources of air pollution • Air quality management objectives consistent with any relevant published EPA and/or EES/DPIE guidelines • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces.	Construction Contractor	Detailed design / Pre-construction	Section 4.4 of QA *G36 Environment Protection*
Air quality	Ongoing air quality monitoring would be carried out at the Helles Park former landfill site to detect any potential landfill gas leaks.	Construction Contractor	Construction / Operation	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Waste	A Waste Management Plan (WMP) would be prepared and implemented as part of the CEMP. The WMP would include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • 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. The WMP would be prepared taking into account the *Environmental Procedure – Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Transport for NSW Waste Fact Sheets.	Construction Contractor	Detailed design / Pre-construction	Section 4.2 of QA *G36 Environment Protection*
Utilities	Prior to the commencement of work: • The location of existing utilities and relocation details would be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment would be carried out.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard
Hazards and risk management	A Hazard and Risk Management Plan (HRMP) would be prepared and implemented as part of the CEMP. The HRMP would include, but not be limited to: • Details of hazards and risks associated with the activity	Construction Contractor	Detailed design / Pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• 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. The HRMP would be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or DPIE publications.			

6.12 Cumulative impacts

6.12.1 Study area

The cumulative impact assessment considers other major projects in the vicinity of the proposal including the suburbs of Moorebank, Liverpool and Casula. This assessment considered the location, scale and timing of projects in the area. The assessment includes review of the NSW Major Project Register (DPE, 2021) and Liverpool City Council Major Projects (Liverpool City Council, 2020) databases to identify any projects which may result in a cumulative impact with the proposal.

6.12.2 Other projects and developments

The impacts of other projects near the proposal are outlined in Table 6-57.

Table 6-57 Other developments near the proposal

Project	Construction Impacts	Operational Impacts
Moorebank Avenue realignment: • Realign Moorebank Avenue about 130 metres south of the Anzac Road/ Moorebank Avenue intersection • Provide two lanes in each direction adjacent to the Moorebank Precinct East (MPE) • Signalised intersection for access into the MPE	Construction impacts may include: • Runoff and sedimentation to waterways • Increased noise and vibration • Increased vehicles with construction vehicles • Removal of native vegetation, threatened species habitat and TECs.	Operational impacts may include: • Improved road safety and congestion along Moorebank Avenue • Changes to traffic movements along Moorebank Avenue.
Moorebank Intermodal Precinct West – Stage 3: • **Establishment of works compound** • **Subdivision of site into 9 allotments** • **Ancillary works to facilitate establishment** • **Importation of clean fill material**	Construction impacts may include: • Runoff and sedimentation to waterways • Increased noise and vibration • Increased vehicles with construction vehicles.	Operational impacts may include: • Increased traffic volumes for freight vehicles • Visual impacts.

6.12.3 Potential impacts

Potential cumulative impacts of the proposal with other committed and approved development in the area are presented in Table 6-58.

Table 6-58 Potential cumulative impacts

Environmental factor	Construction	Operation
Traffic	All nearby construction projects would generate additional construction traffic, including increase heavy vehicle activity on the surrounding road network. This is likely to affect the M5 Motorway, Moorebank Avenue and the Hume Highway.	The proposal would improve safety and efficiency of the road network, particularly at the Moorebank Avenue and M5 Motorway intersection. This intersection would be used by vehicles exiting the MLP.
Noise	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 or result in construction fatigue.	Any cumulative noise impacts during operation are expected to be negligible.
Other factors	Other minor cumulative construction impacts that may occur include clearance of native vegetation for the project, which may have a minor cumulative impact on the biodiversity in the region.	Other minor cumulative operational impacts that may occur include minor changes to stormwater drainage and flooding patters.

6.12.4 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 Transport for NSW to work with the other developers to modify the proposal's detailed design, construction methodology and timing to consider the above cumulative effects. Table 6-59 lists the safeguards and management measures that would be implemented to account for the potential cumulative impacts.

Table 6-59 Cumulative impact safeguard and management measures

Impact	Environmental Safeguards	Responsibility	Timing	Reference
Cumulative construction impacts	Developers of the other projects would be consulted in accordance with the Community Stakeholder and Engagement Plan to: • Obtain information about project timeframes and impacts • Manage the interfaces of the proposal's staging and	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard

Impact	Environmental Safeguards	Responsibility	Timing	Reference
	programming in combination with the other projects occurring in the area • Identify and implement appropriate safeguards and management measures to minimise cumulative impacts.			
Cumulative construction impacts	The CEMP would consider potential cumulative construction impacts from known surrounding development activities 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 work is identified that may lead to cumulative impacts or if complaints are received due to cumulative impacts.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard

6.13 Sustainability

6.13.1 Sustainability policy context

Transport for NSW's Environment and Sustainability Policy (2020)

Transport for NSW is committed to delivering infrastructure that contributes to economic prosperity and social inclusion in an environmentally responsible and sustainable manner, consistent with the Future Transport Strategy 2056. This commitment is set out in Transport for NSW's (2020) Environment and Sustainability Policy.

Transport for NSW's activities cover the whole state and that its infrastructure will last for generations to come. Transport for NSW has a duty to undertake its activities in the interest of the greater good, moving beyond compliance, and being a genuine leader in environment and sustainability performance.

Transport for NSW will work towards achieving this for NSW by:

- Leadership – contributing to and influencing the strategic environment and sustainability agenda of the NSW Government
- Environmental protection – being accountable for addressing and minimising the environmental impacts of our activities to satisfy the expectations and legislative requirements of the NSW Government and community
- Energy and carbon – improving energy efficiency and working towards net zero carbon emissions
- Resilience – embedding climate risk and resilience considerations in our activities

- Sustainable procurement – procuring and delivering sustainable, efficient and cost effective transport options, including responsible supply chains
- Whole of life – considering whole of life benefits and impacts from our activities across all life cycle stages – demand/need, plan, acquire, operate/maintain and disposal
- Social – recognising the social impacts and benefits of our activities, and working for healthy liveable communities
- Awareness – raising the awareness and capacity of our workforce to be accountable for implementing the Policy through their activities to achieve enhanced environmental outcomes and a culture of environmental responsibility
- Communication – communicating openly, responsively and empathetically with our customers, partners and stakeholders on environmental matters and report on our performance.

The proposal is being developed, and would be delivered, in accordance with Transport for NSW's Environment and Sustainability Policy. This is discussed further in Section 6.13.2.

Transport for NSW's Transport Sustainability Plan 2021

Transport for NSW's Transport Sustainability Plan 2021 (Transport for NSW, 2021) outlines the agency's vision for sustainability – that every journey is people and planet positive. To achieve this vision, Transport for NSW has identified the following eight focus areas, which address the most important sustainability aspects associated with Transport for NSW's activities.

These focus areas comprise:

- Respond to climate change
- Protect and enhance biodiversity
- Improve environmental outcomes
- Procure responsibly
- Partner with communities
- Respect culture and heritage
- Align spend and impact
- Empower customers to make sustainable choices.

Transport for NSW is embedding the eight sustainability focus areas into all of its processes to ensure optimum sustainability outcomes for infrastructure, services and the communities that it serves.

Each sustainability focus area is supported by sustainability goals, which are aligned with the United Nations Sustainable Development Goals (UNSDGs) as part of best practice sustainability approaches.

Transport for NSW's sustainability focus areas and sustainability goals are listed in Table 6-60.

The proposal is being developed, and would be delivered, in accordance with Transport for NSW's Transport Sustainability Plan 2021 by aligning with the sustainability focus areas and sustainability goals listed in Table 6-60. This is discussed further in Section 6.13.2.

6.13.2 Proposal sustainability objectives and outcomes

Indicative project specific sustainability objective and performance outcomes have been identified for this proposal. These indicative objectives and performance outcomes are listed in Table 6-60.

The indicative project specific sustainability objective and performance outcomes have been developed to align with Transport for NSW's eight key sustainability focus areas and supporting objectives (discussed in Section 6.13.1).

The indicative project specific sustainability objectives and performance outcomes in Table 6-60 would be reviewed and finalised during detailed design and would be used to direct and shape how the proposal will be sustainably developed, delivered and operated.

Table 6-60 Indicative proposal sustainability objectives and outcomes

Sustainability focus areas	Sustainability goals	Sustainability performance outcomes	Indicative sustainability opportunities
Respond to climate change	Net zero emissions by 2050	• Exceed Baseline Sustainability Targets for greenhouse gas emissions reduction in construction and operations • Greenhouse gas footprint is minimised through design decisions	• Undertake materiality assessment once design details are known • Investigate renewable energy options (eg on-site generation or purchased GreenPower) and set targets for reduction of construction and operational emissions • Explore opportunities to source services and materials locally, reducing transport emissions associated with the project • Use energy efficient appliances and practices for compounds • Utilise electric vehicle fleet where possible during construction • Investigate use of construction and maintenance materials with lower embodied emissions and adopt where specifications allow • Ensure project design is consistent with minimising congestion and ensuring efficient journeys, therefore reducing emissions from vehicular sources in operations
	Consider Climate Risk in all decisions	• Undertake a climate risk pre-screening assessment in accordance with Transport Climate Risk Assessment Guidelines • Future climate scenarios and impact on asset resilience are considered in design and materials selection for the proposal	• All ‘very high’ and ‘high’ climate risks are eliminated through adaptation treatments by 100% design stage • Develop climate risk mitigation and adaptation strategies, maintain up to date climate risks in project risk register, and review regularly • Consider future vulnerability of materials under climate change and mitigate risks through design and procurement decisions • Consider possible impact to customer journeys under climate change (eg extreme weather) and mitigate these risks • Consider project design and materials choice impacts on urban heat and mitigate where possible, including re-vegetating areas of high urban heat vulnerability

Sustainability focus areas	Sustainability goals	Sustainability performance outcomes	Indicative sustainability opportunities
			• Consider flood risk under future climate scenarios and mitigate any contribution from the proposal
Protect and enhance biodiversity	No net loss of biodiversity	• Meet the requirements of No Net Loss of Biodiversity Policy • Offset any unavoidable impacts	• Biodiversity offsets are provided in accordance with Transport for NSW's Biodiversity Policy
Improve environmental outcomes	Develop a circular economy for transport by designing waste and pollution out and keeping products and materials in use	• Consider whole-of-life impacts in design decisions • Maximise diversion of waste from landfill • Incorporate recycled materials where possible	• Undertake life cycle analysis for high materiality aspects of the project (eg pavement) • Aim to exceed Baseline Sustainability Requirements targets for circular economy • Investigate opportunities to reuse local materials and/or partner with nearby developments to minimise materials transport emissions • Reuse waste materials on site where feasible (eg reuse of spoil for flood mitigation, landscaping or embankments) • Implement a spoil and/or waste management plan
	Reduce environmental impacts of projects and operations	• Minimise use of potable water in construction • Reduce water use at site compounds	• Investigate use of rainwater or recycled water for construction • Investigate use of rainwater for non-potable compound use • Use water efficient appliances in line with minimum Water Efficiency Labelling Scheme standard per Baseline Sustainability Requirements • Consider integration of water sensitive urban design options where feasible • Identify opportunities to achieve 'stretch' targets for Baseline Sustainability Requirements for pollution control and water cycle management

Sustainability focus areas	Sustainability goals	Sustainability performance outcomes	Indicative sustainability opportunities
Procure responsibly	• All suppliers meet the standards in the Transport Supplier Sustainability Charter • Social and environmental outcomes included in all procurement decisions • Go beyond minimum compliance targets in Aboriginal Procurement Policy	• Sustainability objectives are emphasised to contractors • Provide financial incentives for contractors to exceed sustainability commitments in targeted contracts • Consistently exceed minimum targets in Aboriginal Procurement Policy	• Weightings for sustainability are at least 10% of overall non-price criteria for tender evaluations • Integrate contractual obligations to report and continually improve on key sustainability indicators • Meet Baseline Sustainability Requirements where relevant to the proposal • Set minimum and stretch targets for Aboriginal participation and procurement
Partner with communities	• Always leave a positive legacy for communities as a result of projects	• Engage with the community to create positive relationships with the project throughout all phases	• Develop and implement a communications and stakeholder engagement strategy • Deliver better connectivity for the community through car travel

Sustainability focus areas	Sustainability goals	Sustainability performance outcomes	Indicative sustainability opportunities
	• Uphold, apply and report on community engagement		
Respect heritage and culture	• Aboriginal culture is integrated and preserved • Acknowledging and incorporating culture through stories, examples, and best practice	• Avoid impacts to Aboriginal heritage as far as practicable • Engage with Aboriginal stakeholders in accordance with Transport for NSW's Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI)	• Review the proposal's potential to impact on Aboriginal heritage and avoid impacts where practicable • Continue to engage with Aboriginal stakeholders in accordance with Transport for NSW's Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI)
Align spend and impact	• All decisions consider value created from sustainability alongside financial analysis • Reduce whole of life costs for the transport network	• Meet Baseline Sustainability Requirements in the purchase of materials, products and services • Prioritise spending options that link with emissions reduction goals, including considering sustainability opportunities in supply chain	• Review and align with Baseline Sustainability Requirements early in planning and design stages • Include greenhouse gas externalities in the financial costing for all project planning and associated procurement

Sustainability focus areas	Sustainability goals	Sustainability performance outcomes	Indicative sustainability opportunities
		• Consider sustainability innovations in improving cost benefits of materials and services over the life of the project/s and beyond • Ensure investment is aligned with the findings of climate change risk assessment	
Empower customers to make sustainable choices	• Use customer journeys to inform, engage and inspire more sustainable practices and demonstrate Transport's progress	• Consider opportunities to integrate active transport and/or greening options	• Incorporate separated walkways/cycleways and landscape design • Investigate linkages with other active and public transport infrastructure

6.13.3 Safeguards and management measures

Table 6-61 describes the proposed safeguards and management measures that would be implemented to meet the proposal's sustainability objectives and outcomes.

Table 6-61 Sustainability safeguard and management measures

Impact	Environmental Safeguards	Responsibility	Timing	Reference
Sustainability	The indicative project specific sustainability objectives and performance outcomes in Table 6-60 of the project REF would be reviewed and finalised during detailed design and would be used to direct and shape how the proposal will be sustainably developed, delivered and operated.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard

6.14 Climate Resilience

6.14.1 Methodology

The *Climate Risk Assessment* (Aurecon, 2022) was undertaken to assess and evaluate the exposure of the proposal to risks associated with climate change. The methodology for this assessment (Appendix L) included:

- Detailing the risk assessment context including legislative and policy settings
- Adopting an appropriate climate scenario across the lifetime of the manages assets
- Defining the scope of the assessment
- Identifying climate hazards under the chosen climate scenario
- Evaluating identified risks in line with the AS 5334-2013 *Australian Standard for Climate Change Adaptation for Settlements and Infrastructure*
- Identifying adaptation action for those risks rated as high and the impact of these actions on residual risk.

6.14.2 Current climate

Climate change creates and multiplies risks to infrastructure, people, the environment, and the economy. Increasingly frequent and severe extreme events already impact the operation and maintenance of transport assets. These extreme events are likely to increase in a climate-affected future and be compounded by the impacts of chronic climate change.

Sydney's climate is already changing, and the frequency and severity of extreme events increasing. Over the last three years, Sydney has experienced multiple climate-related extreme events, including severe rainfall and flooding, heatwaves and bushfires. Each of these events impacted Sydney's transport infrastructure, causing damage and operational disruption.

Temperatures across Australia, and particularly across the south-east coast, have increased. The recent decades have been the warmest on record for both mean, maximum, and minimum average temperatures (CSIRO, 2022). Weather records from Bankstown Airport AWS (Bureau of Meteorology (BoM) site 066137) highlight the increasing frequency of hot days over the last decade for south-west Sydney. There has been a long-term increase in extreme fire weather and in the length of the fire season across large parts of Australia. Observed changes in southern and eastern Australia include more extreme conditions during summer, as well as an earlier start to the bushfire season.

Average rainfall across south-west Sydney has been decreasing over the last decade. Despite this overall drying trend, the severity of extreme rainfall events has increased. This means that, though it rains less frequently overall, far more rain is delivered in a single event than the historical average would suggest.

6.14.3 Future climate

Most transport assets have long design lives and were built to standards defining their ability to safely operate under historical climate conditions. Under projected climate change, the assumptions underlying these standards no longer hold true, meaning many of these assets may not be safely operable for their full intended design life.

Managing the likely future impacts of climate change on new transport infrastructure, like the M5 Motorway Westbound Traffic Upgrade, requires understanding the timing and likelihood of climate risks, and how these intersect with asset maintenance and renewal timeframes.

Under climate change, the future climate experienced in south-west Sydney is likely to be substantially different to the observed historical climate. Climate risks were assessed for the proposal in the context of the worst-case climate change scenario with a timescale to 2090 (RCP 8.5). This is the worst case climate scenario, representing a 'very high baseline emission scenario'. Using this scenario aligns with the requirements of the Transport for NSW Climate Risk Assessment Guidelines.

Major climate hazards identified as likely to impact the Liverpool area under this scenario include:

- Bushfires
- Chronic heat
- Extreme heat events
- Extreme rainfall events
- Increased atmospheric CO_2
- Increased humidity

Climate change projections were developed for two time periods time periods, reflecting the operating lives of the assets and infrastructure for the proposal:

- **2050**: Assets and systems with short to medium term operating lives such as road pavements surface layers and electronic controls, which are expected to reach end of life in the next 25-30 years.
- **2090**: Assets and systems with long operating lives, which in most instances are fixed and on-going features such as structures or drainage.

The Australian Climate Futures tool (CSIRO, 2022 and Dowdy et al., 2015) was used to establish RCP 8.5 projections for the Liverpool area. Under these projections:

- The severity and frequency of extreme temperatures and warm spells is projected to continue increasing in all seasons. It is likely that by 2050 the region will experience, on average, double the number days each year where temperatures exceed 35°C.
- Increasing temperatures and extreme heat events are projected to increase the frequency of days with harsher fire weather conditions. The proposal borders an area burnt during the 2019-2020 Black Summer bushfires. The risk of future direct fire impacts is moderated by the Liverpool area being primarily urban with limited connectivity through vegetated areas. However, the risk of reduced visibility and poor air quality due to smoke haze remains high.
- Average winter rainfall is projected to decrease throughout south-east Australia and changes in other seasons are possible. When rainfall does occur, it is likely to be more intense and extreme, flooding waterways and causing overland flows that pose risks to transport infrastructure, road users and staff.
- Mean sea level rise is projected with very high confidence to continue to rise along with the height of extreme sea-level events (wave heights and storm tide inundation).
- Atmospheric carbon dioxide projected to continue increasing under RCP 8.5. Increased carbonation of concrete is likely to reduce the structural durability of concrete and subsequently impact the service life of assets.

6.14.4 Climate Risk Assessment

The climate risks of the RCP 8.5 scenario for the proposal were identified and business as usual (BAU) likelihoods and consequences assessed using the AS-5334 guidance. The rated risks are detailed in Table 5 of the Climate Risk Assessment (Appendix L).

6.14.5 Adaptation action

The local scope of the proposal resulted in no extreme and very few high risks being identified. The residual risk rating for these risks is likely to reduce to moderate once adaptation measures are integrated into the final design.

Existing adaptation measures

The BAU risks rated as high primarily relate to extreme rainfall events and associated storm surge and flooding impacts. Adaptation to mitigate these risks is underway through the inclusion of climate change in the Hydrology and Flooding Assessment (Aurecon, 2022), and the Surface Water and Groundwater Technical Assessment (Aurecon, 2022). Implementation of mitigation measures into the final design would likely reduce the residual risks associated with extreme rainfall to moderate.

Other high risks identified in the risk assessment are associated with the predicted increase in extreme heat events. The rating of some of these risks may be reduced through changes to the final design, such as by providing shade for the shared use access path. However, there is a limit to which heat-related risks can be economically mitigated, given the nature of the design. It is therefore likely that the proposal would contribute to and be impacted by increasingly severe urban heat island effects.

Recommended further investigations

The climate risk assessment identified ‘high’ risks associated with extreme rainfall and heat. A more detailed climate risk assessment and climate adaptation plan would be prepared and would allow these risks to be more thoroughly interrogated. It is recommended that this assessment is supported by an evaluation to characterise the likely impacts for ‘high’ risks (and potentially some ‘moderate’ risks where the consequence is ‘major’ or ‘moderate’).

A more detailed climate risk assessment in line with AS 5334 would also allow a broader exploration of climate risk. In particular, climate change impacts occur at both localised and regional levels. Though this risk assessment was limited to the site of the proposal, the operation of this infrastructure would be affected by regional and network-level climate impacts.

There is opportunity to broaden the risk assessment further to consider natural hazards and system shocks and stressors. Risks may warrant further investigation include:

- Identifying cascading and compound natural hazard risks, including those that flow from and through the broader road network
- Considering the impact of shocks and stressors on the proposal area.

7 Environmental management

This chapter describes how the proposal would 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

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 Project Environmental Management Plan (PEMP) and Construction Environmental Management Plan (CEMP) would be prepared to describe the safeguards and management measures identified. The CEMP would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The plans would be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment Officer, prior to the commencement of any on-site work. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP 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 G10 – Traffic Management.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF would 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 would minimise any potential adverse impacts arising from the proposed work 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	Reference
GEN1	General –- minimise environmental impacts during construction	A Project Environmental Management Plan (PEMP) would be prepared to outline and describe the key environmental issues associated with the proposal. The PEMP would be the overarching document in the environmental management system for the proposal that includes a number of management documents. It is applicable to all staff and contractors associated with the development, design and construction of the proposal. The PEMP would be prepared and implemented with the Environmental Management System (EMS) which has been prepared in accordance ISO14001:2016.	Construction Contractor	Pre-construction / Detailed design	Core standard safeguard
GEN2	General – minimise environmental impacts during construction	A CEMP would be prepared and submitted for review and endorsement of the Transport for NSW Environment Manager prior to commencement of the activity. As a minimum, the CEMP would address the following: • Any requirements associated with statutory approvals • Details of how the proposal would implement the identified safeguards outlined in the REF • Issue-specific environmental management plans	Construction Contractor	Pre-construction / Detailed design	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• 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. The endorsed CEMP would be implemented during the undertaking of the activity.			
GEN3	General – notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity would be notified at least five days prior to commencement of the activity.	Construction Contractor / Transport for NSW	Pre-construction	Core standard safeguard
GEN4	General – environmental awareness	All personnel working on site would receive training to ensure awareness of environment protection requirements to be implemented during the proposal. This would include up-front site induction and regular 'toolbox' style briefings. Site-specific training would be provided to personnel engaged in activities or areas of higher risk. These include: • Areas of Aboriginal heritage sensitivity • Threatened species habitat.	Construction Contractor / Transport for NSW	Pre-construction/ Detailed design	Additional safeguard
NV1	Noise and vibration	A Noise and Vibration Management Plan (NVMP) would be prepared and implemented as part of the CEMP. The NVMP would generally follow the approach in the *Interim*	Construction Contractor	Detailed design / Pre-construction	Section 4.6 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Construction Noise Guideline (ICNG) (DECC, 2009) and identify: • Nearby sensitive receivers • All potential significant noise and vibration generating activities associated with the activity • Description of work, construction equipment and hours the work would be completed • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Transport for NSW, 2014) • Criteria for the proposal and relevant licence and approval conditions • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Details on how respite would be applied where ongoing high impacts are seen at certain receivers • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.			
NV2	Noise and vibration	All sensitive receivers (eg residential properties and schools) likely to be affected by construction noise and vibration would be notified at least seven days prior to the commencement of noise and vibration intensive activities. The notification would provide details of:	Construction Contractor	Detailed design / pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information			
NV3	Construction noise and vibration assessments	Location and activity specific noise and vibration impact assessments would be carried out prior to (as a minimum) activities: • With the potential to result in noise levels above 75 dBA at any receiver • Required outside standard construction hours and likely to result in noise levels greater than the relevant Noise Management Levels • With the potential to exceed relevant criteria for vibration. The assessments would 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.	Construction Contractor	Pre-construction/ construction	Additional safeguard
NV4	Construction noise exceedances	Where noise intensive equipment is to be used near sensitive receivers, the work would be scheduled during standard construction hours, where possible. If it is not possible to restrict the work to the daytime, then they would be completed as early as possible in each work shift, where possible. Appropriate respite would also be provided to affected receivers in accordance with the CNVG.	Construction Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV5	Compounds with long term work	Hoarding, or other shielding structures, would be used where receivers are impacted near compounds or fixed work areas with long durations. To provide effective noise mitigation, the barriers would break line-of-sight from the nearest receivers to the work and be of solid construction with minimal gaps.	Construction Contractor	Construction	Additional safeguard
NV6	Monitoring	Monitoring would be carried out at the start of noise and/or vibration intensive activities to confirm that actual levels are consistent with the predictions and that appropriate mitigation measures from the CNVG have been implemented.	Construction Contractor	Construction	Additional safeguard
NV7	Construction traffic	The potential impacts from construction traffic would be reviewed at a later stage when more information is available.	Construction Contractor	Pre-construction / Construction	Additional safeguard
NV8	Vibration work within minimum working distance	Where work is within the minimum working distances and considered likely to exceed the cosmetic damage criteria: • Different construction methods with lower source vibration levels would be investigated and implemented, where feasible • Attended vibration measurements would be carried out at the start of the work to determine actual vibration levels at the item. Work would be ceased if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
NV9	Vibration work within minimum working distance	The potential human comfort impacts and requirement for vibration intensive work would be reviewed as the proposal progresses.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV10	Vibration work within minimum working distance	Building condition surveys would 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.	Construction Contractor	Pre-construction / Construction	Additional safeguard
TT1	Traffic and transport	A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would be prepared in accordance with the Roads and Maritime *Traffic Control at Work Sites Manual* (RTA, 2010) and *QA Specification G10 Control of Traffic* (Roads and Maritime, 2008). The TMP would include: • 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 including between Campbelltown and Liverpool LGAs • 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	Construction Contractor	Detailed design/pre-construction	Section 4.8 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms.			
TT2	Construction site access	Construction site access would be designed and implemented in consideration of: • Road design guidelines and turning paths for heavy vehicles • Appropriate sight distances 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 • Provision of deceleration lanes at accesses next to highly trafficked roads • Minimising the size of heavy vehicles that would use local roads to access construction zones (particularly at Area 5).	Construction Contractor	Detailed design/ construction	Additional safeguard
TT3	Traffic impacts	Consultation would be carried out with the NSW Barefoot Water Ski Club to confirm temporary closures of the Georges River during construction.	Transport for NSW / Construction Contractor	Pre-construction / construction	Additional safeguard
TT4	Traffic impacts	For construction area 6, during stage 2 work further traffic modelling would be carried out during detailed design following confirmation of the construction methodology and traffic staging to confirm the potential for traffic impacts and	Construction Contractor	Detailed design	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		identify whether any additional mitigation measures or traffic control measures would be required.			
TT5	Impact on rail operations	If any potential impact on rail operations is identified, Transport for NSW would consult with Sydney Trains and ARTC, as required, and obtain any necessary permits or licences.	Transport for NSW / Construction Contractor	Pre-construction	Additional safeguard
TT6	Impact on bus stops or routes	If any potential direct impacts on bus stops or routes are identified, Transport for NSW would consult with the relevant bus operator (Interline Bus Services or Transdev) to identify alternate arrangements.	Transport for NSW / Construction Contractor	Pre-construction	Additional safeguard
TT7	Damage to local roads	A Road Dilapidation Report would 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 would be remediated / rectified by the Construction Contractor to be similar to the existing road condition or compensation would be paid to the relevant road authority.	Construction Contractor	Pre-construction / Construction	Additional safeguard
TT8	Impacts on cycling	Community consultation would be carried out to understand the travel patterns of cyclists and inform the cyclists of any alternate access arrangements.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard
TT9	Temporary access changes	Detours during temporary access changes would be implemented with directional signage along alternate routes. Signage along the M5 Motorway and the associated on-ramps would be provided to advise pedestrians and cyclists of any path closures.	Construction Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
TT10	Traffic management measures	Any temporary traffic diversions, clearways and road closures would be implemented in accordance with Transport Management Centre (TMC) requirements.	Construction Contractor	Construction	Additional safeguard
TT11	Property access	Property access would be maintained where feasible and reasonable and property owners (including ABB Australia) would be consulted before starting any work that may temporarily restrict or control access.	Construction Contractor	Construction	Additional safeguard
T12	Local road or shared path closures	Liverpool City Council would be consulted prior to any local road or shared path closures to identify suitable mitigation measures such as detour routes.	Construction Contractor	Construction	Additional safeguard
TT13	Parking	Off-road parking for construction vehicles would be provided within the ancillary facility and construction areas.	Construction Contractor	Parking	Additional safeguard
TT14	Cumulative traffic impacts	Transport for NSW and the Construction Contractor would coordinate with the project team for nearby road projects (including the Moorebank Avenue Realignment) and the Transport Management Centre with regard to the proposed timing of any road and lane closures and identify alternate routes or additional safeguards and management measures, as required.	Transport for NSW / Construction Contractor	Cumulative traffic impacts	Additional safeguard
F1	Flooding	A building floor level survey would be conducted for properties impacted by up to 20 millimetre increase in flood level peak to allow a more detailed assessment during detailed design.	Transport for NSW	Detailed design	Additional safeguard
F2	Flooding	A survey of a limited section of the Powerhouse Road and rail corridor (where the precited flood overtopping in one per cent AEP design event occurs) would be conducted during detailed design. This would allow more detailed assessment of the flooding impacts in these areas.	Transport for NSW	Detailed design	Additional Safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
F3	Flooding	A flood warning and evacuation plan would be developed as part of the Construction Environmental Management Plan. This would include details on the prediction of floods of five per cent AEP or greater severity and provide safeguards to allow the safe evacuation of personnel during flood events.	Construction Contractor	Pre-construction / Construction	Additional safeguard
F4	Flooding	Facilities used by personnel during working hours such as semi-permanent offices would be positioned outside the five per cent AEP flood extent.	Construction Contractor	Pre-construction / Construction	Additional safeguard
F5	Flooding	During flood events, the barge used for bridge construction would be moved to a safer location along the river.	Contractor	Construction	Additional safeguard
W1	Soil erosion and water pollution	A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP. The SWMP would identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks would be addressed during construction.	Construction Contractor	Detailed design / pre-construction	Section 2.1 of QA G38 Soil and Water Management
W2	Soil erosion and water pollution	A site-specific Erosion and Sediment Control Plan/s would be prepared and implemented as part of the Soil and Water Management Plan. The Plan would 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.	Construction Contractor	Detailed design / Pre-construction	Section 2.1 of QA G38 Soil and Water Management
W3	Accidental spill	A site-specific emergency spill plan would be developed and include spill management measures in accordance with the Transport for NSW *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan would address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and	Construction Contractor	Detailed design / Pre-construction	Standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		relevant authorities (including Transport for NSW and EPA officers).			
W4	Soil erosion and water pollution	An assessment of the requirement for a temporary construction sediment basin would be conducted to inform the ESCP as part of the SWMP and CEMP. Investigation of alternative erosion and sedimentation control measures would be carried out in the event that spatial constraints restrict the implementation of basins.	Construction Contractor	Detailed design	Additional safeguard
W5	Construction water quality assessment	A construction water quality monitoring plan would be prepared and implemented as part of the SWMP. The plan would be prepared in accordance with the Transport for NSW *Guideline for Construction Water Quality* and EPA publication *Approved* *Methods for the Sampling and Analysis of Water Pollutants in NSW.*	Construction Contractor	Construction	Additional safeguard
W6	Construction within the waterway	Control measures and mitigation measures that relate to working within the waterways would be outlined in the SWMP and in particular an Environmental Work Method Statement (EWMS) would be completed. This includes measures to reduce potential for spills into the river. Construction work should take into consideration the *Guidelines for instream works on waterfront land* (DPI, 2012). Instream erosion and sedimentation controls would be considered in line with *Code of Practice – Minor work in NSW waterways* (RMS, 2014) to keep sedimentation within the work area. Water quality monitoring to be conducted during construction would include visual monitoring and monitoring of turbidity.	Construction Contractor	Detailed design / pre-construction / construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
W7	Piling work of the bridge footings and excavation work to impact groundwater flow patterns	A Groundwater Management Plan (GMP) would be prepared to outline measures for interaction, dewatering and treatment of groundwater. The piling methodology should be chosen to reduce groundwater interface with groundwater flow. Piling activities should be closely monitored to ensure that contamination through leaks, spills or ambient groundwater does not accumulate within pile borings resulting in point source pollution with the potential to impact Groundwater Dependent Ecosystems (GDEs). Monitoring may include regular inspections of pile borings to monitor for any light non-aqueous phase liquids (LNAPL), oils, staining, or odours. Groundwater monitoring would be carried out. Groundwater impacts as a result of piling would be included in the GMP.	Construction Contractor	Detailed design / pre-construction	Additional safeguard
W8	Discharges	The discharges from any sediment basins would be assessed in line with the Guideline for Assessing the Impacts of Treated Water Discharge from Water Quality Treatment Controls (Transport for NSW, 2020). The results of such assessment would inform design of sediment basins to adhere to EPL discharge requirements.	Construction Contractor	Detailed design / pre-construction	Additional safeguard
W9	Construction across waterways leading to erosion or disturbance of the bed and banks	NSW DPE-Water Guidelines for watercourse crossings on waterfront land and NSW DPE-Water Guidelines for instream works on waterfront land guidelines would be adhered to for constructions across the Georges River.	Construction Contractor	Enabling work – Earthworks – Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
W10	Flooding of ancillary facilities	Ancillary facilities would be designed to accommodate local flood risk.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard
W11	Disturbance of historical legacy contamination leading to water pollution	A contamination management plan would be prepared prior to the commencement of construction and implemented during construction by the Construction Contractor. Measures would be put in place to monitor the risk of contaminated water within the landfill site escaping into the underlying aquifer.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard
W12	Aquifer interference from bridge footings	Design should consider impacts to groundwater during operation and piles be chosen to have the least amount of impact as possible on the aquifer.	Transport for NSW	Detailed design / Pre-construction	Additional safeguard
W13	Discharge associated with wet weather stormflows leading to water pollution	Design suitable stormwater infrastructure including pipes, culverts, pits, grass swales and appropriately sized water quality basin (sediment basin) to manage stormwater runoff from the site during operation and reduce loads of suspended solids entering waterways.	Transport for NSW	Detailed design / Pre-construction	Additional safeguard
CL1	Contaminated land	A Contaminated Land Management Plan would be prepared in accordance with the Guideline for the Management of Contamination (Transport for NSW, 2013) and implemented as part of the CEMP. The plan would include, but not be limited to: • 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)	Construction Contractor	Detailed design / Pre-construction	Section 4.2 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• 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.			
CL2	Contaminated land	If contaminated areas are encountered during construction, appropriate control measures would be implemented to manage the immediate risks of contamination. All other work that may impact on the contaminated area would cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.	Construction Contractor	Detailed design / Pre-construction	Section 4.2 of QA *G36 Environment Protection*
CL3	Accidental spill	A site specific emergency spill plan would be developed, and include spill management measures in accordance with the Transport for NSW *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan would address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Construction Contractor	Detailed design / Pre-construction	Section 4.3 of QA *G36 Environment Protection*
CL4	Gas monitoring	An Environmental Management Plan (EMP) would be prepared to manage the risks from methane and CO_2 during construction. The EMP would form a part of the overall Construction and Environmental Management Plan and focus on potential risks from the identified methane and carbon dioxide. The EMP would be reviewed by Transport for NSW to ensure it is adequate to address the potential risks. Active removal of methane and carbon dioxide could be considered prior to commencing	Construction Contractor	Pre-construction / construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		construction activities. Demountable designs would consider the presence of these gases.			
CL5	Contaminated land	If not already remediated by Council, ACM identified in the southern portion of Helles Park would be remediated prior to establishing the ancillary facilities on this property.	Construction Contractor	Pre-construction	Additional safeguard
CL6	Ancillary facility	The design of temporary offices would consider the presence of LFG in the southern portion of Helles Park if it is not addressed prior to establishing the site offices. In accordance with Appendix 5 of the NSW EPA's Assessment and Management of Hazardous Ground Gases: Contaminated Land Guidelines 2020, (NSW EPA, 2020), these design measures may include an installation of a gas membrane, allowing passive ventilation below the temporary offices, installation of active ventilation below the buildings, application of a positive pressure in the structures and / or internal gas monitoring. The exact mitigation approaches would be further evaluated when the nature and design of the ancillary facilities is finalised.	Construction Contractor	Pre-construction	Additional safeguard
CL7	Contaminated land	The EPA would be notified in writing at least two days before work commences that would exhume waste from a landfill site or former landfill site (located on the eastern side of the Georges River), in accordance with the requirements of Clause 110A of the Protection of the Environment Operations (Waste) Regulation 2014.	Transport for NSW / Construction Contractor	Pre-construction / construction	Additional safeguard
CL8	Contaminated land	If the Helles Park former landfill site were to become an EPA regulated site, work at the site would need to adhere to the sites Voluntary Management Proposal (VMP) as developed by the responsible party.	Construction Contractor	Construction	Additional safeguard
CL9	Contaminated land	Additional sampling would be carried out in the proposal area prior to construction to further characterise wastes likely to be encountered on site and the potential hazards	Construction Contractor	Pre-construction / construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		and risks associated with handling and disposing of these materials.			
CL10	Acid Sulfate Soils	An Acid Sulfate Soils Management Plan (ASSMP) would be prepared with reference to "*Guidelines for the Management of Acid Sulphate Materials: Acid Sulphate Soils, Acid Sulphate Rock and Monosulphidic Black Ooze"* (RTA, 2005).	Construction Contractor	Pre-construction / construction	Additional safeguard
B1	Biodiversity	A Flora and Fauna Management Plan would be prepared in accordance with Transport for NSW 's *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011) and implemented as part of the CEMP. It would include, but not be limited to: • 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 Landscape Guideline (RTA, 2008) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling • Procedures addressing relevant matters specified in the Policy and guidelines for fish habitat conservation and management (DPI Fisheries, 2013) • Protocols to manage weeds and pathogens.	Construction Contractor	Detailed design / Pre-construction	Section 4.8 of QA *G36 Environment Protection*
B2	Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal would be investigated during detailed design and implemented where practicable and feasible.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B3	Removal of native vegetation and habitat	Opportunities to further minimise native vegetation and threatened species habitat removal would be considered during detailed design.	Transport for NSW	Detailed design	Additional safeguard
B4	Removal of native vegetation and habitat	Pre-clearing surveys would be carried out in accordance with Guide 1: Pre-clearing process of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Pre-construction	Additional safeguard
B5	Removal of native vegetation and habitat	Vegetation and habitat removal would be carried out in accordance with *Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
B6	Removal of native vegetation	Native vegetation would be re-established in accordance with *Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
B7	Removal of native vegetation	The unexpected species find procedure is to be followed under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) if threatened ecological communities or species, not assessed in the biodiversity assessment, are identified in the proposal site.	Construction Contractor	Construction	Additional safeguard
B8	Removal of threatened species habitat and habitat features	Targeted surveys would be carried out prior to construction for microbat species considered likely to occur within the study area. It is recommended these be carried out during the warmer nights (October to February). If species are found to occur, appropriate measures to minimise impacts would be developed. Including preparing a microbat management plan and incorporated into construction management plans.	Transport for NSW	Pre-construction	Additional safeguard
B9	Removal of threatened	Habitat would be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock and Guide*	Construction Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
	species habitat and habitat features	*8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).			
B10	Aquatic impacts	Aquatic habitat would be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	Construction Contractor	Construction	Additional safeguard
B11	GDE	Interruptions to water flows associated with groundwater dependent ecosystems would be minimised through detailed design.	Transport for NSW	Detailed design	Additional safeguard
B12	Changes to hydrology	Changes to existing surface water flows would be minimised through detailed design.	Transport for NSW	Detailed design	Additional safeguard
B13	Edge effects on adjacent native vegetation and habitat	Exclusion zones would be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
B14	Injury and mortality of fauna	Fauna would be managed in accordance with *Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
B15	Invasion and spread of weeds	Weed species would be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Construction Contractor	Construction	Additional safeguard
B16	Invasions and spread of pests	Pest species would be managed within the proposal site.	Construction Contractor	Construction	Additional safeguard
B17	Invasion and spread of	Pathogens would be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines:*	Construction Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
	pathogens and disease	*Protecting and managing biodiversity on RTA projects* (RTA 2011).			
B18	Noise, light and vibration	Opportunities to reduce shading and artificial light impacts would be considered during detailed design. Microbat survey at the bridge location would identify if further vibration mitigation measures are required at specific locations of the bridge.	Transport for NSW	Detailed design	Additional safeguard
AH1	Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) would be prepared in accordance with the *Procedure for Aboriginal cultural heritage consultation and investigation* (Roads and Maritime, 2012) and *Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) and implemented as part of the CEMP. It would provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The AHMP would be prepared in consultation with all relevant Aboriginal groups.	Construction Contractor	Detailed design/pre-construction	Section 4.9 of QA *G36 Environment Protection*
AH2	Aboriginal heritage	*The Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) would be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Transport for NSW 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 would only re-commence once the requirements of that Procedure have been satisfied.	Construction Contractor	Detailed design / pre-construction	Section 4.9 of QA *G36 Environment Protection*
AH3	Aboriginal heritage	In the event of the discovery of Aboriginal objects, Heritage NSW should be notified in accordance with section 89(A) of the NPW Act.	Construction Contractor	Construction	Additional safeguards

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
AH4	Aboriginal heritage	If suspected Aboriginal object(s) outside the boundary of the destroyed Aboriginal site MA PAD1 (MA9) (AHIMS #45-5-4280) are encountered during the proposed works, any further excavation or ground disturbance in the area should cease and the find(s) managed in accordance with the Roads & Maritime Services' *Unexpected Heritage Items Procedure.*	Construction Contractor	Construction	Additional safeguards
AH5	Aboriginal heritage	AHIMS site #45-5-4281 should be protected through the installation of temporary fencing. The location of the site should be identified in the CEMP for the proposal.	Construction Contractor	Construction	Additional safeguards
NH1	Non-Aboriginal heritage	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.	Construction Contractor	Detailed design/pre-construction	Section 4.10 of QA *G36 Environment Protection*
NH2	Non-Aboriginal heritage	*The Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) would be followed in the event that 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.	Construction Contractor	Detailed design/pre-construction	Section 4.10 of QA *G36 Environment Protection*
NH3	Non-Aboriginal heritage	Temporary fencing should be installed in front of the “Yulong” playing field entrance gates for the duration of the work to protect the physical curtilage and prevent accidental impacts from vehicles of mobile plant.	Construction Contractor	Construction	Additional safeguard
NH4	Non-Aboriginal heritage	Ground disturbance work would not commence in the area associated with former earthworks (training of practice trenches) until an Exception Notification under section 139(4) of the *Heritage Act 1977* or Excavation Permit under	Construction Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		section 140 of the *Heritage Act 1977* is endorsed/issued by the Heritage Council.			
NH5	Non-Aboriginal heritage	In the event of the discovery of relics of State significant, the Heritage Council of New South Wales should be notified in accordance with section 146 of the *Heritage Act 1977.*	Construction Contractor	Construction	Additional safeguard
NH6	Non-Aboriginal heritage	The location of the railway viaducts (Woodbrook Road item 12 LEP 2008) should be identified in the CEMP and include information relating to significance and ensure the need for care to avoid vehicle damage is included in site inductions.	Construction Contractor	Construction	Additional safeguard
LCVIA1	Landscape character and visual impact	A Landscape and Urban Design Plan would be prepared to support the final detailed proposal design and implemented as part of the CEMP. The Landscape and Urban Design Plan would present an integrated urban design for the proposal, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan would include design treatments for: • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges and noise walls • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as seating, lighting, fencing and signs • Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage	Construction Contractor	Detailed design / Pre-construction	Standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Procedures for monitoring and maintaining landscaped or rehabilitated areas. The Landscape and Urban Design Plan would be prepared in accordance with relevant guidelines, including: • *Beyond the Pavement urban design policy, process and principles* (Roads and Maritime, 2014) • *Landscape Guideline* (RTA, 2008) • *Bridge Aesthetics* (Roads and Maritime 2012) • *Noise Wall Design Guidelines* (RTA, 2006) • *Shotcrete Design Guideline* (RTA, 2005).			
LCVIA2	Landscape character and visual impact	Consider using safety screen elements that are of a light colour to limit contrast with the sky backdrop.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
LCVIA3	Landscape character and visual impact	Consider opportunities to establish large scale vegetation intermittently situated in front of the bridge to visually settle the structure in its setting.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
LCVIA4	Landscape character and visual impact	Consider opportunities to establish dense vegetation including shrubs and stands of trees to provide for effective screening.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
LCVIA5	Landscape character and visual impact	Consider establishing stands of trees and dense shrubs along batters.	Construction Contractor	Detailed design / Pre-construction / Construction	Additional safeguard
LCVIA6	Landscape character and visual impact	Maximise large scale tree planting along the south eastern verge to provide for visual screening and re-establish the green character that the current interchange has.	Construction Contractor	Detailed design / Pre-	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
				construction / Construction	
SC1	Community consultation	A Communication Plan (CP) would be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP would include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • Contact name and number for complaints. The CP would be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008).	Transport for NSW / Construction Contractor	Pre-construction	Standard safeguard
SC2	Property impacts	Transport for NSW would continue to consult with affected property owners and land occupiers until the completion of the proposal. Discussions, including the nature and timing of construction work, would be required to identify relevant mitigation measures for noise, traffic and visual impacts.	Transport for NSW	Pre-construction / Construction	Additional safeguard
SC3	Changes in access	Temporary and permanent changes in access would be discussed with impacted land occupiers prior to commencement of construction and during construction activities should arrangements change. Temporary changes in access to social infrastructure facilities including the Casula Parklands and Georges River foreshore areas would be notified via signage and notification. Transport for NSW would confirm any realignment of street access or inter-property access under the proposal, in consultation with property owners.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SC4	Social infrastructure	Access to social infrastructure facilities including parks and reserves would be maintained during construction, with safety measures in place for noise and amenity impacts. Key facilities that would be consulted include the John Grant International Raceway, Liverpool City Council (Casula Parklands) and the Barefoot Water Ski Club. Should any active pathways or routes require closure during construction, Transport for NSW would consult with Council and the community.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard
SC5	Planning for construction pressures due to cumulative impacts	Transport for NSW and their contractor would consult with the Liverpool City Council, other project teams and the community throughout the construction period to reduce cumulative impacts during construction.	Transport for NSW / Construction Contractor	Pre-construction	Additional safeguard
SC6	Planning for construction pressures – events	Transport for NSW would work with the Liverpool City Council through the construction period to minimise impacts during events, such as the Barefoot Water Ski Club Championships to minimise any adverse impacts on the road network and surrounding areas.	Transport for NSW	Pre-construction	Additional safeguard
SC7	Visual impacts – lighting	During periods that require nightwork, lighting would be focused on the construction areas to avoid light spill and disturbance to surrounding properties and road users.	Construction Contractor	Construction	Additional safeguard
SC8	Cumulative impacts	Consultation with other projects including MLP and Moorebank Avenue Realignment would be carried out to reduce cumulative impacts to the community including traffic and amenity impacts.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard
AQ1	Air quality	An Air Quality Management Plan (AQMP) would be prepared and implemented as part of the CEMP. The AQMP would include, but not be limited to: • Potential sources of air pollution	Construction Contractor	Detailed design / Pre-construction	Section 4.4 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Air quality management objectives consistent with any relevant published EPA and/or EES/DPIE guidelines • Mitigation and suppression measures to be implemented • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces.			
AQ2	Air quality	Ongoing air quality monitoring would be carried out at the Helles Park former landfill site to detect any potential landfill gas leaks.	Construction Contractor	Construction / Operation	Additional safeguard
W1	Waste	A Waste Management Plan (WMP) would be prepared and implemented as part of the CEMP. The WMP would include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • 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. The WMP would be prepared taking into account the *Environmental Procedure – Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Transport for NSW Waste Fact Sheets.	Construction Contractor	Detailed design / Pre-construction	Section 4.2 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
U1	Utilities	Prior to the commencement of work: • The location of existing utilities and relocation details would be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment would be carried out.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard
HR1	Hazards and risk management	A Hazard and Risk Management Plan (HRMP) would be prepared and implemented as part of the CEMP. The HRMP would include, but not be limited to: • 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. The HRMP would be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or DPIE publications.	Construction Contractor	Detailed design / Pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
CI1	Cumulative construction impacts	Developers of the other projects would be consulted in accordance with the Community Stakeholder and Engagement Plan to: • 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.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard
CI2	Cumulative construction impacts	The CEMP would consider potential cumulative construction impacts from known surrounding development activities 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 work is identified that may lead to cumulative impacts or if complaints are received due to cumulative impacts.	Transport for NSW / Construction Contractor	Pre-construction / Construction	Additional safeguard
SUS1	Sustainability	The indicative project specific sustainability objectives and performance outcomes in Table 6-60 of the project REF would be reviewed and finalised during detailed design and would be used to direct and shape how the proposal will be sustainably developed, delivered and operated.	Transport for NSW / Construction Contractor	Pre-construction and construction	Additional safeguard
CR1	Climate risk	A more detailed climate risk assessment and climate adaptation plan would be prepared accordance with AS 5334. This assessment would be supported by an evaluation to characterise the likely impacts for 'high' risks (and potentially some 'moderate' risks where the consequence is 'major' or 'moderate').	Transport for NSW	Pre-construction	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
Protection of the Environment Operations Act 1997 (s43)	Environment protection licence (EPL) for scheduled activities [road construction] from the EPA	Prior to start of the activity.
Heritage Act 1977 (s139)	Excavation permit from the Heritage Council of NSW / the Minister to allow historical archaeological testing to be carried out.	Prior to start of the activity
Heritage Act 1977 (s140)	Excavation permit from the Heritage Council of NSW / the Minister if historical archaeological testing identified any relics.	Prior to start of the activity
Crown Land Management Act 2016 (Division 3.4, 5.5 and 5.6)	Lease or licence to occupy areas of Crown land.	Prior to start of the activity
Roads Act 1993 (Section 138)	A road occupancy licence would be obtained.	Prior to start of the activity
Biodiversity Conservation Act 2016 (Clause 5.16(1))	Receive consent from the NSW Minister for Environment prior to commencing work on the biodiversity stewardship site.	Prior to start of the activity

8 Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. 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 2021

8.1 Justification

The M5 Motorway is a key through-traffic arterial connection for south west Sydney. It is used by local and regional motorists, freight carriers and businesses and supports economic and residential growth in the Western Sydney region.

The proposal would improve safety along the M5 Motorway for motorists travelling between Moorebank Avenue and the Hume Highway. This is consistent with the strategic priorities listed in Section 2.1, of improving road's safety performance and efficiency needs. The proposal would eliminate the existing weaving issue that occurs with vehicles travelling westbound entering the M5 Motorway from Moorebank Avenue. In particular, the potential benefits associated with the development and delivery of the proposal would include:

- Elimination of the existing weaving issue
- Improvement of traffic flow along the M5 Motorway, particularly westbound
- Improvement of motorist, cyclist, and pedestrian safety.

There would be some environmental impacts from the proposal, however they have been avoided or minimised wherever possible through design and site-specific safeguards. The beneficial effects of improving safety and motorway efficiency are considered to outweigh the mostly temporary adverse impacts and risks associated with the proposal.

8.1.1 Social factors

The proposal would provide better connectivity and improve road safety for motorists, cyclists and pedestrians along the M5 Motorway from Moorebank Avenue to the Hume Highway. However, during construction there would be the potential for some negative social impacts. The proposal would cause temporary inconvenience from construction activities associated with equipment noise and visual impacts, reduced capacity when lane closures are required, travel time increases and altered access arrangements. The proposal would also impact some industrial properties due to acquisition of land.

8.1.2 Biophysical factors

The proposal would requirement removal of about 8.82 hectares of vegetation. Removal of this vegetation could lead to loss of threatened fauna habitat and a reduction in connectivity. There is also the risk of fauna injury and mortality from construction equipment and activities. However, a significant impact is not expected. Through the implementation of mitigation and management measures the proposal is not expected to threaten the long term survival of species.

8.1.3 Economic factors

The M5 Motorway is an important connection for freight and businesses. The Moorebank Logistics Park is located within the vicinity of the proposal, and during operation would result in increased heavy vehicle and freight movements along Moorebank Avenue and the M5 Motorway. The proposal would improve freight efficiency by reducing congestion and improving safety. This would support the wider State and national economy.

8.1.4 Public interest

The proposal is in the public interest as it would improve safety along the M5 Motorway and reduce congestion and travel times. The proposal has sought to avoid and minimise environmental impacts through community consultation with stakeholders and the community and design refinements. Consultation would continue through the design stages.

8.2 Objects of the EP&A Act

Table 8-1 describes how the proposal is consistent with or furthers the objects of the EPA&A Act.

Table 8-1 Objects of the EPA&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The proposal would improve freight efficiency along the M5 Motorway resulting in an improvement to freight transportation and support the State and national economy. It would promote the social welfare of the local community by improving connectivity and safety for motorists, cyclists and pedestrians. Socio-economic impacts are assessed in Section 6.10. The assessment includes management measures to avoid and/or minimise impacts.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	The proposal has considered relevant economic, environmental and social considerations. Ecologically sustainable development is considered in Section 8.2.1. Potential impacts have been minimised through design development and would be further mitigated using the measures in Section 7.
1.3(c) To promote the orderly and economic use and development of land.	The proposal would improve an important section of road infrastructure, that promotes efficient freight connectivity. The proposal is aligned with several State and local policies and strategies to provide safe and efficient transport networks (refer to Section 2.1).
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The proposal would require the removal of about 8.82 hectares of native vegetation. The proposal would not have a significant impact on threatened biodiversity. Potential impacts and management measures to protect biodiversity are discussed in Section 6.6.

Object	Comment
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal would have negligible impact on built or cultural heritage.
1.3(g) To promote good design and amenity of the built environment.	Urban design objectives have been developed for the proposal to promote good design and amenity of the built environment (refer to Section 2.3.3).
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Chapter 5 outlines the community and stakeholder consultation carried out during various stages of the proposal. This REF will be on display and further consultation will be carried out with the community if the proposal is determined to proceed.

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 proposal.

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.

<u>The precautionary principle</u>

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.

This principle was considered during route options development (refer to Chapter 2). The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures, as summarised in section 7.

<u>Intergenerational equity</u>

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 consideration so that any likely impacts are not left to be addressed by future generations. The proposal would benefit both current and future generations by improving safety and reducing congestion and travel time along the section of the M5 Motorway.

Issues that have potential long-term effects, such as biodiversity impacts from removal of vegetation, would be avoided and/or minimised through further design development and the application of safeguards and management measures described in Section 7.

Conservation of biological diversity and ecological integrity

The proposal would require the removal of up to 8.82 hectares of vegetation. Removal of this vegetation could lead to loss of threatened fauna habitat. A biodiversity strategy has been developed for unavoidable impacts.

Potential biodiversity impacts are discussed in Section 6.6 and would be avoided and/or minimised through further design development and the application of safeguards and management measures described in Section 7.

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 the options selection process and in the economic and financial feasibility assessments for the proposal. The value of the proposal to the community in terms of improved safety was also recognised.

Environmental safeguards and management measures for avoidance, reuse, recycling and management of waste during construction and operation are to be implemented.

8.3 Conclusion

The proposed widening of the M5 Motorway westbound between Moorebank Avenue and the Hume Highway 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 noise and vibration, traffic and transport, contamination, biodiversity, visual impacts and access.

Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve safety, improve driving conditions, and reduce travel times. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. 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 not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Government Department of Agriculture, Water and 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.

Carolyn McCallig

Principal, Environment and Planning

Aurecon

Date:12 August 2022

I have examined this review of environmental factors and accept it on behalf of Transport for NSW.

Paul Nicholls

Project Manager

Western Sydney Project Office

Date: 26/08/2022

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Terms and acronyms used in this REF

Term/ Acronym	Description
AHD	Australia Height Datum
AHIMS	Aboriginal Heritage Information Management System
Alignment	The vertical and horizontal location of the road
ASRIS	Australian Soil Resource Information System
ASS	Acid sulfate soil
Aurecon	Aurecon Australasia Pty Ltd
BAM	Biodiversity Assessment Methodology
BC Act	Biodiversity Conservation Act 2016 (NSW).
Capacity	Maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or a road in one direction during a given time period under prevailing road and traffic conditions.
CEMP	Construction environmental management plan
CSP	Liverpool City Council Community Strategic Plan
DPI	Department of Primary Industries
DPE	NSW Department of Planning and Environment
EEC	Endangered ecological community
EIA	Environmental impact assessment
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
EPA	NSW Environment Protection Authority
FM Act	Fisheries Management Act 1994 (NSW)
GDE	Groundwater dependent ecosystems
Georges River Catchment REP	Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment
Heritage Act	Heritage Act 1977 (NSW)
LCZ	Landscape character zone
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.

Term/ Acronym	Description
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
MNES	Matters of national environmental significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
NPW Act	National Parks and Wildlife Act 1974 (NSW)
NSW	New South Wales
OOHW	Out of hours work
PAD	Potential archaeological deposit
PCT	Plant community types
PFAS	Per- and polyfluoroalkyl substances
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
Proposal Area	The ‘proposal area’ refers to the area that may be directly impacted by construction and operation of the proposal (shown in figure 1-1 and 1-2).
REF	Review of environmental factors
Roads and Maritime	NSW Roads and Maritime Services, now known as Transport for NSW
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
Study Area	The ‘study area’ consists of land in the vicinity of, and including, the proposal area. The study area is the wider area surrounding the proposal area, including land that has the potential to be indirectly impacted by the proposal beyond the immediate work area (for example, as a result of any noise or traffic diversions). The scope of the study area varies depending on the environmental factor being assessed.
SWMP	Soil and Water Management Plan
TEC	Threatened ecological community
TMP	Traffic Management Plan
WARR Act	Waste Avoidance and Resource Recovery Act 2001 (NSW)
WM Act	Water Management Act 2000 (NSW)
WQOs	Water Quality Objectives

Appendix A

Consideration of Section 171 of the EP&A Reg 2021 and matters of national environmental significance and Commonwealth land

Section 171 Checklist

In addition to the requirements of Guidelines for Division 5.1 assessments (DPE, 2022) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the REF, the following factors, listed in section 171 of the Environmental Planning and Assessment Regulation 2021, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
a) Any environmental impact on a community? • During construction, the proposal would result in impacts to noise and vibration, the visual landscape, traffic and access, and biodiversity. Safeguards to minimise impacts are listed in Section 7 • The proposal would improve safety and access along the section of the M5 Motorway.	Short term, moderate negative Long term, moderate positive
b) Any transformation of a locality? • Construction equipment and activities would have short term visual impacts • Operation of the proposal would result in a reduction of congestion along the M5 Motorway, improving amenity and safety.	Short term, moderate negative Long term, moderate positive
c) Any environmental impact on the ecosystems of the locality? • The proposal would require the removal of 8.82 hectares of native vegetation. Safeguards to minimise impacts are listed in Section 7.	Long term, minor negative
d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? • During construction, the proposal would have noise and visual impacts to closest sensitive receivers including residential properties. • The proposal would have impact to the environmental and scientific quality of the area through habitat and vegetation loss. Safeguards to minimise impacts are listed in Section 7.	Short term, moderate negative Long term, moderate negative
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? • The proposal would have minimal impacts to Aboriginal and non-Aboriginal heritage. Safeguards to minimise the impacts are listed in Section 7.	Short term, negligible negative
f) Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974)?*	Nil

Factor	Impact
• The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974*	
g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? • The proposal would require the removal of up to 8.82 hectares of native vegetation. This removal could lead to loss of threatened fauna habitat. There is also risk of fauna injury and mortality from construction equipment. Safeguards to minimise impacts are listed in Section 7.	Long term, minor negative
h) Any long-term effects on the environment? • The proposal would result in loss of vegetation, however an offset strategy has been developed to minimise impacts. Details are listed in Section 6.6.	Long term, minor negative
i) Any degradation of the quality of the environment? • Providing the mitigation measures outlined in this REF are implemented (refer to Section 7.2), the proposal is not expected to result in noticeable degradation of the quality of the environment.	Nil
j) Any risk to the safety of the environment? • The proposal would result in increased safety for motorists, cyclists and pedestrians using the M5 Motorway through eliminating the existing weaving issue westbound off Moorebank Avenue, and through the provision of new shared user pathways to the Hume Highway.	Long-term major positive impact
k) Any reduction in the range of beneficial uses of the environment? • The proposal would not result in a reduction in the range of beneficial uses of the environment.	Nil
l) Any pollution of the environment? • During construction, there is the potential for water quality impacts as a result of increased sedimentation, increased soil nutrients, wastes and fuel and chemical spills and leakages. Noise and air quality impacts may also occur throughout construction. Safeguards to minimise impacts are listed in Section 7.	Short term, minor negative
m) Any environmental problems associated with the disposal of waste? • The proposal is not likely to cause environmental problems associated with the disposal of waste	Nil

Factor	Impact
n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? • The proposal is not likely to result in increased demands on the resources which are or are likely to become in short supply.	Nil
o) Any cumulative environmental effect with other existing or likely future activities? • The proposal may result in cumulative adverse traffic impacts with other nearby future activities during construction, including the Moorebank Logistics Park. Mitigation measures to avoid or minimise these impacts are detailed in Section 7.2 • Once completed the proposal would result in improvement in the overall road network.	Short-term, minor negative Long term, moderate positive
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
q) Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1 Strategic plans relevant to the proposal which have been considered in this REF (refer to Section 2.1.1) include: • Future Transport Strategy 2056 • Greater Sydney Region Plan: A metropolis of three cities – connecting people • Western City District Plan • The Western Sydney City Deal • State Infrastructure Strategy 2018 to 2038: Building Momentum • NSW Freight and Ports Plan 2018 – 2038 • NSW Road Safety Plan 2021 – Towards Zero • Community Strategic Plan – Our Home, Liverpool 2027 • Local Strategic Planning Statement – Connected Liverpool 2040	Long term, moderate positive
r) Other relevant environmental factors In considering the potential impacts of this proposal all relevant environmental factors have been considered, refer to Chapter 6 of this assessment.	Short-term, minor negative Long term, moderate positive

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 the 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 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
a) Any impact on a World Heritage property?	Nil
b) Any impact on a National Heritage place?	Nil
c) Any impact on a wetland of international importance?	Nil
d) Any impact on a listed threatened species or communities? The proposal would require removal of about 8.82 hectares of native vegetation. This includes 0.96 hectares of PCT 835 – Cumberland riverflat forest, which is listed under the EPBC Act.	Minor
e) Any impacts on listed migratory species?	Nil
f) Any impact on a Commonwealth marine area?	Nil
g) Does the proposal involve a nuclear action (including uranium mining)?	Nil
h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land? The proposal would require Commonwealth land located south of the M5 Motorway. This area is within an industrial zoning and is required to for the upgrade between Moorebank Avenue and the ABB property. There is also a BioBanking site located in this area. More details about the acquisition are detailed in Section 3.6. Potential impacts have been evaluated in accordance with *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies Significant impact guidelines 1.2.*	Minor direct impacts

The proposal would be carried out on Commonwealth land (south of the M5 Motorway). In accordance with the *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies Significant impact guidelines 1.2* (Department of Sustainability, Environment, Water, Population and Communities 2013) consideration has been given to whether these activities have, would have, or is likely to have a significant impact on the environment. This is outlined in Table 10-1.

Table 10-1 Self-assessment for a significant impact on Commonwealth Land

Assessment step	Response
Step 1: Environmental Context	
a. What are the components of features of the environment in the area where the action will take place?	The vegetation to be impacted is part of a BioBanking site located south of the M5 Motorway at Moorebank. The site is 105.94 hectares in size. The area to be impacted is separated from the majority of land in the site and encompasses the Amiens Wetland.
b. Which components or features of the environment are likely to be impacted?	0.23 hectares of vegetation classified as PCT 835 Cumberland Riverflat Forest would be cleared.
c. Is the environment which is likely to be impacted, or are elements of it, sensitive or vulnerable to impacts?	This vegetation forms part of the TEC River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, listed as endangered under the BC Act and critically endangered under the BC Act
d. What is the history, current use and condition of the environment which is likely to be impacted.	The area surrounding Amiens Wetland was largely cleared in the early 20th century, with aerial photography from 1943 showing the area to be lacking woody vegetation except for a few small trees fringing the water body. The current vegetation is primarily regrowth since that time. The area is currently managed for conservation under BioBanking Agreement 341.
Step 2: Potential Impacts	
a. What are the components of the action?	0.23 hectares of vegetation would be completely removed to facilitate construction of the proposal, with a shared user path proposed for construction in the area.
b. What are the predicted adverse impacts associated with the action including indirect consequences?	The primary adverse impact is vegetation clearing, reducing the extent of a TEC. The vegetation may also provide habitat for threatened fauna species. The clearing also poses a risk of runoff of sediments contaminants into Amiens Wetland, which would be managed by standard control measures for construction activities.
c. How severe are the potential impacts?	Vegetation in the impact area would be permanently removed, however this area is

Assessment step	Response
	very small and in poor condition relative to the size of the patch of vegetation.
d. What is the extent of uncertainty about potential impacts?	Vegetation clearing impacts are certain to occur. Given the area was previously cleared and marginal nature of the vegetation present, it is unlikely to support any threatened species. The vegetation is isolated from other patches of PCT 835 in the locality and would not be contributing to the genetic diversity of the local occurrence of the community. The site is currently fenced and vegetation within it would not be used by Koalas to aid movement in the area.
Step 3: Impact avoidance and mitigation	
Will any measures to avoid or mitigate impacts ensure, with a high degree of certainty, that impacts are not significant?	Vegetation clearing has been minimised to the extent possible within the design requirements of the proposal.
Step 4: Are the impacts significant?	
Considering all of the matters in steps 1 to 3 above, is the action likely to have a significant impact on the environment (confirmed against the significance criteria set out in these guidelines)?	The impacts of the proposal on the BioBanking site are not significant due to: • The small scale of the impacts in absolute terms and relative to the extent of PCT 835 within the locality • The disturbance history of the site • The limited value of the patch of PCT 835 vegetation to be impacted to the survival and recovery of the River-flat Eucalypt Forest TEC in the locality.

It is considered with a high degree of certainty that there would be very limited direct and indirect impacts on matters of national environmental significance and/or the environment of the Commonwealth land.

With reference to *Actions on, or impacting upon, Commonwealth land,* and *Actions by Commonwealth agencies Significant impact guidelines 1.2 (*Department of Sustainability, Environment, Water, Population and Communities 2013) the proposal is considered unlikely to have a significant impact on matters of national environmental significance and/or the environment of Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of the Climate Change, Energy, the Environment and Water.

Appendix B

Statutory consultation checklists

Transport and Infrastructure SEPP

Certain development types

Development type	Description	Yes/No	If 'yes' consult with	SEPP section
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No	Liverpool City Council	s2.112
Bus Depots	Does the project propose a bus depot?	No	Liverpool City Council	s2.112
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	Liverpool City Council	s2.112

Development within the Coastal Zone

Issue	Description	Yes/No /NA	If 'yes' consult with	SEPP section
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	Liverpool City Council	s2.14

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 section**
Stormwater	Is the work likely to have a *substantial* impact on the stormwater management services which are provided by council?	Yes	Liverpool City Council	s2.10 (1)(a)

Issue	Potential impact	Yes/No	If ‘yes’ consult with	ISEPP section
Traffic	Is the work likely to generate traffic to an extent that will *strain* the capacity of the existing road system in a local government area?	No	Liverpool City Council	s2.10(1)(b)
Sewerage system	Will the work involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No	Liverpool City Council	s2.10(1)(c)
Water usage	Would the work involve connection to a council owned water supply system? If so, would this require the use of a *substantial* volume of water?	No	Liverpool City Council	s2.10(d)
Temporary structures	Would the work 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, would this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No	Liverpool City Council	s2.10(e)
Road & footpath excavation	Would the work involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads	Yes	Liverpool City Council	s2.10(f)

Issue	Potential impact	Yes/No	If ‘yes’ consult with	ISEPP section
	authority and responsible for maintenance?			

Local heritage items

Issue	Potential impact	Yes/No	If ‘yes’ consult with	SEPP section
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 work? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than *minor* or *inconsequential?*	No	Liverpool City Council	s2.11

Flood liable land

Issue	Potential impact	Yes/No	If ‘yes’ consult with	SEPP section
Flood liable land	Is the work located on flood liable land? If so, would the work change flood patterns to more than a *minor* extent?	Yes	Liverpool City Council	s2.12
Flood liable land	Is the work located on flood liable land? (to any extent). If so, does the work comprise more than minor alterations or additions to, or the demolition of, a building, emergency work or routine maintenance	Yes	State Emergency Services Email: erm@ses.nsw.gov.au	s2.13

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	SEPP section
National parks and reserves	Is the work adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act?	No	Environment, Energy and Science, DPE	s2.15(2)(a)
National parks and reserves	Is the work 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, DPE	s2.15(2)(b)
Navigable waters	Do the works comprise of a fixed or floating structure in or over navigable waters	No	Transport for NSW	s2.15(2)(c)
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	Property NSW	s2.15(2)(d)
Defence communications buffer land	Is the work on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.	No	Secretary of the Commonwealth Department of Defence	s2.152)(h)
Mine subsidence land	Is the work on land in a mine subsidence district within the meaning of the *Mine Subsidence*	No	Mine Subsidence Board	s2.15(2)(i)

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP section
	Compensation Act 1961?			

Appendix C

Noise and Vibration Assessment

Appendix D

Traffic and Transport Impact Assessment

Appendix E

Hydrology and Flooding Assessment

Appendix F

Surface water and Groundwater Assessment

Appendix G

Preliminary Site Investigation and Landfill Gas Assessment

Appendix H

Biodiversity Assessment Report

Appendix I

Aboriginal and Non-Aboriginal Heritage Impact Assessment

Appendix J

Landscape Character and Visual Impact Assessment

Appendix K

Socio-economic Impact Assessment

Appendix L

Climate Risk Assessment