Intersection upgrade at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive, Bella Vista

Review of Environmental Factors

August 2020 | Version: 3

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Executive summary

The proposal

Transport for NSW proposes to upgrade the existing roundabout at the intersection of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive to a signalised intersection (the proposal).

Key features of the proposal include:

- Widening of Norwest Boulevard from two lanes to three lanes in each direction, from its intersection with Old Windsor Road, to 250 metres east of Lexington Drive (to the pedestrian underpass)
- Removal of the existing roundabout at the intersection of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive, and construction of a new four-way signalised intersection allowing all left and right turn movements
- Adding new right turn capacity to each leg of the intersection, as follows:
  - One dedicated right turn lane from Norwest Boulevard eastbound to Elizabeth Macarthur Drive southbound
  - Two dedicated right turn lanes from Norwest Boulevard westbound to Lexington Drive northbound
  - Two dedicated right turn lanes from Elizabeth Macarthur Drive northbound to Norwest Boulevard eastbound
  - Two dedicated right turn lanes from Lexington Drive southbound to Norwest Boulevard westbound
- Providing a single dedicated left turn lane on each leg of the intersection
- Widening of Lexington Drive from one to two lanes in each direction between Norwest Boulevard and the existing roundabout at Irvine Place / Woolworths Way.
- Provision of new pit and pipe drainage and reconnection to the existing stormwater drainage network
- Provision of retaining walls along Norwest Boulevard and Lexington Drive proposed road boundary to limit the extent of earthworks and property impacts.
- New landscaping along the modified median (where feasible) and verge to restore the character of the existing landscaping in Norwest Boulevard.
- Linking the proposed shared paths to the existing shared path on Norwest Boulevard near Old Windsor Road and at the pedestrian underpass
- Utility protections, adjustments and relocations.

Construction of the proposal is proposed in six stages. Subject to approval, construction is expected to commence in August 2023 and would take about 20 months to complete (weather permitting).

Need for the proposal

Norwest Boulevard in Bella Vista is a pivotal travel route between the M7 Motorway and Castle Hill, and provides access to the Norwest Business Park. The existing roundabout intersection at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive is currently experiencing large volumes of traffic and congestion.

In 2017, traffic signals were installed at the roundabout to assist in alleviating congestion. While this work has improved journey reliability and travel times, the upgrade to traffic signal was only a short term solution.

Transport for NSW was tasked with investigating the upgrade of the existing roundabout intersection in response to:

- Extensive congestion and delays during the weekday morning and afternoon peaks at the intersection causing queues to extend on the M7 Motorway off ramp, the Old Windsor Road interchange, Greenhill Drive and Woolworths Way
- The intersection operates poorly for extended periods

Pedestrian safety issues when crossing the road particularly when accessing nearby bus stops. In addition to the above factors, development of the Sydney Metro Northwest is stimulating investment and growth along the rail corridor, with areas surrounding the proposed metro stations becoming the focus for increased housing, economic activity and social infrastructure. While it is recognised that the Sydney Metro encourages a modal shift towards the use of public transport, the level of development will nevertheless place increased pressure on the surrounding road network, and on the capacity of the intersection.

The proposal is within Bella Vista Station Precinct, which was nominated as a Priority Precinct in the Sydney Metro Northwest Priority Urban Renewal Corridor under the North West Rail Link Corridor Strategy (TfNSW, Department of Planning and Infrastructure, 2013). The Priority Precincts program aims to provide new housing, jobs and deliver infrastructure to support the growth. The Bella Vista Station Precinct Finalisation Report (Department of Planning and Environment, 2017) estimates that development in the area will provide:

- About 9,400 new jobs over the next 20 years
- Renewal and expansion of existing business areas in and around the Norwest Business Park, which already supports over 25,000 employees
- About 4,200 additional dwellings over the next 20 years.

The proposal would improve the efficiency of Norwest Boulevard at Lexington Drive/ Elizabeth Macarthur Drive intersection to cater for current and future travel demand in the corridor.

Proposal objectives

Proposal objectives

The objectives of the proposal are:

- Improve the efficiency of Norwest Boulevard at Lexington Drive/Elizabeth Macarthur Drive intersection to cater to current and future travel demand on the corridor
- Improve access and/or crossing opportunities for all road users between Norwest Boulevard and Lexington Drive/Elizabeth Macarthur Drive
- Improve road safety for all road users
- Improve network resilience on Norwest Boulevard to reduce impacts to other arterial roads such as the M7 Motorway and Old Windsor Road.

Options considered

The proposal considered three options, a ‘do nothing’ option (Option 1) and two upgrade options (Option 2 and Option 3). Both upgrade options involved replacing the existing roundabout with traffic signals, with Option 3 including an additional through lane in each direction at the intersection.

These options were evaluated against criteria to assess which option best met the proposal objectives. The assessment criteria included traffic performance, road safety, costs, constructability and environmental impacts ad urban design (eg sensitive integration of the proposal into the landscape).

Option 3 was selected as the preferred option as it best addresses the traffic and safety issues along Norwest Boulevard between the M7 Motorway and Castle Hill. While Option 2 provides operational benefits until 2026, these benefits would erode beyond this year and further investment would be required to provide additional traffic capacity. Option 3 provides sufficient operational capacity for the area until (and possibly beyond) 2036.

Statutory and planning framework

Clause 94 of the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

The proposal is for a road and is to be carried out by Transport for NSW and 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.

Transport for NSW is the determining authority for the proposal. The proposal is not considered likely to have a significant impact on the environment and would not require the preparation of an environmental impact statement (EIS). This review of environmental factors (REF) has been prepared as part of the assessment process.

Community and stakeholder consultation

Transport for NSW has commenced consultation with the community and key stakeholders who have an interest or are likely to be impacted by the proposal.

Online surveys were sent to business owners and/or managers located around the proposal in January 2020 to better understand local business issues. Five businesses participated in the survey.

Due to the COVID-19 pandemic, no further community consultation has been carried out since March 2020. Consultation is expected to continue once pandemic restrictions are eased. .

The Hills Shire Council has been consulted about the proposal as per the requirements of clause 13(1) of ISEPP that is ‘Consultation with Councils – development with impacts on council-related infrastructure or services’. Transport for NSW has also consulted on an ongoing basis with stakeholders and government agencies including Hills Shire Council, McDonalds, ResMed, Woolworths Property Group, Norwest Association/Mulpha and bus operators to ensure stakeholder issues and concerns are understood, documented and addressed.

This REF will be placed on public display to provide the community with the opportunity to provide comment on the proposal. The community will be notified about the REF display through notifications delivered via mail, newspaper advertising, social media campaign, posters in community spaces, an email distribution to the database, and via the Transport for NSW website. Once the consultation period has closed, a consultation report would be collated and made available on the Transport for NSW website.

Environmental impacts

Detailed technical investigations have been carried out to identify, assess, manage and minimise the proposal's potential impacts. The following outlines the proposal's main impacts on the environment and surrounding community. The safeguards and mitigation measures identified in this REF would help minimise the expected adverse impact.

Traffic, transport and access

Construction activities would cause some disruptions to traffic along Norwest Boulevard, Lexington Drive and the surrounding network. This would be related to road and lane closures and construction vehicles using the local roads.

Construction impacts on traffic through the proposal area would be minimised through the staging of construction, allowing the existing road traffic capacity to be maintained throughout most construction activities. During construction, two operating traffic lanes in each direction of Norwest Boulevard would be maintained at all times, with all existing exit and entry movements maintained for impacted commercial and residential properties.

Bus stops and pedestrian traffic will be maintained during construction. Where necessary, temporary bus stops and safe alternative routes, including access to commercial and private property, would be provided with appropriate signage to direct commuters and pedestrians.

Once operational, the proposal would provide a substantial increase in intersection capacity of Norwest Boulevard at the Lexington Drive/Elizabeth Macarthur Drive intersection. In 2026, the average speed during the morning peak would improve substantially with the proposal, with the proposal showing an increase in speeds of 50 per cent from 25 kilometres per hour to over 37 kilometres per hour. In 2036, the proposal would improve the morning peak eastbound travel time by over eight minutes compared to the 'do nothing' scenario. During evening peak, the proposal would continue to provide travel time benefits in the westbound direction beyond 2026 to 2036.

Pedestrian and cycle facilities would also be improved by the proposal, with the introduction of signalised crossings on all four approaches to the Lexington Drive intersection.

Noise and vibration

Noise emissions from day and night-time construction works associated with the proposal were predicted to potentially exceed the applicable noise management levels at surrounding receivers. Surrounding receivers may also potentially be highly noise affected (ie greater than 75dB(A)). Further, based on a worst-case scenario about five residential receivers may be impacted by construction noise levels above the sleep disturbance threshold on nights when the noisiest construction activities occur.

Areas affected by construction noise have been identified using noise contour maps, and feasible and reasonable noise mitigation measures will implemented in accordance with the NSW Roads and Maritime Service's Construction Noise and Vibration Guideline to aid in reducing construction noise impacts such as specific notifications and respite periods.

Operational noise impacts to sensitive receivers adjacent to the project were assessed. Operational traffic noise levels from the proposed upgraded intersection are predicted to increase by up to 1.5 dB(A) at the nearest potentially affected residential receivers. As this increase is less than 2.0 dB(A), in accordance with NSW Roads and Maritime's Noise Criteria Guideline and Noise Mitigation Guideline, there is no requirement for any further operational noise mitigation measures.

Landscape character and visual impacts

Construction activities and potential ancillary facilities may result in temporary visual impacts on the existing landscape.

The impact assessment has assumed that the majority of the road side and median landscape are to be cleared. As such, once the proposal is operating there would be permanent changes in the landscape character and visual amenity of the upgraded section of Norwest Boulevard. These impacts would be mitigated through the implementation of an Urban Design and Landscape Plan, which would detail the new landscaping and re-vegetation requirements.

Biodiversity

The proposal would require the removal of 1.4 hectares of native tree landscape plantings (or about 185 planted trees). While these trees potentially provide marginal foraging habitat for native fauna , tests of significance concluded that they are unlikely to be important due to the relatively small area of potential habitat, and peak flowering in summer when resources for blossom-feeding species are generally more abundant in the local area. As such, threatened fauna species known to forage on these tree species are unlikely to be significantly affected.

Of the 1.4 hectares of native tree landscape plantings in the proposal area, there are 12 planted specimens of *Eucalyptus scoparia*, a threatened species. The removal of trees would be determined during detailed design and it is likely that many trees can be retained. The test of significance concluded that these trees are of little conservation significance to the species and the proposal is unlikely to result in a significant impact.

In addition to the 1.4 hectares of native tree landscape plantings, the proposal would also result in the loss of about 0.34 hectares of Shale Sandstone Transition Forest critically endangered ecological community listed under the NSW Biodiversity Conservation Act. The test of significance concluded that due to the very small impact on this ecological community and the poor quality of the vegetation to be removed there is unlikely to be a significant impact. Where feasible, the ancillary facilities would be located to minimise or avoid removal of Shale Sandstone Transition Forest.

A Construction Flora and Fauna Management Plan would be prepared in accordance with Transport for NSW's Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects and implemented as part of the Construction Environmental Management Plan (CEMP) in order to manage the impacts to biodiversity during the proposal's construction. The management plan would also include unexpected threatened species finds and fauna handling procedure and revegetation requirements.

Socio-economic, property and land use

Land uses surrounding the proposal area mainly comprise commercial or community uses, with residential uses limited to the eastern end of the proposal area. Therefore, impacts are generally expected to be minor given the small number of residences potentially impacted and the location of the residential uses relative to the proposed construction works.

During construction, potential impacts on local access and connectivity would generally be associated with increased construction traffic and temporary changes to road conditions such as reduced speed limits, temporary lane closures and diversions, and temporary access changes. The proposal would also permanently remove a total of 17 unrestricted on-road parking spaces.

The construction of the proposal would result in potential impacts to a number of businesses including ResMed headquarters, McDonalds, Woolworths and Shell service station development however impacts are anticipated to be minor and temporary.

The proposal would require property adjustments and partial property acquisitions (i.e. strip acquisition), from a small number of properties in both private and public ownership. In addition, the proposal would require the temporary lease of land for construction ancillary facilities. All property acquisition will be carried out in accordance with the Land Acquisition Information Guide, the *Land Acquisition (Just Terms Compensation) Act 1991* and the NSW Government Land Acquisition Reform 2016.

A Communication Plan would be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction.

During operation, the proposal has the potential for both regional and local benefits in the medium to longer term through improved access and connectivity between the M7 Motorway and Castle Hill, improved access to the Norwest Business Park, reduced traffic congestion, reduced travel times and improved road safety for all users and pedestrians.

Non-Aboriginal Heritage

A Statement of Heritage Impact was prepared to assess the impact of the proposal on two non-Aboriginal heritage items located within the proposal area:

- Old Windsor Road is listed on the Roads and Maritime s170 State agency heritage register (No. 4301011) and the Hills LEP (ID A2)
- Bella Vista Farm is listed as an item of local significance on the Hills LEP, of state significance on the State Heritage Register, and is also listed on the non-statutory Register of the National Estate.

The proposal involves the acquisition of between one and 20 metres of the curtilage of the Bella Vista Farm along Norwest Boulevard for approximately 230 metres from its junction with Elizabeth Macarthur Drive. In addition, two potential (temporary) ancillary facility sites are proposed within the northern portion of the curtilage adjacent to Norwest Boulevard.

The assessment concluded that the proposal has the potential to impact on a number of heritage components associated with Bella Vista Farm including remnant native woodland, driveways, pasture, replica post and rail fencing, views and curtilage, and archaeologically sensitive soils located on this land.

Any work within the state-listed heritage curtilage of the Bella Vista Farm, including acquisition and the installation of an ancillary facility, would need to be the subject of an application under section 60 of the *Heritage Act 1977*, for a permit to carry out development that will directly affect an item of listed state heritage significance.

The proposal also extends to the intersection with Old Windsor Road at the western extent of works however no impacts are anticipated to any key elements.

A Non-Aboriginal Heritage Management Plan would be prepared and implemented as part of the CEMP. It would provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage, including awareness training and protection for significant trees, important driveways, pastures, vistas and replica post and rail fencing.

There would be no impacts to non-Aboriginal heritage or archaeology once the proposal is operational.

Aboriginal cultural heritage

The wider study area contains evidence of past Aboriginal occupation and behaviour in the form of low-density artefact scatters.

Construction and operation of the proposal is unlikely to impact on any Aboriginal archaeological objects, sites or potential archaeological deposits due to the highly disturbed and urbanised nature of the proposal area. Potential impacts to non-Aboriginal heritage

would be managed through the implementation of Transport for NSW's Unexpected Finds Procedure (Roads and Maritime Services 2013).

Cumulative impacts

The proposal is not expected to start construction until 2023, consequently cumulative traffic and transport impacts are difficult to predict. The study area and wider north western Sydney region are undergoing substantial ongoing growth and development and it is likely that there would be some localised impacts associated with traffic and delays.

The number and scale of new developments identified in the study area demonstrate the increased volume of traffic that can be expected in the area in the coming years. The proposal would contribute to improved traffic flows and reduced travel times across the region, as well as improved network resilience on Norwest Boulevard.

A Consultation Plan will be prepared for the proposal and include requirements for consultation with the proponents of any surrounding proposed developments relevant at the time of construction to coordinate with nearby construction programs and methodologies.

Justification and conclusion

The proposed intersection upgrade at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive is subject to assessment under Division 5.1 of the EP&A Act. This 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 (as relevant) of conservation agreements and plans of management under the *National Parks and Wildlife Act 1974* (NPW Act), biodiversity stewardship sites under the *Biodiversity Conservation Act 2016* (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 Commonwealth *Environment Protection and Biodiversity Conservation Act 1998* (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 proposal objectives but would still result in some impacts on biodiversity, visual amenity, land use, potential impacts on non-Aboriginal heritage, and socio-economic impacts.

Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve the efficiency of Norwest Boulevard at the Lexington Drive/Elizabeth Macarthur Drive intersection to cater for current and future travel demand on the corridor, improve access, crossing opportunities and road safety for all road users and improve road network resilience on Norwest Boulevard to reduce impacts to other arterial roads such as the M7 Motorway and Old Windsor Road. On balance the proposal is considered justified.

Display of the review of environmental factors

This REF is on display for comment between Monday 9th November 2020 and Friday 4th December 2020. 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://www.rms.nsw.gov.au/projects/norwest-boulevard-bella-vista

Copies by request

Printed and electronic copies are available by contacting 1800 577 277, noting that there may be a charge for hard copies, CD or USB.

How can I make a submission

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

Norwest Boulevard Upgrade Project Team, Roads and Maritime Services,

PO Box 973, Parramatta NSW 2124

Or by email:

norwestboulevardupgrade@transport.nsw.gov.au.

Submissions must be received by Friday 4th December 2020. Submissions would be managed in accordance with the Transport for NSW Privacy Statement which can be found https://www.transport.nsw.gov.au/about-us/transport-privacy or by contacting 1800 577 277 for a copy.

What happens next

Transport for NSW would collate and consider the submissions received during public display of the REF. After this consideration, Transport for NSW would determine whether or not the proposal should proceed as proposed and would inform the community and stakeholders of this decision. If the proposal is determined to proceed, Transport for NSW would continue to consult with the community and stakeholders prior to and during construction.

Contents

1 Introduction

This chapter introduces the proposal and provides the context of the environmental assessment.

1.1 Proposal identification

Norwest Boulevard is currently a four-lane divided carriageway with a wide central landscaped median. It has four roundabouts and one signalised intersection over its 3.5 kilometre length from the M7 Motorway in the west, to Windsor Road in the east. The roundabout of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive is the closest intersection to the M7 Motorway and Old Windsor Road.

Transport for NSW proposes to upgrade the existing roundabout at the intersection of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive (herein referred to as 'the intersection') to a signalised intersection.

The intersection currently experiences extended periods of congestion, most notably during morning and afternoon peak times causing queues to extend to the M7 Motorway off ramp, the Old Windsor Road interchange, Greenhill Drive and Irvine Place. Pedestrians also encounter a safety issue when crossing the road to access bus stops surrounding the intersection.

The proposal would improve the efficiency, performance and safety of the intersection. Key features of the proposal would include:

- Widening of Norwest Boulevard from two lanes to three lanes in each direction, from its intersection with Old Windsor Road, to 250 metres east of Lexington Drive (to the pedestrian underpass)
- Removal of the existing roundabout at the intersection of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive, and construction of a new four-way signalised intersection allowing all left and right turn movements
- Adding new right turn capacity to each leg of the intersection, as follows:
  - One dedicated right turn lane from Norwest Boulevard eastbound to Elizabeth Macarthur Drive southbound
  - Two dedicated right turn lanes from Norwest Boulevard westbound to Lexington Drive northbound
  - Two dedicated right turn lanes from Elizabeth Macarthur Drive northbound to Norwest Boulevard eastbound
  - Two dedicated right turn lanes from Lexington Drive southbound to Norwest Boulevard westbound
- Providing a single dedicated left turn lane on each leg of the intersection
- Widening of Lexington Drive from one to two lanes in each direction between Norwest Boulevard and the existing roundabout at Irvine Place/Woolworths Way
- Provision of new pit and pipe drainage and reconnection to the existing stormwater drainage network
- Provision of retaining walls along Norwest Boulevard and Lexington Drive proposed road boundary to limit the extent of earthworks and property impacts

- New landscaping along the modified median (where feasible) and verge to restore the character of the existing landscaping in Norwest Boulevard
- Linking the proposed shared paths to the existing shared path on Norwest Boulevard near Old Windsor Road and at the pedestrian underpass
- Utility protections, adjustments and relocations.

The proposal is located in the suburb of Bella Vista, which is within The Hills Shire local government area (LGA), about 26 kilometres northwest of the Sydney Central Business District. The location of the proposal is shown in **Figure 1-1** and an overview of the proposal is provided in **Figure 1-2**. The proposal would also include four potential (temporary) ancillary facilities, one located within the boundary of the ResMed facilities, two located on the Bella Vista Farm Park and one located to the east of the study area off Westwood Way (refer to **Section 3.4**). Although the most likely scenario is that only one ancillary facility would be required for construction, the decision on which ancillary facility to progress would be made at the detailed design phase. Therefore the REF has assumed a worst-case scenario of all four ancillary facilities operating during construction.

The 'proposal area' refers to the area that may be directly or indirectly impacted by the proposal, and includes the land within a 10 metre buffer on either side of the road corridor in which construction activities would occur (refer to **Figure 1-2**). The proposal area boundary has been extended south along Elizabeth Macarthur Drive and east along Norwest Boulevard (beyond the extent of physical works) to allow for the excavation, transport and containment of fill materials within a single construction boundary. This extension allows for a variety of different remediation/management methods to be implemented to manage contaminated and potential contaminated fill material within the proposal area. This is discussed further in **Section 6.8**.

The proposal area includes Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive. Bella Vista Farm, which adjoins to the south east, is a state heritage listed recreational area that overlaps part of the study area. Commercial developments adjoin the north of the study area, including Woolworths Metro Norwest and the Woolworths Group Head Office, a McDonalds restaurant, Shell service station (under construction), and the Bella Vista Hotel. The ResMed corporate headquarters occupy the site adjoining to the south west.

The Norwest Metro Station to the east of the proposal and Bella Vista Metro Station to the north have been operational since May 2019. The metro line runs under part of Norwest Boulevard.

Chapter 3 describes the proposal in more detail.

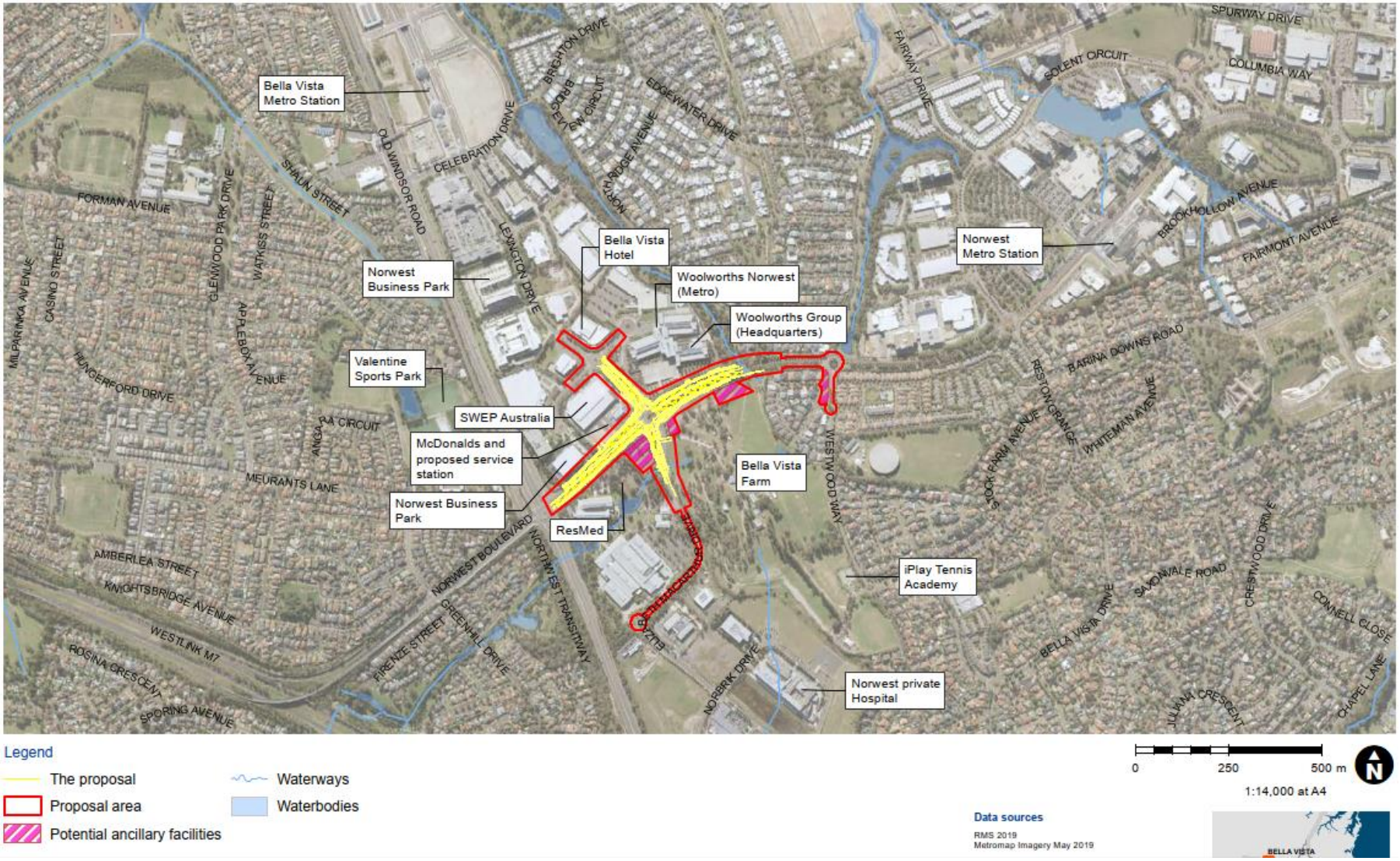


Figure 1-1 Location of the proposal

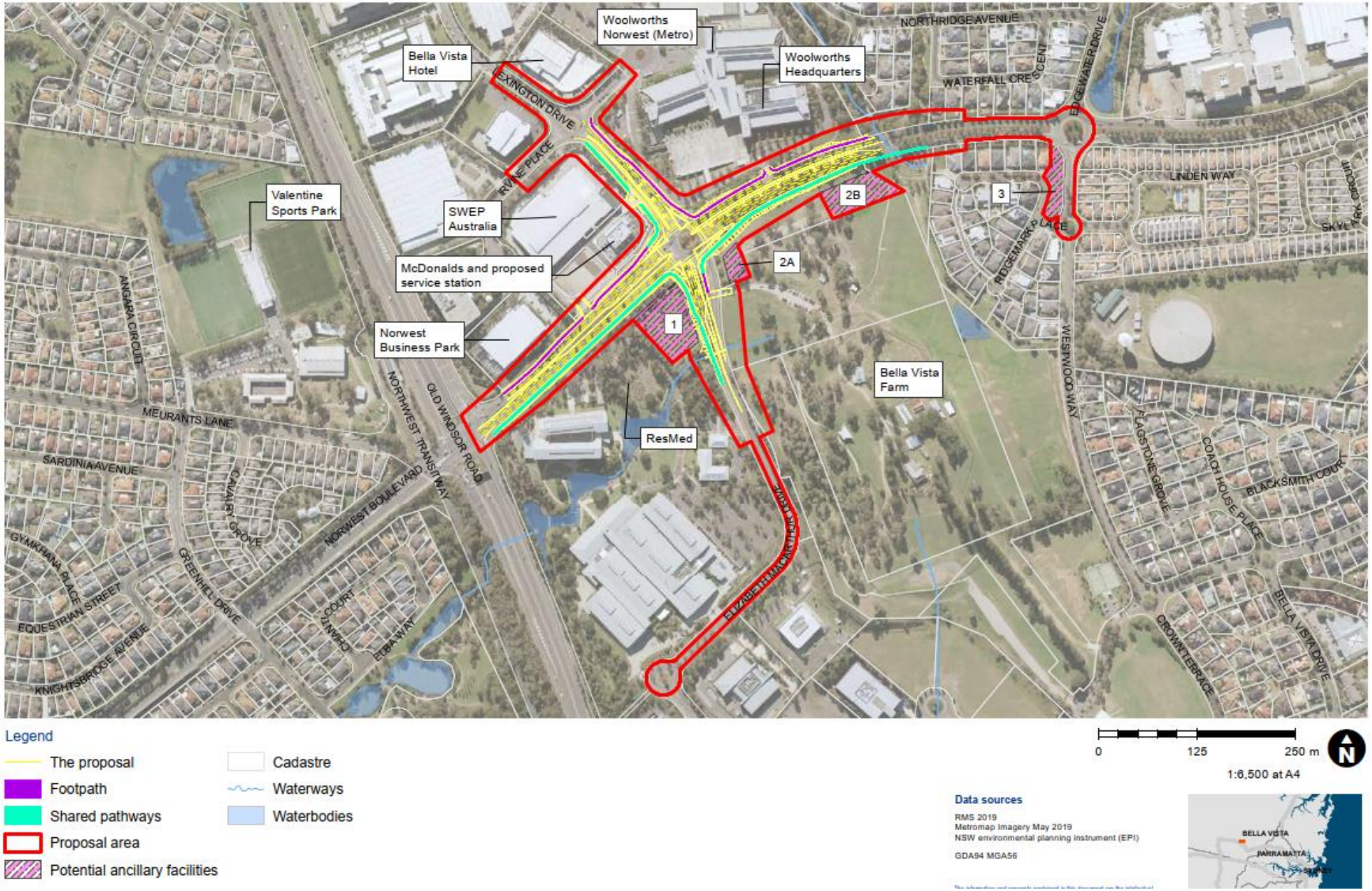


Figure 1-2 Overview of the proposal

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Jacobs 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 its likely impact on the environment, and to detail mitigation and management measures to be implemented.

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

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

- Section 5.5 of the EP&A Act including that 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 Australian Government under the EPBC Act in September 2015, with respect to the impacts of Transport for NSW 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 whether offsets are required and able to be secured
- The potential for the proposal to significantly impact any other matters of national environmental significance or the environment of Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

This chapter outlines the relationship of the proposal to the strategic planning framework. It also identifies the need for the proposal and the proposal objectives

2.1 Strategic need for the proposal

Norwest Boulevard in Bella Vista is a pivotal travel route between the M7 Motorway and Castle Hill, and provides access to the Norwest Business Park. The existing roundabout intersection at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive is currently experiencing large volumes of traffic and congestion, most notably during weekday peak times with commuters using Norwest Boulevard as an arterial road to connect from Old Windsor Road to the west and Windsor Road to the east, and to gain access to the Norwest Business Park.

In 2017, traffic signals were installed at the roundabout to assist in alleviating congestion. While this work has improved journey reliability and travel times, the addition of traffic signals was only a short-term solution.

Transport for NSW was tasked with investigating the upgrade of the existing roundabout intersection in response to:

- Norwest Business Park being highlighted as a centre of metropolitan significance
- Extensive congestion and delays during the weekday morning and afternoon peaks at the Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive roundabout causing queues to extend on the M7 Motorway off ramp, the Old Windsor Road interchange, Greenhill Drive and Woolworths Way
- The intersection operating poorly for extended periods
- Pedestrians confronting safety issues when crossing the road particularly when accessing the bus stops on:
  - Norwest Boulevard eastbound and westbound carriageways around 30 metres east of Lexington Drive and Elizabeth Macarthur Drive
  - Lexington Drive southbound carriageway 55 metres south of Woolworths Way
  - Elizabeth Macarthur Drive northbound carriageway 150 metres south of Norwest Boulevard.

Development of the Sydney Metro Northwest is stimulating investment and growth along the rail corridor, with areas surrounding the proposed metro stations becoming the focus for increased housing, economic activity and social infrastructure. While it is recognised that the Sydney Metro encourages a modal shift towards the use of public transport, the level of development will nevertheless place increased pressure on the surrounding road network, and on the capacity of the intersection.

The proposal is within the Bella Vista Station Precinct, which was nominated as a Priority Precinct in the Sydney Metro Northwest Priority Urban Renewal Corridor. The Priority Precincts program aims to provide new housing and jobs, and deliver infrastructure to support the growth.

The Bella Vista Station Precinct Finalisation Report (Department of Planning and Environment, 2017) estimates that development in the area will provide:

- About 9,400 new jobs over the next 20 years
- Renewal and expansion of existing business areas in and around the Norwest Business Park, which already supports over 25,000 employees
- About 4,200 additional dwellings over the next 20 years.

The proposal would support new development in the area by improving the efficiency and safety of the intersection. It would also support the movement and access needs of public transport, and improve the connectivity of the overall road network in and around the major employment area of the Norwest Business Park.

2.1.1 Consistency with relevant strategies and plans

The consistency of the proposal with relevant strategies and plans is summarised in the sections below.

2.1.1.1 NSW State Infrastructure Strategy 2018-2038

The NSW State Infrastructure Strategy, developed by Infrastructure NSW (Infrastructure NSW, 2018) is a 20-year strategy to build on the NSW Government's major long-term infrastructure plans over the last seven years and set out the government's infrastructure priorities for the next 20 years.

The strategy outlines the need for new infrastructure in the Greater Sydney region to manage the pressures of population growth and strengthen the region's competitive sectors. This is set out in the Greater Sydney Commission's vision to reshape and rebalance the city's structure, creating a metropolis of three cities.

2.1.1.2 Greater Sydney Region Plan – A Metropolis of Three Cities

The Greater Sydney Region Plan – A Metropolis of Three Cities (the Plan) (Greater Sydney Commission, 2018b) is built on a vision of three cities where most residents live within a 30 minute journey of their jobs, education and health facilities, and services. To meet the needs of a growing and changing population, the vision seeks to transform Greater Sydney into a metropolis of three cities: Western Parkland City, Central River City and Eastern Harbour City. The proposal is located in what the plan refers to as the Central River City.

One of the key roles of the Plan is to provide appropriate infrastructure in the right places to support the continued growth of Greater Sydney. The Plan also identifies the importance of investing in and delivering efficient and effective transport systems, including road infrastructure that would improve business to business connections and support the 30-minute city vision. Specifically, objective two of the Plan references the identification of areas that are forecasted for substantial growth and will require new and/or enhanced local and regional infrastructure to support growth.

2.1.1.3 Central City District Plan

As part of the Greater Sydney Region Plan, the Greater Sydney Commission also prepared District Plans which provide a basis for strategic planning at a district level. The Central City District Plan (Greater Sydney Commission, 2018a) sets out priorities and actions for Greater Sydney's Central City District, which includes the Hills Shire LGA where the proposal is located. The Central City District Plan addresses issues influencing Greater Sydney to 2056 with one of the overarching priorities for a productive Central City District including improved access to local jobs, goods and services within 30 minutes. The proposal complements this priority by improving the efficiency of the intersection and improving connectivity for employees accessing the Norwest Business Park.

2.1.1.4 NSW Long Term Transport Master Plan

The NSW Long Term Transport Master Plan (Transport for NSW, 2012a) identifies Norwest as a specialised precinct that should be expanded to develop employment and commercial opportunities within the North West. The need to provide connections into and between areas of growth across the North West is identified as a priority to enable travel from residential areas to commercial areas and vice versa. The proposal would support the objectives of this Plan by providing improved efficiency of the intersection and providing bus priority at the intersection to support operation of the local bus networks.

2.1.1.5 Future Transport Strategy 2056

The Future Transport Strategy 2056 (Transport for NSW, 2018a) is an update on the NSW Long Term Transport Master Plan and sets the 40-year vision, strategic directions and outcomes for customer mobility in NSW. The plan identifies the transport challenges that will need to be addressed to support NSW's economic and social performance over the next 20 years and establishes a number of short, medium and long-term actions to address those challenges. These actions provide the overall framework for how the NSW transport system should develop, in terms of services and infrastructure. The proposal would support this strategy by reducing congestion and improving network efficiency which supports growth, economic development and the mobility of services and labour.

2.1.1.6 North West Rail Link Corridor Strategy

The (then) Department of Planning and Environment and Transport for NSW, in consultation with relevant local councils and State government agencies, finalised the North West Rail Link Corridor Strategy in September 2013 (Transport for NSW and Department of Planning and Environment, 2013). The Corridor Strategy, which included Structure Plans for each station precinct, was prepared to integrate land use and transport planning to meet current and emerging challenges associated with future growth expected in the North West region.

When the Corridor Strategy was made, a local planning direction was issued by the Minister for Planning under Section 117 of the EP&A Act to require future planning in the precincts to be consistent with the Corridor Strategy, including the growth projections and future character of each station precinct.

The North West Rail Link Corridor is now known as the Sydney Metro Northwest Urban Renewal Corridor. The proposal is located within the Bella Vista Station Precinct and as such the proposal would need to be consistent with the North West Rail Link Corridor Strategy. The proposal would support the objectives of the Corridor Strategy by improving accessibility to the Norwest Business Park, which is identified as a major commercial hub of the North West. It would also support the improvement of public transport, and active transport options along Norwest Boulevard by providing a 3.5 metre wide bus queue jump lane on the eastbound carriageway at the intersection, shared paths along the south side of Norwest Boulevard, and the west side of Lexington Drive and Elizabeth Macarthur Drive, and new footpaths along the north side of Norwest Boulevard and east side of Lexington Drive and Elizabeth Macarthur Drive.

2.1.1.7 Bella Vista Station Precinct

The Bella Vista and Kellyville precincts will provide for around 10,400 new jobs and 8,400 new homes over the next 20 years. These precincts have been announced as Priority Precincts by the NSW Government, targeted to maximise the use of the Sydney Metro and other public transport infrastructure (Department of Planning and Environment, 2017).

The vision for the Bella Vista Precinct by 2036 is “a 21st Century Living and Business Precinct” which is guided by the following principles:

- Provision of a range of housing, employment and retail services close to transport connections and high quality open space
- Creation of an attractive, convenient and walkable local centre around the station, providing shops, cafes, restaurants, a village square and jobs
- Provision of a high quality, pleasant network of public, green open space areas including new local parks, riparian corridors and the existing Bella Vista Farm Park
- Expansion of employment and business opportunities through the revitalisation of the existing Norwest Business Park, and the creation of new business locations adjoining the station
- Delivery of more homes close to the station to meet growing demand, and increase housing choice to reflect changing household sizes and lifestyles
- Improving access and connections to the new station and throughout the precinct through new local roads, improved bus services, pedestrian and bicycle paths, and crossings over creek corridors
- Managing impacts on the natural environment including protection of remnant ecological communities in the creek corridors running through the precinct.

The proposal would contribute to the objectives of the precinct plan by upgrading an important intersection that will face increasing volumes of traffic in the future as the precinct plan is implemented.

2.1.1.8 NSW Road Safety Strategy 2012-2021

The NSW Road Safety Strategy 2012-2021 (Transport for NSW, 2012b) sets the direction of road safety in NSW. NSW is committed to reducing fatalities to less than 4.3 per 100,000 by 2016, together with at least a 30 per cent reduction in fatalities and serious injuries by 2021. The proposal supports this strategy by reducing crash, fatality and serious injury potential through improved intersection design, eliminating or shielding road users from roadside objects or from opposing vehicles and by considering pedestrians and bicycle riders.

2.1.1.9 Norwest Boulevard Upgrade – Long term Strategic Design ‘Scoping Study’

Urban Research and Planning (URAP), on behalf of Transport for NSW, have completed a strategic scoping study for the Norwest Boulevard corridor between the M7 Motorway and Windsor Road (URAP, 2015). The objectives of the corridor investigations were to:

- Identify its road reservation and urban design attributes
- Understand its future land use and transport planning context
- Develop cross-section options that consider potential road widening with current landscaping qualities
- Prepare a strategic design and cost estimate that would support further proposal development activities.

The proposal has been developed, as far as possible, in accordance with this scoping study to ensure it is consistent with the above objectives.

2.1.2 Limitations of existing infrastructure

The existing road network within the proposal area comprises of Norwest Boulevard for about 340 metres to the west and 260 metres east of the Lexington Drive/Elizabeth Macarthur Drive intersection. The road network within the proposal area also includes about 170 metres of Lexington Drive extending north from the intersection and 220 metres of Elizabeth Macarthur Drive extending south from the intersection. A description of the existing infrastructure within the proposal area is described in the following sections.

Norwest Boulevard

Norwest Boulevard is a state arterial route between the M7 Motorway to the west and Windsor Road to the east with a posted speed limit of 70 kilometres per hour. Norwest Boulevard is about 3.5 kilometres long about 30 metres wide, with four roundabouts and a signalised intersection along its length. The boulevard is a four lane divided carriageway with a nine metre wide central landscaped median (see **Figure 2-1, Figure 2-2** and **Figure 2-3**). Norwest Boulevard carries around 21,500 westbound vehicles and 15,000 eastbound vehicles per day, which comprises of three per cent heavy vehicles.

Norwest Boulevard provides the main access into the Norwest Business Park to the east, as well as to surrounding residential and commercial receivers. Norwest Boulevard also connects freight between Windsor Road and the M7 Motorway. Within the study area, access to the Woolworths Head Office is via the eastbound carriageway, with no direct access for westbound traffic.

There are pedestrian footpaths on both the eastbound and westbound sides of the road, which are 1.2 metres wide and extending the length of Norwest Boulevard. At the eastern extent of the study area, there is a public footpath (greenway link) providing access from Norwest Boulevard to residential properties on Waterfall Crescent and Cloverhill Grove.

There is one bus stop located on the eastbound side of Norwest Boulevard within the study area, with a dedicated bus layover area and shelter. There is one bus stop with a shelter on the westbound side of the road, located about 40 metres from the intersection. Buses operating on Norwest Boulevard within the study area include the 664, 715, 730, and 745.

One variable message sign (VMS) is located over the westbound side of the road, towards the western end of the study area. To the north of the carriageway is a new McDonalds and future service station (under construction; at the corner of Lexington Drive), the Woolworths Metro Norwest and the Woolworths Group Head Office, and to the south are the ResMed facilities and the recreational and heritage listed Bella Vista Farm.

Norwest Boulevard and its intersecting roads have been identified as having operational and safety issues. During peak hours average traffic speeds have been recorded at less than 46 kilometres per hour; well below the 70 kilometres per hour posted speed limit. This low average speed is due to substantial congestion on the corridor. The 1.8 kilometres long section between Greenhill Drive and Solent Circuit also has a poor crash history with 49 reported crashes between 2014 and 2018. A large number of new developments (both residential and commercial) are being planned within the Norwest Boulevard corridor. These developments will substantially increase traffic movements on Norwest Boulevard and on its intersecting roads, exacerbating existing efficiency and safety concerns.

In the eastbound direction (towards Norwest), the morning peak travel time along Norwest Boulevard is substantially longer than in the evening peak by around 5.5 minutes. During the critical peak hour, the difference was up to 11.5 minutes. In the westbound direction, travel times are similar in both the morning and evening peak periods. The Norwest Boulevard and Lexington Drive roundabout acts as a pinch point for eastbound traffic in the morning peak and for the westbound traffic during both peaks.

In the morning peak, the average travel time on Norwest Boulevard between the M7 Motorway and Lexington Drive (about one kilometre) is around seven minutes. In the westbound direction, between Solent Circuit and Lexington Drive (about 900 metres) the average travel time is over four minutes.

Between 2014 and 2018, a total of 49 crashes occurred along Norwest Boulevard between (and including) Solent Circuit and Greenhill Drive. Of the 49 crashes, 26 crashes resulted in injuries (no fatalities) and the remainder were non-casualty (damage only) crashes. The 26 crashes resulted in 30 casualties. Over one third (35 per cent) of the 49 crashes were rear-end collisions and 12 per cent of crashes occurred when changing lanes.

Figure 2-1 Existing roundabout, facing west

Figure 2-2 Landscaped median, facing west, to the east of the intersection

Figure 2-3 Westbound traffic, queuing at intersection during afternoon peak

Lexington Drive

Lexington Drive is a two-lane undivided carriageway which extends from Norwest Boulevard about 850 metres north to Celebration Drive. Lexington Drive carries about 6,100 southbound vehicles per day, comprising of three per cent heavy vehicles.

Lexington Drive is lined along both sides by corporate and commercial properties of the Norwest Business Park, such as the Sky City Business Park and Lexington Corporate business estate. There are commercial properties to the west, with some lots of vacant land awaiting development.

Within the study area, the Woolworths Group office complex is located to the east of Lexington Drive, with access provided via Norwest Boulevard and via Woolworths Way off Lexington Drive. There is access on the northbound side of Lexington Drive to the McDonalds restaurant and Shell service station site (under development) at 2-8 Lexington Drive.

There is one bus stop about 100 metres north of Norwest Boulevard on the southbound side of Lexington Drive, with no shelter or seating, which is serviced by the 745 bus route.

There is no on-street parking available in Lexington Drive between Norwest Boulevard and the roundabout at Irvine Place/Woolworths Way (see **Figure 2-4**). The only on street kerbside parking available in the proposal area is in Elizabeth Macarthur Drive, where on-street parking is unrestricted on both sides of the road, south of the driveway into Bella Vista Farm.

Traffic at Norwest Boulevard/Lexington Drive experiences delays during both morning and evening peak periods (see **Figure 2-5**). In the morning peak, the roundabout operates at level of service F (poorest performance criteria) with substantial delays and queues on both the Norwest Boulevard approaches.

Figure 2-4 Lexington Drive, facing south towards the intersection

Figure 2-5 Southbound traffic on Lexington Drive, queuing at intersection

Elizabeth Macarthur Drive

Elizabeth Macarthur Drive is a two-lane undivided carriageway which extends from Norwest Boulevard about 950 metres south to Norbrik Drive and carries about 3,000 northbound vehicles per day, comprising of three per cent heavy vehicles. Elizabeth Macarthur Drive provides access to the ResMed corporate headquarters on the western side, and Bella Vista Farm to the east. Norwest Private Hospital is located approximately 700 metres to the south of Norwest Boulevard and can be accessed from Elizabeth Macarthur Drive via Norbrik Drive.

Access to Bella Vista Farm is located within the study area on the southbound side of Elizabeth Macarthur Drive. There is one bus stop on the northbound side of Elizabeth Macarthur Drive within the study area, with no shelter or seating, which is serviced by the 664, 715 and 745 bus routes. Unrestricted on-road parking for about 17 vehicles is provided on both the northbound and southbound side of Elizabeth Macarthur Drive, see **Figure 2-7**.

Similar to Lexington Drive, in the afternoon peak, traffic on the westbound approach and the Elizabeth Macarthur Drive approaches experience substantial delays.

Figure 2-6 View looking north along Elizabeth Macarthur Drive

Figure 2-7 View looking south along Elizabeth Macarthur Drive. There is unrestricted on-street parking on both sides of the road

Norwest Boulevard and Lexington Drive/Elizabeth Macarthur Drive intersection

The existing intersection is a four-way roundabout, with two lanes in both the east and west directions along Norwest Boulevard, and a single lane in each of the north-south directions along Lexington Drive/Elizabeth Macarthur Drive. The roundabout has been designed and built to accommodate two lanes of through traffic in all directions, and Lexington Drive and Elizabeth Macarthur Drive widen to two lanes as they approach the roundabout.

Part time traffic signals are provided on two legs of the intersection to manage traffic flows during peak periods. The existing arrangement of this intersection is shown on **Figure 2-10**.

As described previously, the existing roundabout intersection at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive is currently experiencing large volumes of traffic and congestion, most notably during weekday peak times with commuters using Norwest Boulevard as an arterial road to connect from Old Windsor Road to the west and Windsor Road to the east, and to gain access to the Norwest Business Park. Existing queue lengths during morning and evening peaks are shown in **Figure 2-8** and **Figure 2-9**.

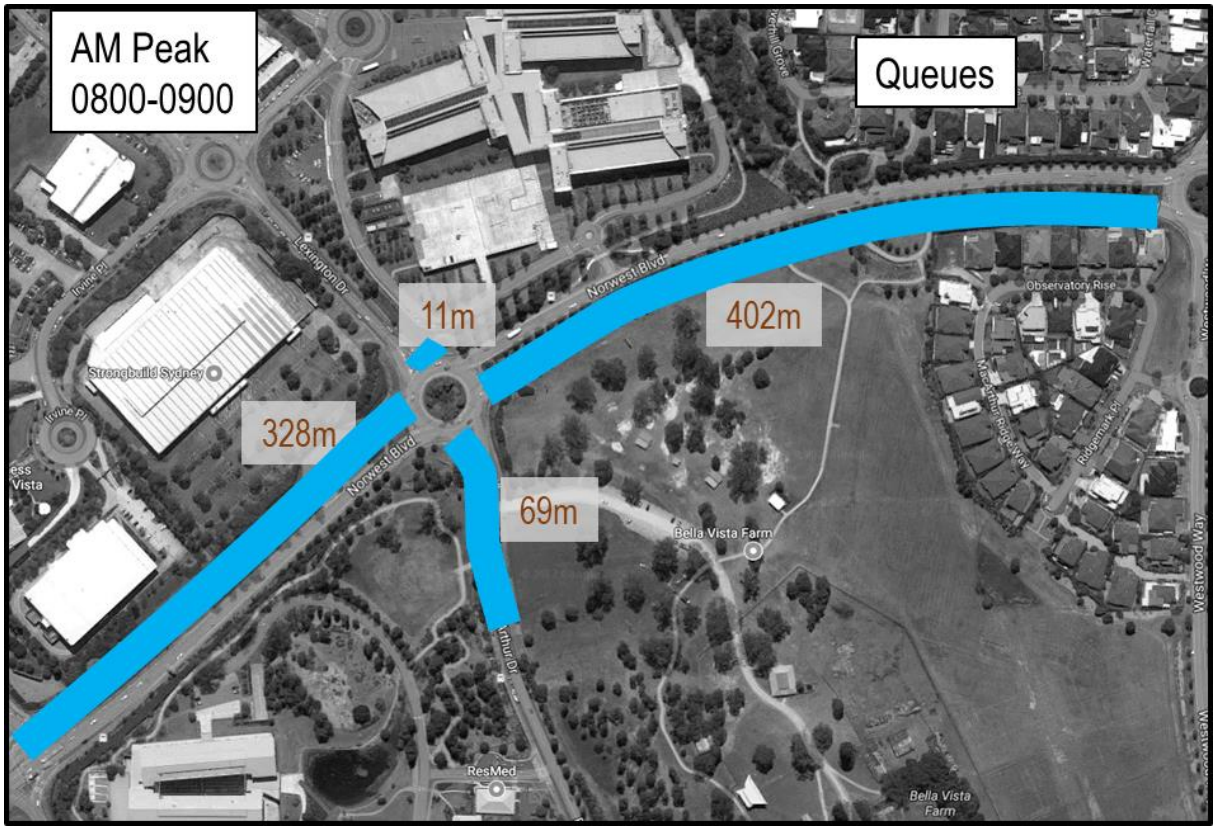


Figure 2-8 Morning peak queues at the Norwest Boulevard / Lexington Drive (Tract, 2020)

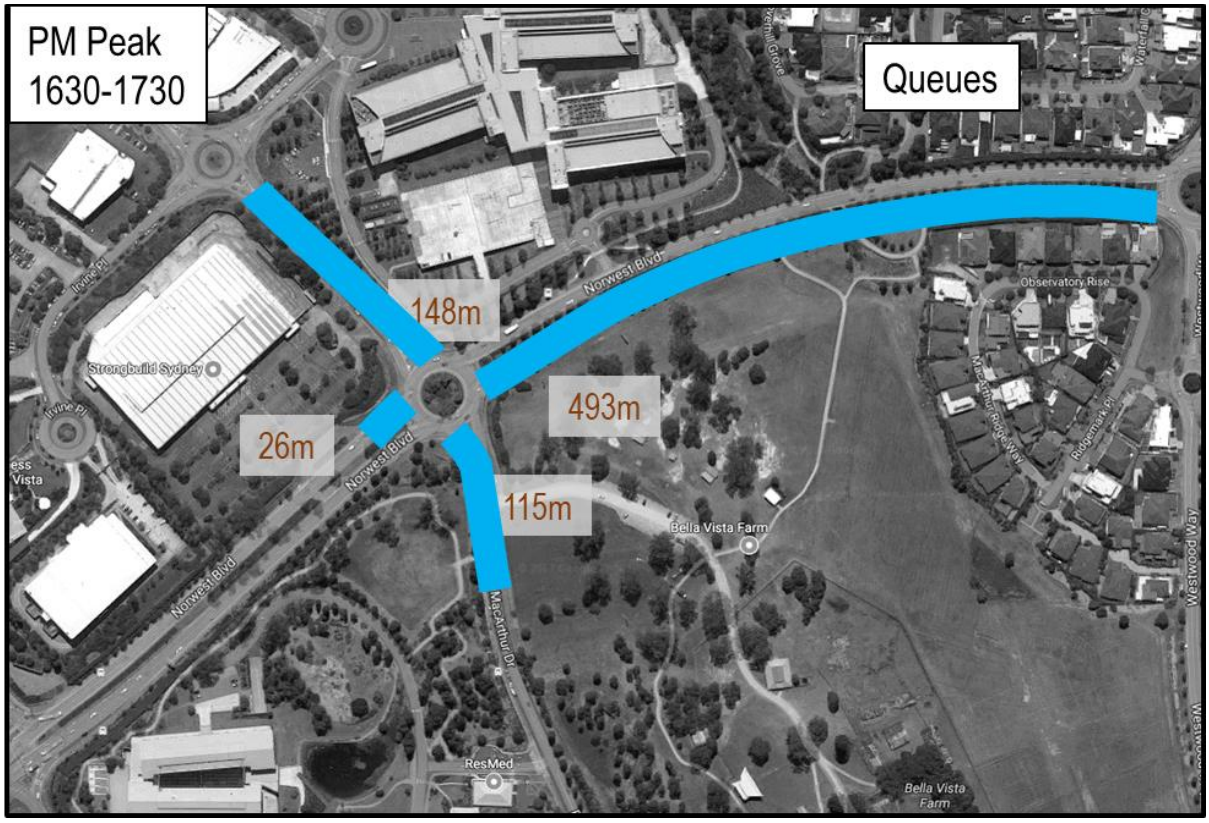


Figure 2-9 Evening peak queues at the Norwest Boulevard / Lexington Drive (Tract, 2020)

Figure 2-10 Existing road arrangement at Norwest Boulevard, Lexington Drive/Elizabeth Macarthur Drive intersection

2.2 Proposal objectives and development criteria

2.2.1 Proposal objectives

The objectives of the proposal include:

- Improve the efficiency of Norwest Boulevard at Lexington Drive/Elizabeth Macarthur Drive intersection to cater for current and future travel demand on the corridor
- Improve access and/or crossing opportunities for all road users between Norwest Boulevard and Lexington Drive/Elizabeth Macarthur Drive
- Improve road safety for all road users
- Improve network resilience on Norwest Boulevard to reduce impacts to other arterial roads such as the M7 Motorway and Old Windsor Road.

Supporting proposal objectives include:

- Manage environmental impacts during construction and operation of the proposal
- Deliver a value for money proposal.

2.2.2 Development criteria

The development and assessment of options was carried out to determine how well the options would perform in achieving the proposal objectives. The development criteria included consideration of:

- Network statistics
- Ability to service traffic demands
- Queue lengths on major arterial roads and side roads
- Provision of safe crossings for pedestrians and cyclists at intersections
- Provision of shared paths or active transport facilities
- Potential for road crashes
- Strategic costs
- Constructability, including requirement to maintain existing travel lanes during peak hours
- Environmental impacts.

2.2.3 Urban design objectives

Urban and landscape design objectives for the proposal include:

- Maintain the fundamental characteristics of the existing road corridor which signify the Norwest Business Park and the experience of the road user
- Enable the sensitive integration of the proposal into the landscape context
- Maximise safety of road and path users by ensuring adequate and safe pedestrian and cycle connectivity along and across the corridor
- Provide a robust and sustainable environment, which minimises maintenance and is safe to maintain.

The principles and objectives have responded to the landscape character and visual context of the study area (described in **Section 6.3.2**). Objectives have been developed to ensure the relationship between the proposal and the surrounding landscape character are adequately considered and addressed.

The objectives and how they relate to the design principles are discussed further in **Section 3.2.5.**

2.3 Alternatives and options considered

2.3.1 Methodology for selection of the preferred option

As part of the strategic design process, a number of options for the Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive intersection were developed.

In 2016, Transport for NSW undertook a strategic design for an upgraded intersection. As part of the strategic design process, a number of options for the intersection (four in total) were developed. The options were reviewed in a value management workshop and a preferred option, with equal widening on both sides with six lanes along Norwest Boulevard through the intersection, was selected to be progressed to concept design.

In 2017, Transport for NSW commenced the concept design however the proposal was placed on hold prior to completion of the 20 per cent concept design. Traffic signals were installed on the westbound and northbound approaches and activated during the morning peak hours, with the aim of assisting eastbound traffic on Norwest Boulevard to enter and clear the intersection, thereby minimising queue-back effects towards the M7 Motorway.

Since then two upgrade options have been considered for the Norwest Boulevard and Lexington Drive intersection, both options replacing the existing roundabout with a new signalised intersection. The identified options, analysis of options and preferred outcome are detailed in the following sections.

2.3.2 Identified options

Option 1 – Do Nothing

The ‘do nothing’ option involves undertaking no improvement works and retaining the existing intersection configuration between Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive.

Option 2 – Traffic signal upgrade

This option involves replacing the existing roundabout with a signalised intersection, with the following features (see **Figure 2-11**):

- Two lanes for through traffic in each direction on Norwest Boulevarde (existing)
- Two right turn lanes for Norwest Boulevarde westbound to Lexington Drive northbound
- One right turn lane for Norwest Boulevarde eastbound to Elizabeth Macarthur Drive southbound
- Two right turn lanes, one through lane and one left turn lane on the Lexington Drive and Elizabeth Macarthur Drive approaches Signalised pedestrian crossing facilities across all legs including slip lanes
- Signalised pedestrian crossing facilities on all four approaches of the Norwest Boulevard/Lexington Drive intersection substantially improving conditions for both pedestrians and cyclists. There would also be demand activated pedestrian crossings across the two left turn slip roads.

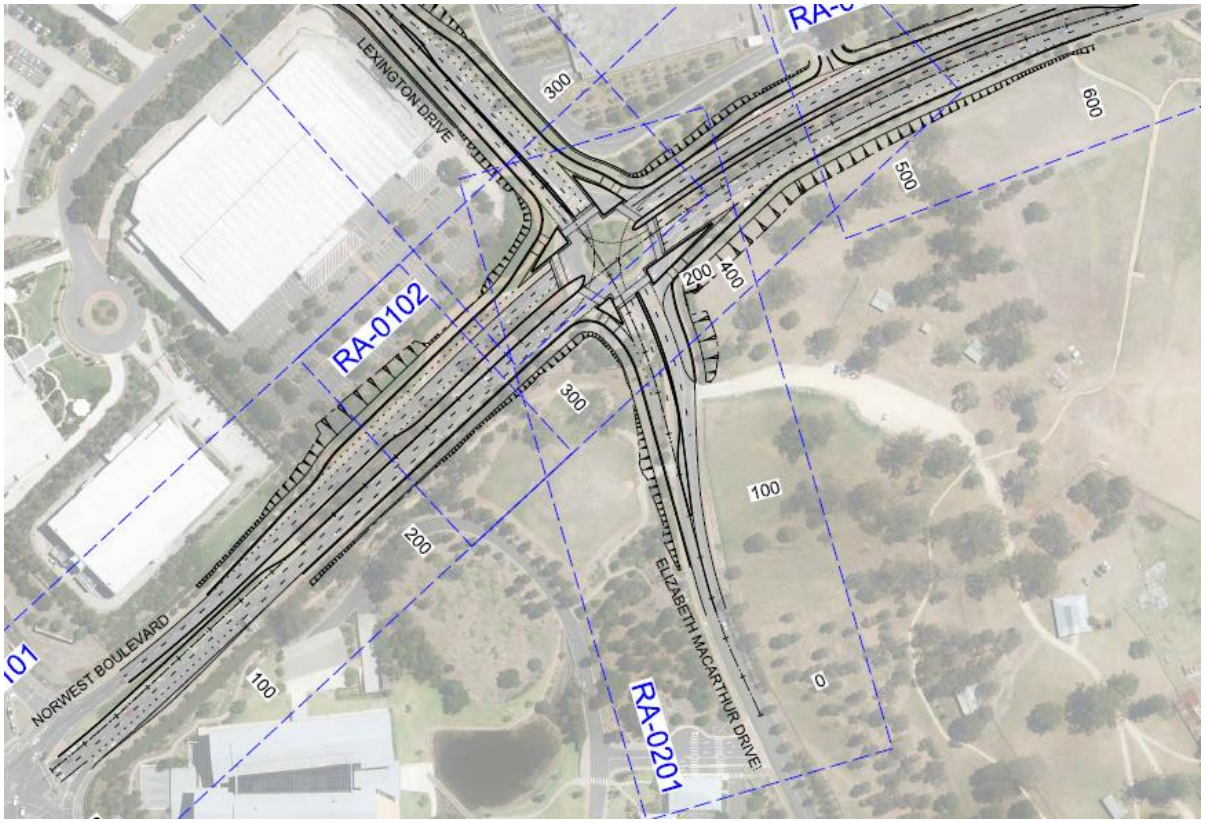


Figure 2-11 Traffic Signal Upgrade at Norwest Boulevard / Lexington Drive Intersection (Option 2)

Option 3 – Ultimate signalised intersection configuration (*Preferred option*)

This option would comprise the following (see **Figure 2-12**):

- Three lanes for through traffic in each direction on Norwest Boulevard
- Left turn slip lanes on all four corners of the intersection
- Two right turn lanes from Norwest Boulevard westbound into Lexington Drive northbound
- One right turn lane from Norwest Boulevard eastbound to Elizabeth Macarthur Drive southbound
- Three traffic lanes on the Lexington Drive and Elizabeth Macarthur Drive approaches
- Signalised pedestrian crossing facilities on all four approaches of the Norwest Boulevard/Lexington Drive intersection substantially improving conditions for both pedestrians and cyclists. There would also be demand activated pedestrian crossings across the two left turn slip roads.
- A shared path on the southern side of Norwest Boulevard and on the western side of Lexington Drive
- Five new sections of retaining wall.

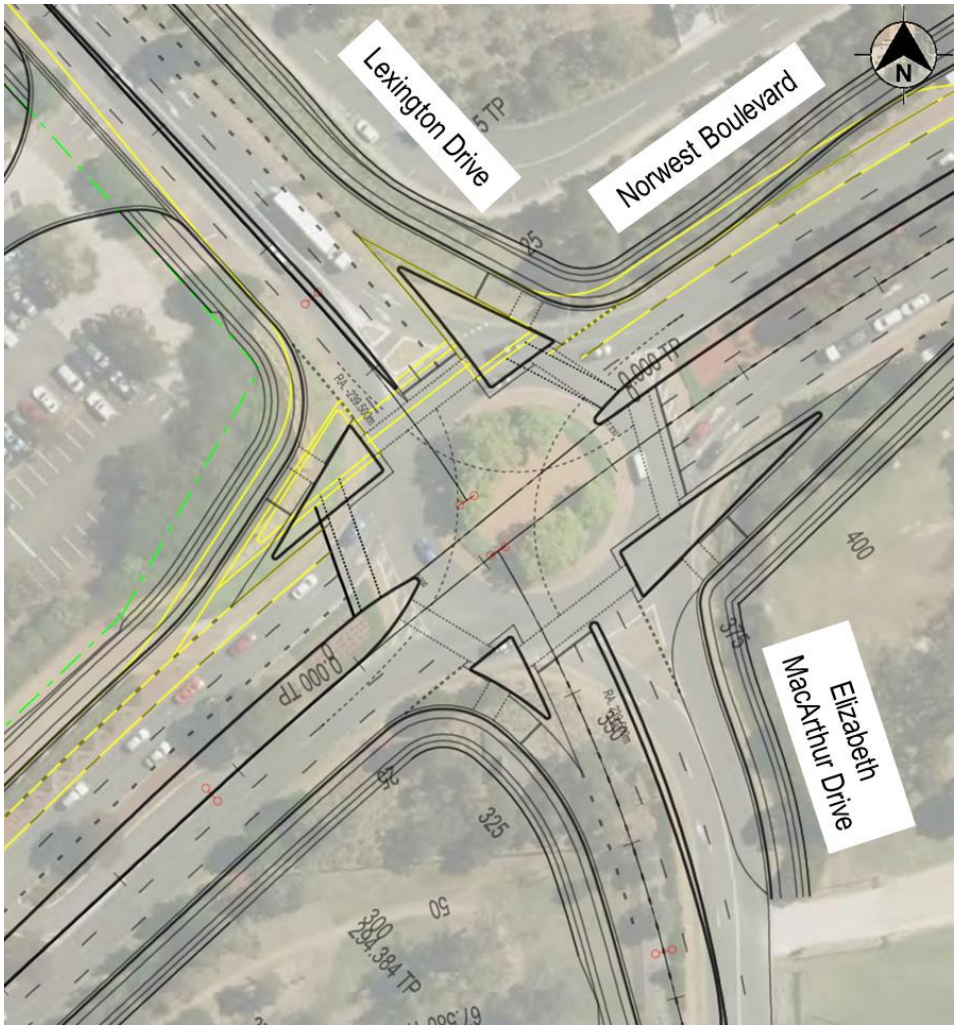


Figure 2-12 Ultimate Upgrade of Norwest Boulevard / Lexington Drive Intersection (Option 3)

2.3.3 Analysis of options

The potential benefits and impacts of each option on traffic and transport were assessed in the Traffic Impact Assessment (Bitzios Consulting, 2020), which is provided in **Appendix D**. The traffic assessment identified the following impacts for Option 1 'Do nothing' (discussed further in **Section 6.1.3.2**):

- Many of the key intersections on Norwest Boulevard, including the Lexington Drive and Edgewater Drive intersections, operate poorly in 2026 and 2036 with substantial delays.
- During 2026 morning peak, a substantial increase in eastbound travel time (over four minutes) is forecast between the M7 Motorway and Lexington Drive. A substantial increase in travel time (over nine minutes) is also forecast in the evening peak between Solent Circuit and Lexington Drive.
- Modelling demonstrates that the network is at capacity at 2026, therefore, there is very little capacity for the additional 2036 traffic during both peak periods. The majority of additional 2036 traffic would not be able to access the corridor.
- In 2026 and 2036 the road network would not service a substantial proportion of the traffic generated by the eastern zones including Norwest Boulevard (east of Edgewater Drive), Edgewater Drive and Westwood Way due to capacity constraints at the Edgewater Drive roundabout

- During the 2026 morning peak, queues along Norwest Boulevard eastbound extend over two kilometres from the Lexington Drive roundabout back beyond the Old Windsor Road intersection and up to the M7 Motorway. This queue also delays traffic on the Old Windsor Road southbound off-ramp turning left into Norwest Boulevard, resulting in queueing all the way back to the main carriageway.
- During both 2026 peak periods, queues along Norwest Boulevard westbound extend from the Lexington Drive roundabout to Solent Circuit (about one kilometre long). This delays traffic and causes queuing on all approaches to the Lexington Drive/ Elizabeth Macarthur Drive and Edgewater Drive/Westwood Way roundabouts.
- During the 2026 evening peak, queues from traffic turning right from the Old Windsor Road northbound off-ramp into Norwest Boulevard extend back to the main carriageway (over 800 metres) impeding through traffic on Old Windsor Road
- During the 2026 evening peak, queues along Elizabeth Macarthur Drive northbound extend from the Lexington Drive roundabout to south of Elizabeth Macarthur Drive roundabout (toward Norbrik Drive), causing substantial delays

The traffic assessment compared the proposed upgrade options (Option 2 and Option 3) against the 'do nothing' scenario (Option 1). A summary of the assessment is provided in the following sections.

Intersection performance

Intersection performance for 2026 and 2026 under Option 2 and Option 3 scenarios is shown in **Table 6-5**. The key findings are:

- The intersection performance would improve under both Option 2 and 3 when compared to 'do nothing' scenario (Option 1)
- The Option 3 layout has substantial spare capacity and hence a longer practical life than Option 2. Option 2 would reach capacity soon after 2026
- While the proposed upgrade at the Lexington Drive intersection (Option 2 and Option 3) would substantially improve intersection capacity, the constraints associated with the limited capacity of the Edgewater Drive roundabout would limit the performance of the study section. Therefore, upgrades at the Norwest Boulevard intersection with Edgewater Drive would be critical to servicing the 2026 and 2036 demand traffic within the corridor.

Travel times

The traffic modelling forecasted the following conditions for 2026:

- During the morning peak, eastbound travel time would be substantially reduced (by over eight minutes) with both Option 2 and 3. The reduction in travel time is associated with the increased intersection throughput. This suggests that delays and queues associated with the Lexington Drive roundabout 'pinch point' would be substantially reduced. The assessment identified a substantial improvement in the eastbound travel time between M7 Motorway and Greenhill Drive.
- Both Option 2 and 3 would also reduce the evening peak westbound travel time when compared to the 'do nothing' scenario (Option 1). The reduction is mainly associated with the substantial improvement in travel time between Edgewater Drive and Lexington Drive. This is due to capacity improvements at the Lexington Drive intersection.

- The average speed during the morning peak would improve substantially with both Option 2 and Option 3 with both options showing an increase in speeds of 50 per cent from 25 kilometres per hour to over 37 kilometres per hour.

The traffic modelling forecasted the following conditions for 2036:

- Option 3 would improve the morning peak eastbound travel time by over eight minutes compared to the 'do nothing' scenario (Option 1). Under the Option 2 scenario, there would be improvements in travel time in 2026 (about four minutes) when compared to the 'do nothing' scenario (Option 1). However, if no other network upgrades are implemented between 2026 and 2036, the reduction in the 2026 morning peak eastbound travel time would erode and by 2036, travel times would return to 2017 levels.
- During evening peak, both Option 2 and Option 3 would continue to provide travel time benefits in the westbound direction beyond 2026 to 2036. Both options are however influenced by limitations at the Edgewater Drive roundabout.

Unreleased trips

Unreleased trips are those trips made where vehicles were not able to enter the network and were held back or stuck at a network entry point (such as a feeder road or side road) throughout a nominal assessment period. Unreleased trips are usually a consequence of delays caused by congestion (discussed further in **Section 6.1**)

Under both Option 2 and Option 3, there is an increase in the overall number of vehicles through the network (ie more capacity). Option 3 would service substantially more vehicles because it has more capacity than Option 2, demonstrated by the decrease in unreleased trips under the proposed upgrade options (see **Table 2-1**).

Table 2-1 Future unreleased trips under Option 2 and Option 3

Scenario	2026		2036	
	AM	PM	AM	PM
'Do nothing' scenario	1,319	1,734	4,722	4,449
Option 2	909	850	3,409	3,345
Option 3	823	633	2,016	2,616

Overall network statistics

Both Option 2 and Option 3 would reduce average network delay and improve the average network speed compared to the 'do nothing' scenario. However, under Option 2 the improvements are eroded between 2026 and 2036 (see **Table 2-2**).

Table 2-2 Future network statistics under Option 2 and Option 3

Network statistic	2017	2026			2036		
		Do nothing	Option 2	Option 3	Do nothing	Option 2	Option 3
Morning peak							
Average Delay (s)	64	186	93	90	311	246	105

Network statistic	2017	2026			2036		
		Do nothing	Option 2	Option 3	Do nothing	Option 2	Option 3
Average Network Speed (km/h)	40.3	24.7	37.3	37.9	17.0	21	35.7
VKT	61,903	67,755	70,256	69,967	71,629	78,141	81,270
VHT	1,619	2,867	1,905	1,866	4,266	3,808	2,321
Stops	96,250	287,427	127,641	151,494	474,733	359,708	159,684
Completed Trips	32,240	42,020	43,278	43,359	44,269	46,581	48,633
Unreleased Vehicles	0	1,319	909	823	4,722	3,433	2,016
Incomplete Trips	250	751	500	495	1,426	1,162	575
Evening peak							
Average Delay (s)	46	237	181	144	256	241	162
Average Network Speed (km/h)	45.3	21.8	26.2	30.0	20.1	21.6	27.9
VKT	40,016	39,400	41,016	41,649	43,274	45,075	46,820
VHT	1,158	1,890	1,610	1,421	2,255	2,106	1,706
Stops	60,085	235,063	153,805	128,967	292,860	218,627	171,777
Completed Trips	22,498	24,424	25,314	25,588	26,951	27,901	28,911
Unreleased Vehicles	0	1,734	580	633	4,449	3,345	2,616
Incomplete Trips	350	680	565	471	817	858	662

Future traffic performance observations

For 2026 and 2036, the proposed upgrades would result in the following queuing:

- Under both Option 2 and Option 3, the long morning peak queues along Norwest Boulevard eastbound would be reduced substantially as a result of the upgrade of the Lexington Drive/Norwest Boulevard intersection. Option 3 would continue to provide the benefit of shorter eastbound queues beyond year 2036 however Option 2 queue lengths would start to increase again after 2026.

- Under both Option 2 and Option 3, long queues on the Norwest Boulevard westbound approach at the Edgewater Drive roundabout during both peaks would continue, indicating a need to upgrade this intersection to mitigate these effects.
- Modelling shows that with Option 3 both the northbound and southbound exit ramps at Old Windsor Road would provide acceptable traffic performance in 2026 and 2036. However, Option 2 would only provide acceptable performance until 2026 with long queues on the northbound exit ramp in the 2036 morning peak.
- Similarly at Lexington Drive, under Option 2 there would be limited queueing during the 2026 evening peak. However, during the 2036 evening peak there would be persistent queuing and over 480 unreleased vehicles from this approach. Under Option 3, queuing in 2036 would occur on Woolworths way during the core peak period (4.30pm to 5.30 pm) however this would dissipate relatively quickly.

Crash reduction

Option 2 and Option 3 would improve the carrying capacity and performance of the section of Norwest Boulevard between M7 Motorway and Edgewater Drive. The existing pinch point at Lexington Drive roundabout would be removed, resulting in less stop-start conditions and unexpected queues. This would reduce the likelihood of rear-end crashes.

The introduction of signalised pedestrian crossings on all approaches to the Lexington Dive/ Norwest Boulevard intersection would substantially improve pedestrian and cyclist safety. The addition of new shared paths on Norwest Boulevard and Lexington Drive, as in Option 3, would further improve active transport users' safety.

The operational benefits achieved with Option 2 would be eroded between 2026 and 2036 and hence the prevalence of rear-end crashes would be expected to increase between 2026 and 2036. Option 3 would continue to provide operational benefits between 2026 and 2036.

Impacts on public transport

Bus services 745, 730, 664 and 715, which pass through the Lexington Drive intersection would benefit from the intersection upgrade under both Option 2 and Option 3. While the benefits with Option 3 would prevail until and beyond 2036, benefits with Option 2 would gradually erode between 2016 and 2036.

Impacts on active transport

Pedestrian and cycle facilities would be improved with both Option 2 and Option 3 with the proposed introduction of signalised crossings on all four approaches to the Lexington Drive intersection. Additionally, Option 3 would provide a shared path on the southern side of the Norwest Boulevard and on the eastern side of Lexington Drive.

2.3.4 Preferred option

Option 1 would not include any vegetation removal, impact to adjacent heritage curtilage or other construction-related impacts. However, based on the traffic and transport assessment, Option 1 is not preferred as it does not improve the efficiency, performance or safety of the intersection. Traffic modelling demonstrates that the network is at capacity at 2026. Therefore, the majority of additional 2036 traffic would not be able to access the corridor. In addition, despite Option 1 not incurring an initial cost, the economic costs from traffic congestion and delays for commuters and freight along Norwest Boulevard, in the absence of any proposed upgrades, would constitute a real negative impact.

Option 2 has a smaller footprint than Option 3 and as expected, its capital costs would be lower including its land acquisition costs. Due to the reduced footprint, Option 2 would also have a smaller impact on adjacent heritage items (Bella Vista Farm) and roadside vegetation when compared to Option 3. However, Option 2 would only provide operational benefits until

2026 with its benefits eroding after that. In order to maintain operational performance and the associated safety outcomes, further investment would be required after 2026 to provide additional traffic lanes and longer turning bays. Further construction to provide these supplementary upgrades within a few years of the opening of Option 2 is not considered cost-effective and would lead to excessive construction period traffic disruptions.

In comparison, Option 3 has a larger footprint and a greater construction cost. However, it would provide sufficient operational capacity for the area until (and possibly beyond) 2036. As such, Option 3 is considered the preferred option as it meets the proposal objectives and would provide a long term solution to existing and predicted traffic constraints, thereby improving the efficiency, performance and safety of the intersection. Further information on the preferred option is provided in **Chapter 3.**

2.4 Design refinements

Since the development of the strategic design in 2017, the concept design has been refined to develop the 50 per cent concept design for Option 3. The main design refinements from the preliminary design (20 per cent) include:

- The Lexington Drive and Elizabeth Macarthur Drive horizontal alignment has been straightened, removing the requirement for lane widening
- The Lexington Drive and Elizabeth Macarthur Drive horizontal alignment has been moved further west to reduce land acquisition from the heritage listed Bella Vista farm site, to straighten the pedestrian crossings on Norwest Boulevard, and to mitigate the clash with the existing 132 kV underground transmission cable
- A new typical cross section for Norwest Boulevard has been adopted, which includes reduced lane widths (3.3 metres general traffic lanes and 3.2 metres auxiliary traffic lanes), and a 2.0 metres outside verge to allow non-frangible trees at the back of the shared path/footway on both sides of the carriageway
- The Norwest Boulevard eastbound left turn auxiliary lane has been shortened to separate the auxiliary lane from the future service station access
- The shared paths were extended to tie into the existing shared paths at Old Windsor Road, the shared path connection east of the pedestrian underpass on Norwest Boulevard and the existing bus stop on Elizabeth Macarthur Drive
- The Norwest Boulevard eastbound carriageway bus jump lane has been removed from the design
- The retaining wall along the Norwest Boulevard westbound verge adjacent Bella Vista Farm has been removed from the design. The removal of the retaining wall structure is to address the conflict between the Sydney Water trunk water mains and the proposed retaining wall footing.

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. Where feasible, potential ancillary facilities would be located to minimise or avoid removal of native vegetation.

Similarly, during detailed design the proposal would aim to avoid the installation of ancillary facilities (2A and 2B) within the heritage curtilage of Bella Vista Farm.

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 is proposing to upgrade Norwest Boulevard at Bella Vista, in the vicinity of the existing roundabout at Lexington and Elizabeth Macarthur Drive. The proposal is shown in **Figure 1-2**.

Key features of the proposal would include:

- Widening of Norwest Boulevard from two lanes to three lanes in each direction, from its intersection with Old Windsor Road, to 250 metres east of Lexington Drive (to the pedestrian underpass)
- Removal of the existing roundabout at the intersection of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive, and construction of a new four-way signalised intersection allowing all left and right turn movements
- Adding new right turn capacity to each leg of the intersection, as follows:
  - One dedicated right turn lane from Norwest Boulevard eastbound to Elizabeth Macarthur Drive southbound
  - Two dedicated right turn lanes from Norwest Boulevard westbound to Lexington Drive northbound
  - Two dedicated right turn lanes from Elizabeth Macarthur Drive northbound to Norwest Boulevard eastbound
  - Two dedicated right turn lanes from Lexington Drive southbound to Norwest Boulevard westbound
- Providing a single dedicated left turn lane on each leg of the intersection
- Widening of Lexington Drive from one to two lanes in each direction between Norwest Boulevard and the existing roundabout at Irvine Place/Woolworths Way.
- Tie-ins to the existing adjoining road network, as follows:
  - Norwest Boulevard would tie into the existing lanes on the westbound approach to the intersection at Old Windsor Road, with widening in the existing landscaped median and verge to allow the left turn lane onto Old Windsor Road southbound to extend up to intersection of Norwest Boulevard and Elizabeth Macarthur Drive/Lexington Drive
  - Lexington Drive would tie into the existing roundabout at Irvine Place/ Woolworths Way with provision to incorporate a (future) dual lane roundabout upgrade by The Hills Shire Council
  - At the proposal's eastern extent, Norwest Boulevard eastbound carriageway would merge from three lanes in each direction back to two lanes in each direction before the existing pedestrian underpass
  - At Elizabeth Macarthur Drive, the proposed road widening works would tie into the existing formation about 120 metres south of Norwest Boulevard

- New stormwater drainage including longitudinal and cross drainage on Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive to suit the proposed road configuration
- New shared path pedestrian and cycle facilities along the south side of Norwest Boulevard, and west side of Lexington Drive and Elizabeth Macarthur Drive
- New pedestrian footpaths along the north side of Norwest Boulevard and east side of Lexington Drive and Elizabeth Macarthur Drive
- Removal of portions of the existing Norwest Boulevard landscaped median to accommodate proposed road widening
- Removal of roadside vegetation on Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive to accommodate proposed road widening
- Relocation of electric, communication, gas, water utilities as required to suit the proposed road widening
- New or adjusted private property access driveways including left-in only access to Shell service station from Norwest Boulevard eastbound, left-in/left-out access into the Woolworths Group complex from Norwest Boulevard eastbound, left in/left out access to the ResMed park site from Elizabeth Macarthur Drive northbound, and left-in/left out access into McDonalds from Lexington Drive northbound and left-in/left-out access into Bella Vista Farm from Elizabeth Macarthur Drive southbound and removal of the existing U-turn facility for westbound traffic 80 metres west of the intersection
- Property adjustments and full/partial acquisition of private properties to accommodate the proposed roadworks
- New retaining walls along the Norwest Boulevard and Lexington Drive proposed road boundary
- New landscaping along the modified median (where feasible) and verge to restore the character of the existing landscaping in Norwest Boulevard
- New raised concrete medians and pedestrian refuge islands.

3.2 Design

The overall approach to design has been driven by the key proposal objectives (see **Section 2.2**) relating to improved road safety, accessibility and transport efficiency at the existing intersection. Other factors influencing the design are the major utilities which are to be retained in the proposed design, the relocation of major utilities and coordination with the road design and the importance of a construction sequence and schedule that is safe and which avoids interruptions to traffic flows along Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive in both directions.

Details about the proposal's design, engineering and construction are discussed in the following sections.

3.2.1 Design criteria

Main carriageway (Norwest Boulevard)

The proposal would provide three through lanes in each direction on Norwest Boulevard. In addition, the eastbound carriageway would provide one left turn lane to Lexington Drive and one dedicated right turn lane to Elizabeth Macarthur Drive, and the westbound carriageway would provide one left turn lane to Elizabeth Macarthur Drive and dual right turn lanes to Lexington Drive.

A new pedestrian and cycle shared path would be provided along the westbound (southern) side of Norwest Boulevard and a pedestrian footpath would be provided along the eastbound (northern) side (see **Table 3-1**).

Typical cross sections for Norwest Boulevard are presented in **Figure 3-1** (proposed layout to the west of the intersection) and **Figure 3-2** (proposed layout to the east of the intersection).

Table 3-1 Main carriageway design criteria

Design parameter	Value
Posted speed limit	70 km/h
Design speed	80 km/h
Minimum general traffic lane width	3.3 m
Median width	2.6 m to 7.6 m
Right and left turn lane widths	3.2 m
Bus lane width	3.5 m
Shared pedestrian and cycle path width	2.5 m
Pedestrian footpath width	1.5 m

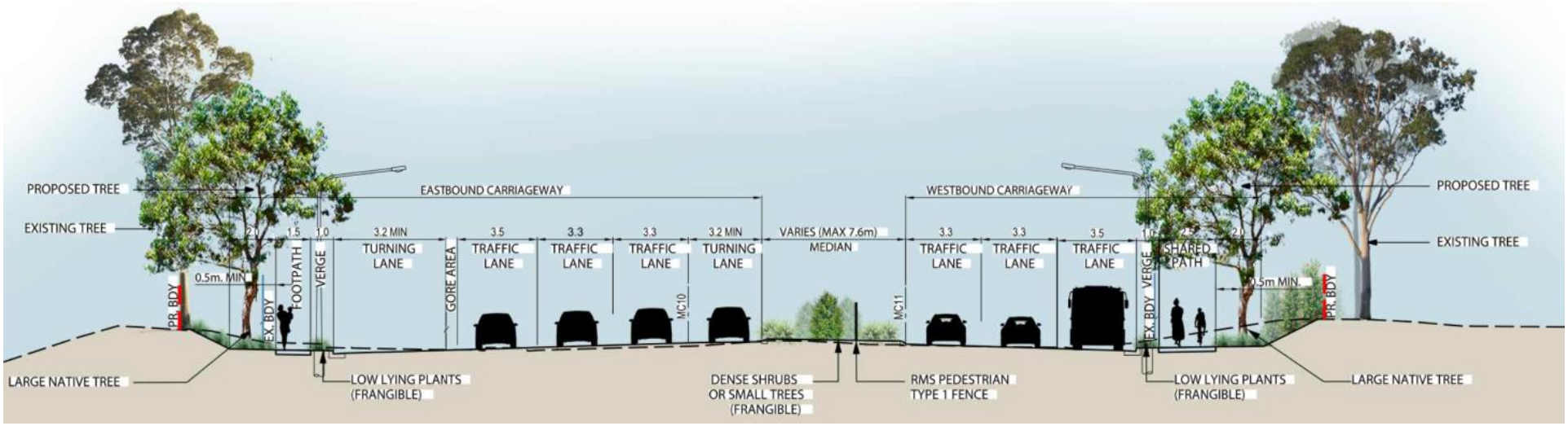


Figure 3-1 Cross section for Norwest Boulevard (west of the intersection)

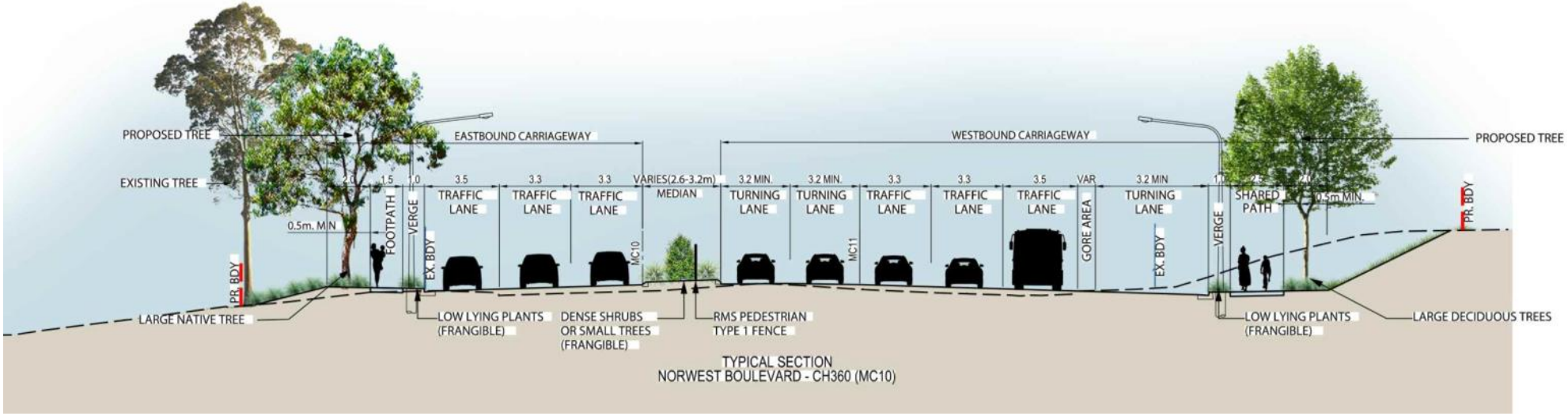


Figure 3-2 Cross section for Norwest Boulevard (east of the intersection)

Side roads (Lexington Drive and Elizabeth Macarthur Drive)

Lexington Drive southbound and Elizabeth Macarthur Drive northbound consist of one through lane, one left turn lane and two right turn lanes. Two through lanes from the intersection are provided on Lexington Drive northbound and Elizabeth Macarthur Drive southbound to facilitate turn movements from Norwest Boulevard.

A new pedestrian and cycle shared path would be provided along the northbound (west) side of both Lexington and Elizabeth Macarthur Drive and a pedestrian footpath would be provided along the southbound (east) side (refer to **Table 3-2**).

Typical cross sections for Lexington Drive and Elizabeth Macarthur Drive are presented in **Figure 3-3** and **Figure 3-4** below.

Table 3-2 Side roads design criteria

Design parameter	Value
Posted speed limit	50 km/h
Design speed	60 km/h
Minimum general traffic lane width	3.5 m
Median width	1.5 m (minimum)
Right and left turn lane widths	3.0 m (minimum)
Shared pedestrian and cycle path width	2.5 m
Pedestrian footpath width	1.5 m

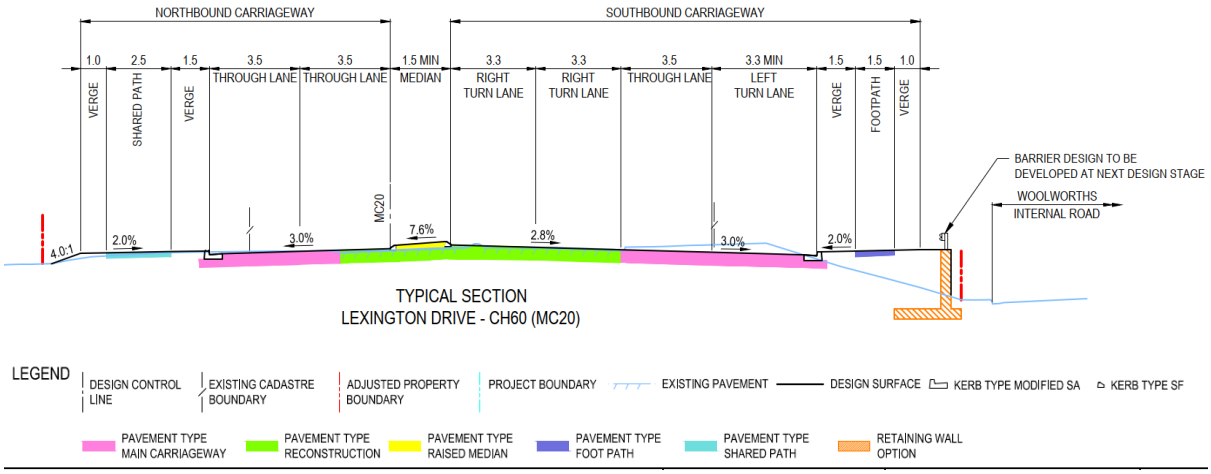


Figure 3-3 Cross section for Lexington Drive

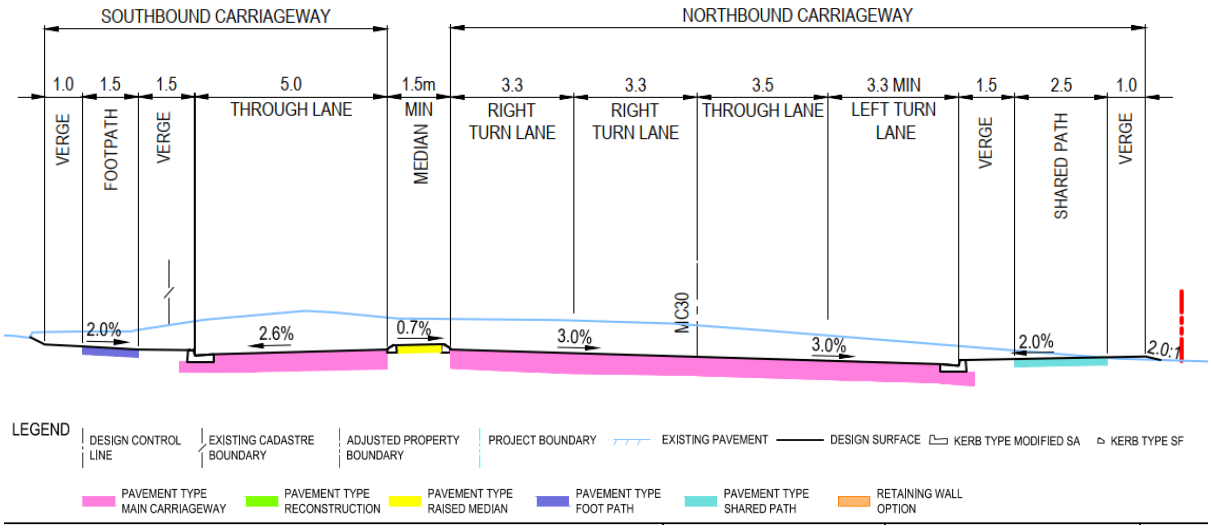


Figure 3-4 Cross section for Elizabeth Macarthur Drive

3.2.2 Engineering constraints

The proposal area is highly constrained within the boundaries of the existing road corridor of Norwest Boulevard and Lexington Drive. Within the existing road boundaries, there is limited space in which to configure all of the necessary infrastructure such as:

- Required traffic lane widths and capacity
- A shared path for pedestrians and cyclists, and pedestrian refuge islands
- Dedicated turning lanes and storage
- Utilities, traffic signals and road signs
- New landscaping and roadside vegetation
- Safe access and egress to and from adjoining private properties
- Bus stops.

The local topography also presents challenges to the proposal's design and construction. East of Elizabeth Macarthur Drive, Norwest Boulevard follows a contour slightly below the crest of a broad ridge, which runs east-west and up to a high point within the Bella Vista Farm. The topography falls away from the Norwest Boulevard roundabout to the north, south and west, and there are substantial retaining walls between the road and the surrounding properties.

The design of the proposed intersection has addressed these issues while achieving a cost-effective solution and meeting the objectives for the proposal. The ways in which the design has responded to these engineering issues and constraints is outlined in **Table 3-3**.

Table 3-3 Engineering constraints and proposed design response

Issue / constraint	Proposed design response
Topography and geotechnical conditions	• East of Elizabeth Macarthur Drive, Norwest Boulevard follows a contour slightly below the crest of a broad ridge, which runs east-west and up to a high point within the Bella Vista Farm. The topography falls away from the Norwest Boulevard roundabout to the north, south and west, and there are substantial retaining walls between the road and the surrounding properties. • Design utilises existing road footprint where possible. • Embankments have been designed with a typical batter slope of 1V:2H or flatter. The batter slope would be vegetated to prevent scour and erosion.
Required traffic lane widths and capacity	• A new typical cross section for Norwest Boulevard has been adopted in the concept design. The typical cross section includes reduced lane widths (3.3 m general traffic lanes and 3.2 m turn traffic lanes), and 2.0 m outside verge to allow non-frangible trees at the back of the shared path on both sides of the carriageway.
Existing utilities	• Numerous existing underground utilities (electricity, gas, water, telecommunications) would require relocation into the proposed utility corridors along the proposed verges. The utility alignments have been co-ordinated with new landscaping and road infrastructure. • The horizontal and vertical alignment of Elizabeth Macarthur Drive has been aligned further west to mitigate the clash with the existing 132 kV underground transmission cable.
Adjoining land uses	The design would require acquisition/resumption of adjoining land on both sides of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive. The property acquisition boundary has been located outside the extent of the earthworks, the works outside of the property acquisition boundary would be completed as property adjustment works.
Safe access and egress to and from adjoining private properties	The existing property accesses must be maintained during construction. The access to properties has been considered for all six stages of the construction staging design.
Existing bus stops	Existing bus stops are located on Norwest Boulevard eastbound 60 m east of Lexington Drive, Norwest Boulevard westbound 40 m east of Lexington Drive, Elizabeth Macarthur Drive northbound 150 m south of Norwest Boulevard and Lexington Drive southbound 110 m north of Norwest Boulevard. The existing bus stop on Lexington Drive southbound is proposed to be relocated north of the Woolworths Way roundabout prior to construction. Connection to bus facilities has been considered for all six stages of the construction staging design.
Landscaping	The existing Norwest Boulevard has a strong and bold landscaping design. The proposed road cross section has been developed to consider the precinct's urban design objectives and expectations of key stakeholders
Heritage	Bella Vista Farm, which adjoins to the south east, is a state heritage listed recreational area that overlaps part of the study area. Any works that would impact the heritage curtilage of the Bella Vista Farm, including the acquisition and the installation of an ancillary facility (2A or 2B), would need to be the subject of an application under section 60 of the Heritage Act

3.2.3 Key design features

Intersections

Norwest Boulevard is proposed to be upgraded from two lanes to three lanes in each direction, from its intersection with Old Windsor Road, to 250 metres east of Lexington Drive (to the pedestrian underpass). The road would generally be widened on the verge side, but widening into the median would be required to accommodate new right turn bays. The upgrade would require the removal of the existing roundabout at the intersection of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive and construction of a new four-way signalised intersection allowing all left and right turn movements.

The proposed intersection of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive caters for a 19.0 metres semi-trailer design vehicle and 26.0 metres B-Double checking vehicle for all turn movements. The layout of the intersection allows for Double Diamond Overlap (DDO) phasing configuration for the 19.0 metres semi-trailer design vehicle.

The design allows for the19.0 metres semi-trailer design vehicle to make the right turn from either inside or outside right turn lane with a car beside it. High entry angle left turn treatments have been provided for all legs of the intersection.

Medians

Raised medians are proposed along Elizabeth Macarthur Drive and Lexington Drive at a typical minimum width of 1.5 metres. The existing raised central median on Norwest Boulevard would be retained where possible but widening into the median would be required to provide right turn bays.

Shared paths and footpaths

New shared paths for pedestrians and cyclists are proposed along the south side of Norwest Boulevard, and west side of Lexington Drive and Elizabeth Macarthur Drive. New pedestrian footpaths are proposed along the north side of Norwest Boulevard and east side of Lexington Drive and Elizabeth Macarthur Drive.

Stormwater and road drainage

At Lexington Drive, Norwest Boulevard and Elizabeth Macarthur Drive, the drainage design includes the following:

- Provision of drainage inlet pits on the new kerb and gutter and at traffic islands to limit gutter flow widths to acceptable limits. An indicative pit spacing for gutter flow width requirements was estimated at between 15 to 25 metres depending on the specific road width and longitudinal grade
- Provision of a new pipe network that connects to the existing system, minimises crossings of existing road pavement and minimises crossing the existing utilities (trunk water mains and 132 kV electrical cables) that would be retained
- Where connecting to the existing drainage system, existing pits would be removed, and the pipe extended to the widened kerb and pit location as required
- Provide open drains/channels at the top of cut batters and retaining walls where runoff flows toward them and convey flow to nearest drainage system or receiving watercourse.

Property access

There are several existing property accesses to be retained and modified including:

- Woolworths site: 1 Woolworths Way, Bella Vista
- Future Shell Service Station (to be installed prior to intersection upgrade works): Norwest Boulevard eastbound carriageway west of the intersection
- McDonalds site: 2 Lexington Drive, Bella Vista
- Bella Vista Farm: Norwest Blvd and Elizabeth Macarthur Drive, Bella Vista
- ResMed Site: 1 Elizabeth Macarthur Drive, Bella Vista

Bus facilities

There are several bus stops which would need to be relocated as part of the proposal. These adjustments are summarised in **Table 3-4**. The final locations of bus facilities within the proposal area are subject to change pending discussions with Transport for NSW, Hillsbus and Busways.

The proposal would not provide bus queue jump lanes on Norwest Boulevard.

Table 3-4 Proposed bus stop relocations

Existing bus stop location	Bus Route	Proposed works
Norwest Boulevard westbound (40m east of the intersection)	664, 715, 730	Existing indented bus bay replaced with on line bus stop and relocated 100m east
Norwest Boulevard eastbound (60m east of the intersection)	664, 715, 730	Existing indented bus bay replaced with on line bus stop and relocated 30m west
Lexington Drive southbound (110m north of the intersection)	745	Existing on-line bus stop relocated 170m north opposite existing southbound bus stop.
Elizabeth Macarthur Drive northbound (150m south of the intersection)	664, 715, 745	Existing on-line bus stop retained in existing location

Bicycle and pedestrian facilities

The current design provides 1.2 metre footpaths on each side of the road. The proposal would provide a 2.5 metres wide shared path along the south side of Norwest Boulevard and east side of Lexington Drive and Elizabeth Macarthur Drive, and a 1.5 metres wide footpath provided along the north side of Norwest Boulevard and west side of Lexington Drive and Elizabeth Macarthur Drive.

The shared paths would tie into the existing shared paths at Old Windsor Road, the shared path connection east of the pedestrian underpass on Norwest Boulevard and the existing bus stop on Elizabeth Macarthur Drive.

Retaining walls

The proposal would include four retaining structures located as follows:

- Two along eastbound carriageway on Norwest Boulevard (west of the intersection)
- Northbound carriageway on Lexington Drive (north of the intersection)
- Southbound carriageway on Lexington Drive (north of the intersection).

Walls are required to limit footprint and/or the extent of property acquisition. Further investigation to confirm the extents of the retaining structures would be undertaken during detailed design.

These walls would become visual elements. The finish on the walls would consider applications that soften their visual appearance and reduce their visual presence. The design would aim for the walls' presence to recede in terms of height and scale. Their finish would be sympathetic to the local road environment and boulevard feel of the proposal, and the treatment of the walls would be responsive to their context.

Within the main alignment the walls are generally low landscape walls, less than two metres in height. Where visible from the main alignment, landscaping would limit the visibility of these structures.

Lighting

Norwest Boulevard is currently lit by standard gooseneck lights set behind the footpath and painted black. The proposal would continue to adopt this approach and match the fittings. The design of lighting would seek to minimise the need for lighting and ensure that light spillage into residential properties is minimised or avoided as per AS4282-1997.

Safety barriers and fencing

Safety barriers have not been provided along Norwest Boulevard. In general, the design has sought to limit barriers and provide an uncluttered streetscape. Pedestrian fencing is proposed within the narrow median to discourage unsafe crossing. Along the frontage of the Bella Vista Farm, fencing would replicate the existing post and rail fence to maintain the character, feel and presence along the street frontage.

VMS and traffic signals

Signage would be installed in accordance with relevant standards. Vehicle and pedestrian signals would be provided on all legs of the intersection. An existing VMS on Norwest Boulevard, west of the intersection would be retained as part of the proposal.

3.2.4 Safety in design

A safety in design workshop was conducted in May 2020, to address issues of constructability such that the proposal could be constructed without undue risk to construction workers, road users, adjoining landowners and residents. The workshop also sought to ensure that the concept design would incorporate features to enable the safe ongoing maintenance of built infrastructure.

The construction methodology and sequence detailed in **Section 3.3.1** aims to balance construction safety with safe operation of the existing intersection during the construction period. Other elements of the proposal for which safety in design is a key consideration include:

- Major road components such as full depth asphalt pavement can be constructed off-line from live traffic and behind road safety barriers
- Works around major underground utilities such as 132 kV power cables and Sydney Water trunk mains.

3.2.5 Urban design

Design principles

Urban design objectives were prepared to guide the design and consider how the proposal would integrate physically and visually with the surrounding environment. The urban design objectives for the proposal are derived from Transport for NSW (formerly Roads and Maritime) document *Beyond the Pavement* and described below:

Objective 1

Maintain the fundamental characteristics of the existing road corridor which signify the Norwest Business Park and the experience of the road user.

Design principles:

- Maintain the strong vegetated and landscaped character of the corridor
- Maintain views to identified landmarks and heritage properties including Bella Vista Homestead, and avoid impacts on the setting of these properties
- Maintain and emphasise identifiable transitions along the route which define intersections and entrances to key properties. Employ treatments which contribute to the definition of these areas
- Ensure the varying vertical and horizontal road geometry is maintained where possible to conserve the varied and sequential visual experience of the journey
- Ensure signage, utilities, and other structures are sited and designed to avoid adverse impacts on important views along the route.

Objective 2

Enable the sensitive integration of the proposal into the landscape context

Design principles:

- Keep the footprint to a minimum in order that good design outcomes can be reinforced
- Minimise the extent of disturbance and vegetation clearance required to facilitate the upgrade of the road corridor, with particular effort to maintain visually important roadside vegetation and connections to heritage properties
- Avoid substantial vertical deviations which would require construction of retaining walls, substantial batters, or other barriers
- Limit the impact of construction activity and storage on the landscape and visual environment, particularly in relation to sensitive receivers
- Celebrate the heritage elements along the alignment providing visual connection, and reinforcement to the character of their setting.

Objective 3

Maximise safety of road and path users ensuring adequate and safe pedestrian and cycle connectivity along and across the corridor

Design principles:

- Avoid potential conflicts between different transport mode users, such as cyclists and drivers
- Ensure the appropriate application of CPTED (Crime Prevention through Environmental Design) principles to provide high levels of surveillance, avoid opportunities for entrapment, and enhance perceptions of safety
- Provide paths consistent with the overall Norwest Boulevard Upgrade objectives including shared path on at least one side of the corridor
- Enable connections to adjoining shared path/cycleway facilities including those within Old Windsor Road
- Design intersection to reflect needs of pedestrians as well as motorist enhancing pedestrian permeability

- Pedestrian and cycleway facilities to be developed to appropriate standards.

Objective 4

Provide a robust and sustainable environment, which minimises maintenance and is safe to maintain

Design principles:

- Use robust and durable materials fit for purpose and place
- Provide a landscape which is maintainable and requires minimal maintenance
- Provide a design which avoids and discourages opportunities for vandalism.

Urban design concept

The urban design and landscape concept have been developed to achieve an integrated outcome that helps fit the proposal as sensitively as possible within its context and to minimise impacts of the proposal on current and future character of the area.

The design of Norwest Boulevard would require the removal of parts of vegetated medians and an expansion of the road footprint, which would mean a loss of existing vegetation with the construction of the new alignment.

A variety of landscape treatments would be adopted and would include:

- Establishment of street trees with advanced specimens, similar in scale to those used for the Sydney Metro Northwest works. This treatment type would be utilised within the verges
- Use of garden beds within the verge and median where instant plant densities are required to provide stability and minimise weed growth
- Application of turf rolls as a verge or broader landscape treatment.

As part of the process the design strategy has identified four precincts which can be used to describe the varying response to the corridor, these being:

- Arrival precinct – located between Old Windsor Road and the intersection of Lexington Drive/Elizabeth Macarthur Drive. Marks the entrance into the Norwest Business Park and as such requires a response which immediately establishes the overall character and feel of the broader estate
- The Transition precinct – represents the movement from the arrival precinct into the overall estate
- Lexington Drive precinct – based on the topography, this precinct requires the use of retaining structure. The design has responded to this providing an initial open transition at the intersection and then the adoption of a smaller scale canopy tree commensurate with the reduced corridor size and the constraints within it
- Elizabeth Macarthur Drive precinct – the Bella Vista Farm dominates its eastern edge presenting a more open character. The adjoining developments including ResMed are located below the road which also aids this sense of open and spaciousness.

The urban concept design for the proposal is shown in **Figure 3-5**. A further breakdown of the treatments for each precinct is provided in **Appendix F.**

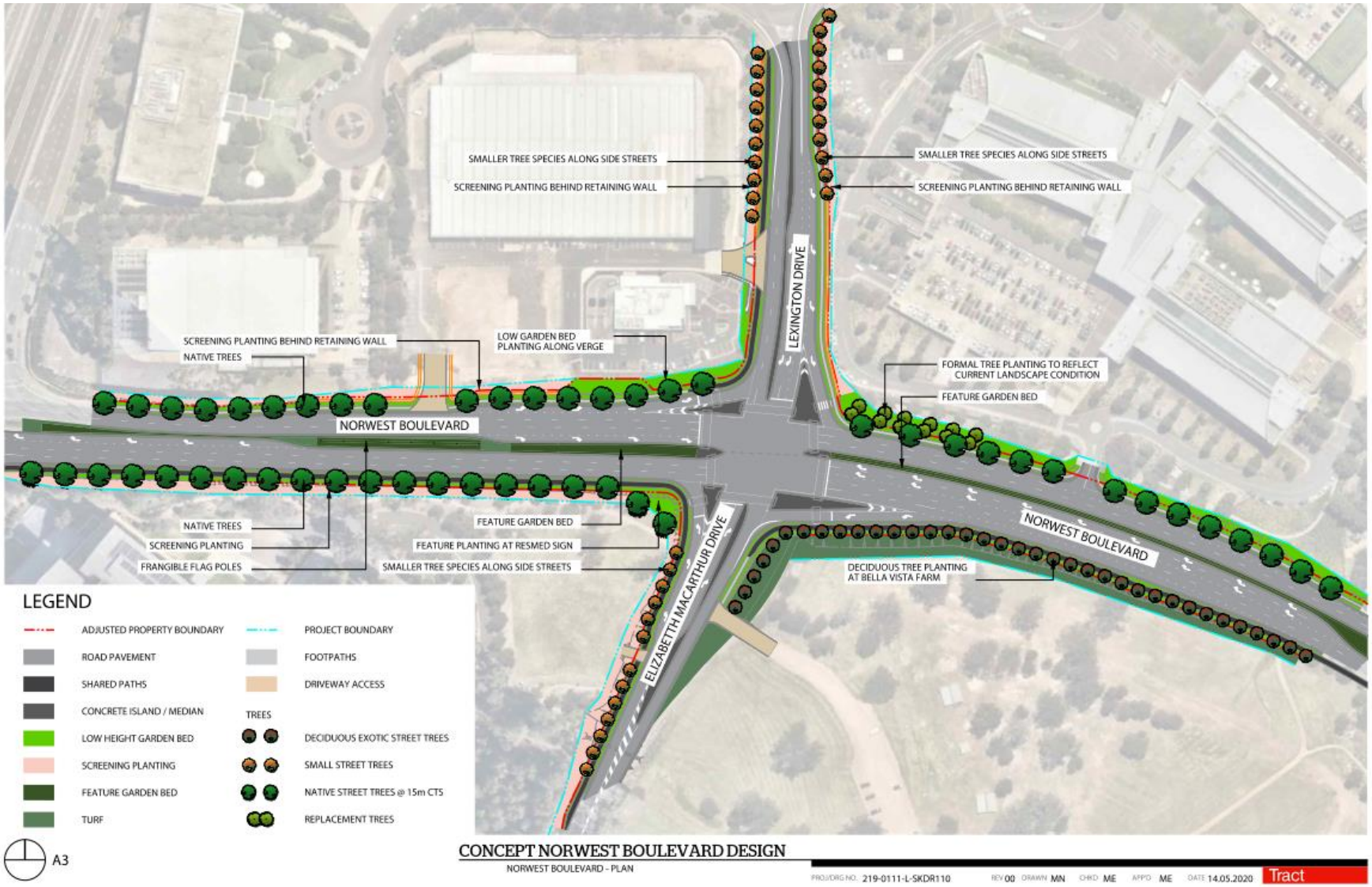


Figure 3-5 Urban concept design for the proposal

3.3 Construction activities

3.3.1 Work methodology, sequencing and staging

Construction of the proposal is proposed in six stages and is presented in **Table 3-5**. The proposed construction works and methodology provided is indicative and based on the current concept design and would be further developed during detailed design prior to construction. Construction activities would be guided by a construction environmental management plan (CEMP) to ensure that work is carried out to Transport for NSW specifications, and that environmental commitments documented in this REF are adhered to.

Table 3-5 Proposed work stages

Stage	Proposed works
Stage 1	• Establishment of construction ancillary facility/facilities • Nightworks to remove landscaping in the existing median including tree removal and disassembly of the flag poles • Nightworks to demolish existing kerb along the verge and median and to install temporary pavement to be trafficked in the next stage. Nightwork lane closures would be required on: - Norwest Boulevard eastbound and westbound carriageway median side through lanes to demolish the kerb and install temporary pavement - Norwest Boulevard roundabout to demolish existing roundabout and install temporary pavement. - Lexington Drive to demolish kerbed median and install temporary pavement on the southbound lane verge - Elizabeth Macarthur Drive to demolish median island and install temporary pavement • Remove existing traffic signal infrastructure on Norwest Boulevard and Elizabeth Macarthur Drive.
Stage 2	• Establish temporary traffic signals • Demolish Woolworths, ResMed and Bella Vista signs • Earthworks • Install retaining wall on the east side of Lexington Drive. The construction of the wall would likely require establishment of a construction area on the Woolworths internal road. Further consultation with Woolworths is required to confirm construction requirements. • Utility relocation and protection works • Install new footpaths and shared paths • Install pavement drainage and connections with the existing drainage network; • Install new verge side kerbs • Install new pavement and tie into edge of existing pavement.
Stage 3	• Establish temporary traffic signals • Install retaining wall on the east side of Lexington Drive • Install temporary and new pavement in the median.
Stage 4A	• Establish temporary traffic signals • Install new pavement at the north-west corner of the existing roundabout.
Stage 4B	• Establish temporary traffic signals • Earthworks to tie in the new Elizabeth Macarthur Drive with Norwest Boulevard

Stage	Proposed works
	• Install new pavement in the Norwest Boulevard westbound carriageway and overlay to meet final design level • Modification of drainage structures to meet final design level • Install median islands and final traffic signal infrastructure • Install street lighting • Install landscaping.
Stage 5A	• Establish temporary traffic signals • Install new pavement in the Norwest Boulevard eastbound carriageway and overlay to meet final design level • Modification of drainage structures to meet final design level • Install median islands and final traffic signal infrastructure • Install street lighting • Install landscaping.
Stage 5B	• Establish temporary traffic signals • Install new pavement at the south-east corner of the existing roundabout and the Norwest Boulevard westbound left turn lane onto Elizabeth Macarthur Drive
Stage 6	• Installation of median islands and final traffic signal infrastructure • Installation of line marking and signage • Installation of street lighting • Installation of landscaping.

3.3.2 Construction hours and duration

Subject to approval, it is anticipated that construction would start around August 2023 and would take about 20 months to complete (weather permitting). The indicative duration of each stage is:

- Stage 1 – About 3 weeks
- Stage 2 – About 5 months
- Stage 3 – About 2 months
- Stage 4A – About 2 months
- Stage 4B – About 3 months
- Stage 5A – About 3 weeks
- Stage 5B – About 1 month
- Stage 6 – About 1 month

It is anticipated that construction would generally be carried out during standard construction working hours in accordance with the Interim Construction Noise Guideline (ICNG) (Department of Energy and Climate Change, 2009):

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- Sundays and public holidays: no work.

To minimise disruption to daily traffic and disturbance to surrounding land owners and businesses, it would be necessary to carry out some work outside of these hours. Out of hours work would be subject to permitted road occupancy licences (ROLs) and construction staging. Out of hours works would be carried out in line with the procedures contained within

the ICNG and the Roads and Maritime Construction Noise and Vibration Guidelines (CNVG) (Roads and Maritime, 2016).

The local community would be notified a minimum of five business days prior to works outside of standard construction hours commencing. They would be provided with works details and contact information if there are any issues.

A noise and vibration assessment has been carried out for the proposal. Further details are provided in **Section 6.2** and **Appendix E** for details.

3.3.3 Plant and equipment

A range of plant and equipment would be used during construction. The final equipment and plant requirements would be determined by the construction contractor. An indicative list of plant and equipment is provided below:

- Front end loaders
- Bulldozers
- Backhoes
- Dump trucks
- Road trucks
- Excavators
- Road sweepers
- Water trucks
- Cherry pickers
- Concrete saws
- Two tonne road roller
- Asphalt/concrete pavers
- Plate compacters
- Graders
- Scrapers
- Concrete trucks
- Generators
- Pneumatic and electrical hand tools
- Air compressors

3.3.4 Earthworks

Most of the earthworks would be associated with excavation of road pavements, medians and road verges, utility relocations and upgrades, and pavement installation as part of the road widening works and stormwater drainage upgrades. No large scale earthworks are required as part of this proposal.

The volumes of materials associated with earthworks would be small due to the localised nature of the roadworks. It is estimated that about 13,500 cubic metres of spoil would be exported for the proposal. Earthworks requirements would be confirmed during detailed design.

3.3.5 Source and quantity of materials

Based on the concept design, the estimated quantities of the main materials associated with proposal are provided in **Table 3-6**.

Table 3-6 Materials and estimated quantities required

Material	Volume
Topsoil (removal)	2500 m^3
Earthworks cut for road pavement for off-site disposal	13,500 m^3
Imported materials from beyond the proposal area	15,000 m^3

Material	Volume
Stormwater precast concrete and fibre reinforced drainage pipes	1300 m^3
Kerbs and gutters	3700 m^3
Pavement (subbase and base)	1000 m^3
Heavy duty asphalt	20,500 m^3
Concrete paving (medians, footpaths, driveways)	4500 m^3

The road pavement materials would be sourced from appropriately licensed facilities (e.g. quarries). The demand for resources would be separated into the various stages of construction works.

Surplus or unsuitable material that cannot be used on site would be classified in accordance with the Waste Classification Guidelines (NSW EPA, 2014) and disposed of at an approved materials recycling or waste disposal facility.

The amount of water that would be required during construction is unknown at this stage. The amount would depend on material sources and methodologies applied by the contractor. It is proposed that water would be obtained from the local water supply network.

3.3.6 Traffic management and access

Road closures/potential delays

There would be no permanent or temporary road closures as a result of the proposal. However, there would be temporary lane closures to demolish existing kerbs and median islands and install temporary pavement. Lane closures would be undertaken during nightworks under traffic management.

Traffic switching

The following traffic management and switching is anticipated based on the proposed construction stages as follows:

- Under Stage 1 traffic would remain in its existing configuration during the day. Switches to close lanes would be done as night works
- Under Stage 2, once traffic has been switched and barriers are setup, all works can be undertaken during the day and any works across property access would be done at night in consultation with the respective owners
- Under Stage 3, 4A, 4B, 5A and 5B, all stages would require the traffic to be switched followed by moving traffic barriers to the new designated work zones. Once traffic has been switched and barriers are setup, all works can be undertaken during the day.
- Under Stage 6, once traffic has been switched and barriers are setup, all works can be undertaken during the day

Construction vehicles

Construction of the proposal would generate heavy vehicle movements. These heavy vehicle movements would mainly be associated with:

- Delivery of construction materials
- Spoil removal and disposal
- Delivery and removal of construction equipment and machinery.

Light vehicle movements would be required for the movement of construction personnel, including contractors, site labour force and specialist supervisory personnel. Construction vehicles would access the site via arterial roads wherever possible.

During standard working hours, construction is expected to require about 50 to 100 heavy vehicle movements and up to 50 light vehicle movements in and out of the site per day. During night works, the number of vehicles accessing the site would decrease to about 16 heavy vehicles and 30 light vehicles

The slowing down, entering and turning movements of construction traffic into and out of work sites has the potential to impact the safety of other road users. This would be mitigated by ensuring that adequate roadwork signage, truck turning signage and the roadwork speed limit are planned and implemented in accordance with a detailed Traffic Management Plan (TMP) in accordance with the Traffic Control at Work Sites Manual Version 4 (RTA, 2010) and approved by Transport for NSW before implementation. The TMP would provide details of the traffic management measures to be implemented during construction to ensure traffic flow on the surrounding network is maintained where possible.

There may be some short term disruptions to property access during construction. Affected businesses would be notified prior to works and impacts managed through the TMP. There would be no change to bus services during construction, other than temporary relocation of bus stops where required. Further details and assessment of traffic and transport impacts are provided in **Section 6.1**.

Haul routes

The primary construction vehicle and haulage routes would be via Norwest Boulevard eastbound to Windsor Road and Norwest Boulevard westbound to Old Windsor Road (see **Figure 3-6**). It is expected that construction access into the proposal area and to potential ancillary facilities would be restricted to left-in/left out turn movements only.

Construction vehicles are not expected to traffic local roads north of Woolworths Way roundabout and south of Elizabeth Drive roundabout.

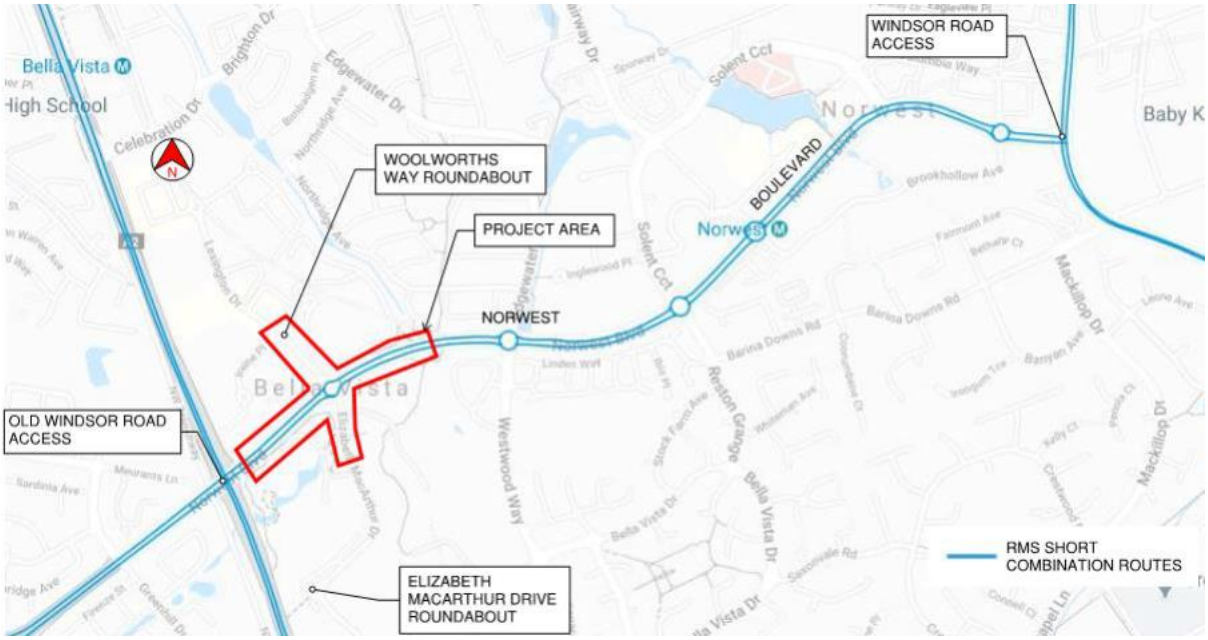


Figure 3-6 Proposed haulage routes during construction of the proposal

Impacts to property access

There are several existing property accesses which must be maintained during construction. The property accesses are summarised in **Table 3-7**. Further stakeholder consultation is required to confirm the property hours of operation and design requirements.

Table 3-7 Property access to be maintained during construction

Lot/ DP	Property description	Access type	Road	Carriageway
8000/1087092	Woolworths site	Left In/Left Out	Norwest Boulevard	Eastbound
701/1000143	Future shell service Station	Left in	Norwest Boulevard	Eastbound
701/1000143	McDonalds site	Left In/Left Out	Lexington Drive	Northbound
102/817929	Bella Vista Farm	Left In/Left Out	Elizabeth Macarthur Drive	Southbound
6001/1036256	ResMed site	Left In/Left Out	Elizabeth Macarthur Drive	Northbound

3.4 Ancillary facilities and construction workforce

Four potential ancillary sites have been considered (see **Figure 1-2**):

- Ancillary facility 1: the north eastern corner of the ResMed facility property
- Ancillary facility 2A: Bella Vista Farm, extending from access road at Elizabeth Macarthur Drive
- Ancillary facility 2B: Bella Vista Farm, at eastern extent of study area
- Ancillary facility 3: in vacant open space adjacent to the roundabout east of the study area at Norwest Boulevard and Westwood Way.

The decision on which ancillary facility to progress would be determined at the detailed design phase, therefore the REF has assumed a worst-case scenario of all four ancillary facilities operating during construction. The proposal would most likely only progress with one ancillary facility.

Ancillary facilities would include:

- Site offices including meeting rooms, cribs huts and toilets
- Light vehicle parking for staff
- Laydown areas and material storage for various work sites
- Potential material stockpile area (pending pavement design)
- Connection to utilities such as electrical, power, water and telecommunications.

Any stockpiling of materials would be managed in accordance with the Stockpile Site Management Procedure and the QA Specification R44 – Earthworks (Roads and Maritime, 2011c) and sites would be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions.

Based on the scale of the proposal, it is estimated that eight staff and 30 workers would be required during the construction stage. The nominated main ancillary facility may require some enabling works due to sites existing ground slope.

Upon completion of construction, the ancillary facilities would be demobilised and the area restored to pre-construction conditions.

The ancillary facilities may also include areas for wash downs and refuelling. All fuels, chemicals, and liquids would be stored at least 50 metres away from the existing stormwater drainage system and would be stored in an impervious bunded area within the ancillary facilities. Refuelling of plant and maintenance machinery would be undertaken in impervious bunded areas in the designated ancillary facilities.

3.5 Public utility adjustment

Detailed utility surveys have indicated extensive utilities would require relocation as part of the proposal. Where possible, existing trunk utilities which are already under the road would be maintained in their current location. The utility relocation strategy assumes that all of the utilities beneath the footpaths would be relocated. The following utility service providers have been identified within the proposal area:

- Endeavour Energy
- Sydney Water
- Jemena Gas
- Telstra
- Optus
- NBN
- Nextgen
- Vocus
- Uecomm
- TPG
- AAPT
- Transport for NSW
- M7 Motorway.

The sections below give a description of the existing utilities for each provider and a high-level strategy for the treatment of affected utilities.

3.5.1 Endeavour Energy

Endeavour Energy has an extensive power network along both sides of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive. These include:

- Low Voltage (LV) cables along the verges of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive. These cables would likely require relocation outside of the proposed road widening
- 11 kilovolt (kV) and 22 kV High Voltage (HV) cables along the verges of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive. These cables would likely require relocation outside of the proposed road widening
- 132 kV Transmission HV cables at:
  - Norwest Boulevard east of the intersection under the existing median then turning onto Elizabeth Macarthur Drive under the road pavement
  - Lexington Drive and Elizabeth Macarthur Drive under the road pavement.

The 132kV transmission cables are proposed to be retained in their existing position, this was determined to be the most effective solution as relocation of the 132kV transmission cables would impose major cost and time constraints on the proposal.

3.5.2 Sydney Water

Sydney Water has several assets which would be affected by the works, these include:

- 200 mm water main along the south side of Norwest Boulevard and west side of Elizabeth Macarthur Drive. These mains would likely require relocation outside of the proposed road widening and into the proposed road verge
- 250 mm diameter water mains along the west side of Elizabeth Macarthur Drive south of the intersection with Norwest Boulevard. These mains would likely require relocation outside of the proposed road widening and into the proposed road verge
- 375 mm water main along the east side of Lexington Drive and north side of Norwest Boulevard. These mains would likely require relocation outside of the proposed road widening and into the proposed verge
- The three water mains (600 mm, 1200 mm and 450 mm) along the south side of Norwest Boulevard starting east of the intersection, crossing Elizabeth Macarthur Drive, then crossing north on Norwest Boulevard 140 metres west of the intersection and continuing west along north side of Norwest Boulevard. The three water mains are a major constraint for the proposal. The design would aim to retain the water mains in their current positions. However, further consultation with Sydney Water is required.

3.5.3 Jemena Gas

Jemena Gas has 210 kPA gas mains along the south side of Norwest Boulevard, east of the intersection and along the west side of Lexington Drive and Elizabeth Macarthur Drive. These gas mains would require relocation outside of the proposed road widening and into the proposed verge.

3.5.4 Telstra and communications infrastructure

Telstra has an extensive communication network along both sides of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive. Telstra cables would likely require relocation outside of the proposed road widening and into the proposed verges and would involve fibre optic jointing works.

The relocation of the Telstra assets would have a knock-on effect to several other utility authorities who utilise Telstra conduits to carry telecommunication cables. These authorities include NBN, Vocus, TPG, AAPT, Uecomm and Optus.

Coordination between Telstra and the other telecommunication utility authorities would be required during the relocation detailed design and construction staging to minimise disruption and ensure all works are coordinated efficiently.

3.5.5 Transport for NSW

TfNSW utilities are generally associated with the Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive signalised intersection infrastructure. The utilities design has allocated space for the ITS backbone in the Norwest Boulevard south side verge.

3.5.6 M7 Motorway

M7 Motorway has communication and power infrastructure feeding the VMS on the south side of Norwest Boulevard at the western extent of the proposal area. The design would aim to retain these assets.

3.6 Property acquisition and adjustments

The land acquisition area and property adjustment works detailed below are indicative only based on the stage of concept design at the time of writing this report. The items are to be confirmed pending consultation with stakeholders and design development (see **Figure 3-7** and **Table 3-8**).

A number of properties in close proximity to the proposal have the potential to be impacted as part of design refinements during the detailed design phase. As a conservative approach, these properties have been included in **Table 3-8** and **Figure 3-7**, for consideration.

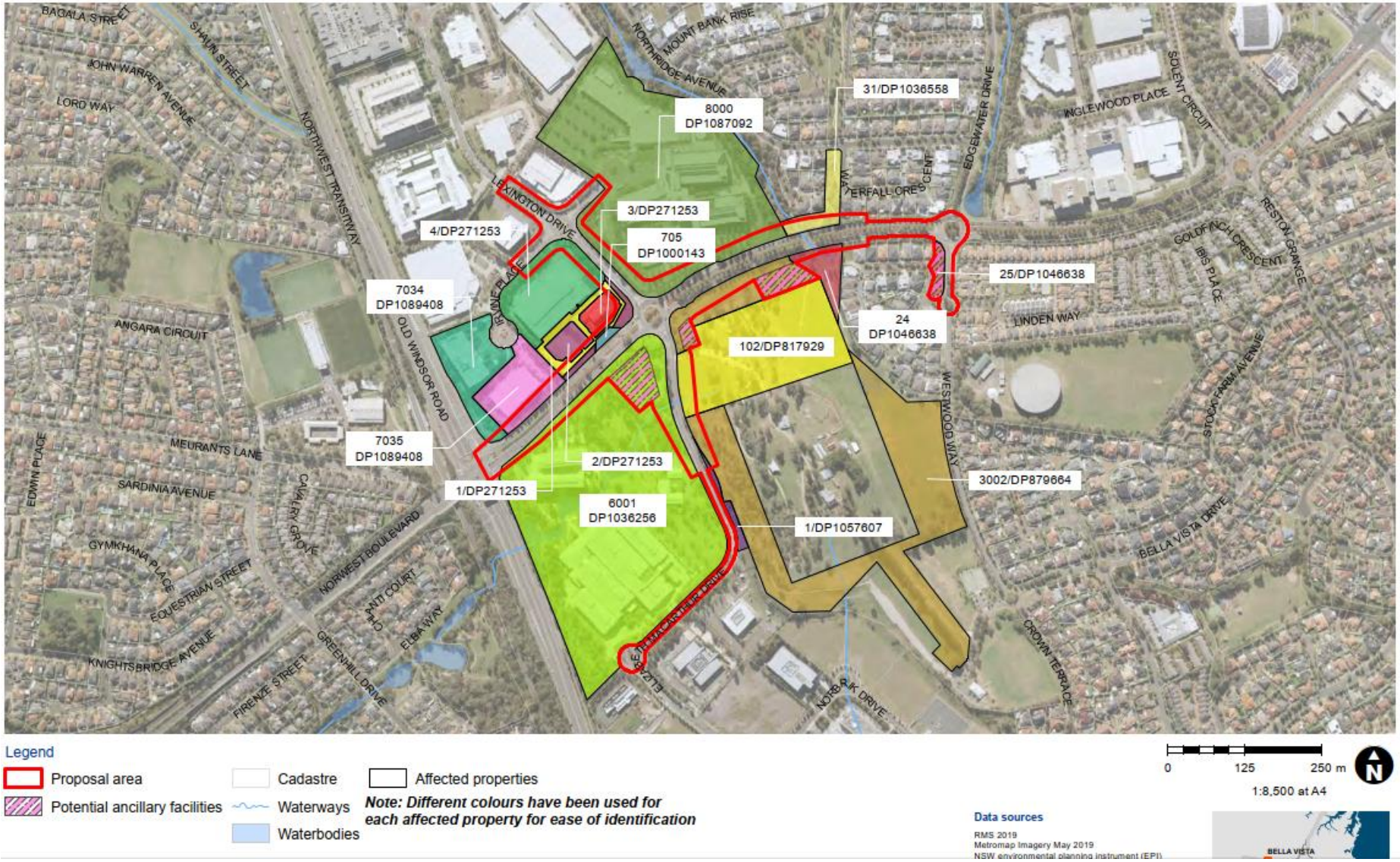


Figure 3-7 Affected properties

Table 3-8 Proposed property adjustments/ acquisitions

Lot and DP	Property address	Description	Land acquisition	Total area	Acquisition type	Current owner	Land use zone [1]
Property acquisitions							
Lot 7035 DP1089408	11 Irvine Place, Bella Vista NSW 2153	• Reinstatement of landscaping	553 m^2	11,700 m^2	Partial (4.7 per cent)	Private property	B7
Lot 1 DP271253	Community Assn Property 6 Lexington Drive, Bella Vista, NSW 2153	• Tie-in Lexington Drive left-in / left-out driveway to McDonalds • Tie-in Norwest Boulevard Left-In access to Shell service station development • Relocation of the McDonalds sign • Reinstate landscaping • Retaining wall construction	80 m^2	4076 m^2	Partial (2.0 per cent)	Private property	B7
Lot 2 DP271253	4 Lexington Dr, Bella Vista NSW 2153	• Reinstate landscaping • Retaining wall construction	1627 m^2	4585 m^2	Partial (36 per cent)	Private property	B7
Lot 4 DP271253	6-8 Lexington Dr, Bella Vista NSW 2153	• Reinstate landscaping	290 m^2	17,135 m^2	Partial (1.7 per cent)	Private property	B7
Lot 705 DP1000143	Norwest Boulevard, Bella Vista NSW 2153	• Widening of Norwest Boulevard (location of left turn lane)	627 m^2	627 m^2	Full	Private property	B7
Lot 8000 DP1087092	1 Woolworths Way, Bella Vista NSW 2153	• Tie-in to Woolworths access on Norwest Boulevard with existing Woolworths internal road. • Removal/ Relocation of access stairs from Lexington Drive southbound verge to Woolworths internal road footpath.	2785 m^2	89,900 m^2	Partial (3.1 per cent)	Private property	B7

Lot and DP	Property address	Description	Land acquisition	Total area	Acquisition type	Current owner	Land use zone [1]
		• Relocation of Woolworths Group masonry sign at north-east corner of the intersection. • Relocation of Woolworths Group masonry sign at Woolworths site access on Norwest Boulevard eastbound. • Relocation of Woolworths service shed at north-east corner of the intersection. • Adjustment to Woolworths utilities including telecommunication, gas, power, water and irrigation services. • Adjustment of Woolworths private footpaths to tie-into new works. Reinstate landscaping					
Lot 6001 DP1036256	1 Elizabeth Macarthur Dr, Bella Vista NSW, 2153	• Tie-in driveway on Elizabeth Macarthur Dr northbound to ResMed site • Relocation of ResMed sign • Adjustment to ResMed utilities including telecommunication, gas, power, water and irrigation services • Reinstate landscaping	4220 m^2	120,000 m^2	Partial (3.5 per cent)	Private property	B7
Lot 3002 DP879664	Bella Vista Farm, Bella Vista NSW 2153	• Relocation of Bella Vista Farm Sign • Reinstate landscaping • Earthworks for batters and to reinstate open grass drain	2080 m^2	70,900 m^2	Partial (2.9 per cent)	Hills Shire Council	RE1

Lot and DP	Property address	Description	Land acquisition	Total area	Acquisition type	Current owner	Land use zone [1]
Property adjustments							
Lot 102 DP817929	Bella Vista Farm, Bella Vista NSW 2153	• Tie-in driveway on Elizabeth Macarthur Dr southbound to Bella Vista Farm site • Reinstate landscaping	N/A	N/A	N/A	Hills Shire Council	RE1
Lot 3 DP271253	2 Lexington Dr, Bella Vista NSW 2153	• Reinstate landscaping	N/A	N/A	N/A	Private property	B7
Lot 7034 DP1089408	7-9 Irvine Place, Bella Vista NSW 2153	• Potential to be impacted during detailed design adjustments	N/A	N/A	N/A	Private property	B7
Lot 1 DP1057607	Elizabeth Macarthur Drive, Bella Vista	• Potential to be impacted during detailed design adjustments	N/A	N/A	N/A	Hills Shire Council	RE1 / B7
Lot 24 DP1046638	Norwest Boulevard, Bella Vista NSW 2153	• Potential to be impacted during detailed design adjustments	N/A	N/A	N/A	Hills Shire Council	RE1
Lot 31 DP1036558	Norwest Boulevard, Bella Vista NSW 2153	• Potential to be impacted during detailed design adjustments	N/A	N/A	N/A	Hills Shire Council	RE1
Lot 25 DP1046638	Westwood Way, Bella, Vista NSW 2153	• Potential to be impacted during detailed design adjustments	N/A	N/A	N/A	Hills Shire Council	RE1

1 Note: B7= Business Park, RE1= Public Recreation Further information provided in ***Section 4.1.2***

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 (Infrastructure) 2007

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

Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road and is to be carried out by Transport for NSW, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent from council is not required.

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

Part 2 of ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in **Section 5.5**.

4.1.2 Local Environmental Plan

The Hills Local Environmental Plan 2012

The Hills Local Environmental Plan 2012 (the LEP) applies to land within The Hills Shire local government area (LGA). The proposal area is located within or in the immediate vicinity of land with a number of different zonings, which are listed in **Table 4-1** which also lists the objectives that apply to each zone, and summarises the consistency of the proposal with these objectives. The location of these zones is shown in **Figure 4-1.**

The proposal may interact with items listed in Schedule 5 of the LEP as having local heritage significance. However, Clause 94 of the ISEPP removes the requirement to seek development consent from The Hills Shire Council. If the proposal is likely to affect the heritage significance of a local heritage item, consultation requirements in Clause 14 of the ISEPP would apply. ISEPP consultation is discussed in **Chapter 5**.

Table 4-1 LEP zone objectives

Zone	Objectives	Consistency with objectives
B7 Business Park	• To provide a range of office and light industrial uses	The proposal would improve the operation of the intersection, and support access to and from Norwest Business Park The proposal is consistent with the objectives of this zone.
	• To encourage employment opportunities.	
	• To enable other land uses that provide facilities or services to meet the day to day needs of workers in the area.	
	• To make provision for high technology industries that use and develop advanced technologies, products and processes.	
R3 – Medium Density Residential	• To provide for the housing needs of the community within a medium density residential environment.	The proposal would improve the operation of the intersection, and support access to and from Norwest Business Park The proposal is consistent with the objectives of this zone.
	• To provide for a variety of housing types and densities within a medium density residential environment.	
	• To enable other land uses that provide facilities or services to meet the day to day needs of residents.	
	• To encourage medium density residential development in locations that are close to population centres and public transport routes	The proposal provides an important route for public transport and would support access to the Norwest Business Park and Norwest Metro Station, once operational. The proposal is consistent with the objectives of this zone.
SP2 – Infrastructure	• To provide for infrastructure and related uses.	The proposal would provide new road related infrastructure, to reduce congestion and improve traffic flow within the area.
	• To prevent development that is not compatible with or that may detract from the provision of infrastructure	The proposal involves the upgrade of existing infrastructure, and is consistent with the objectives of this zone.
RE1 – Public Recreation	• To enable land to be used for public open space or recreational purposes	The proposal would improve pedestrian access to surrounding land uses and encourage the use of public transport, which is consistent with the objectives of this zone.
	• To provide a range of recreational settings and activities and compatible land uses	
	• To protect and enhance the natural environment for recreational purposes	The proposal aims to minimise any adverse impacts to the natural environment.

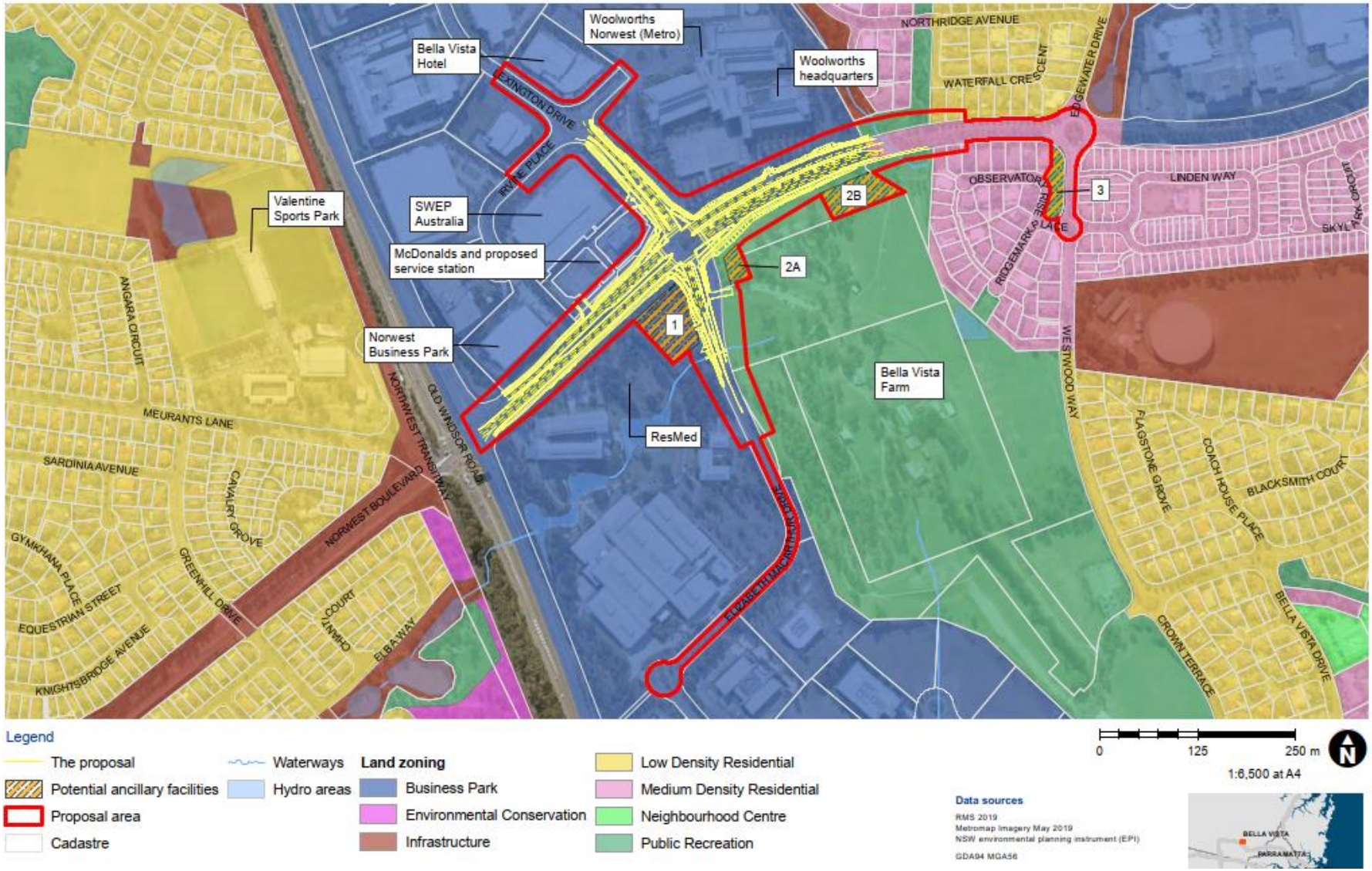


Figure 4-1 Land zoning within the proposal area

4.2 Other relevant NSW legislation

4.2.1 Roads Act 1993

Norwest Boulevard is classified as a State Road. Lexington Drive and Elizabeth Macarthur Drive are unclassified roads.

Section 138 of the *Roads Act 1993* (Roads Act) requires consent from the relevant road authority for the carrying out of work in, on or over a public road. Clause 5(1) in Schedule 2 of the Roads Act states that public authorities do not require consent for works on unclassified roads.

On 1 December 2019, Roads and Maritime Services and Transport for NSW joined together to create one integrated Transport for NSW. All functions and responsibilities will now be performed by Transport for NSW and any references to Roads and Maritime Services will automatically be legally taken to mean Transport for NSW. Therefore, Transport for NSW (now integrated with Roads and Maritime) is considered the relevant road authority for the proposal.

4.2.2 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides a number of mechanisms by which items and places of heritage significance may be protected. The Heritage Act is designed to protect both listed heritage items such as standing structures, and potential archaeological remains or relics.

The Heritage Council of NSW maintains the State Heritage Register (SHR), which controls activities such as alteration, damage, demolition and development. Applications under section 60 of the Heritage Act must be made to the Heritage Council of NSW for any major work which could impact an item listed on the SHR.

Section 139 of the Heritage Act also requires any person who knows or has reasonable cause to suspect that their proposed works will expose or disturb an archaeological ‘relic’ to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to section 140), unless there is an applicable exception (pursuant to Section 139(4)).

The proposal would impact on the state-heritage listed Bella Vista Farm (SHR# 00754). The proposal involves the acquisition of a strip of the curtilage of the Bella Vista Farm, between one and 20 metres in width, along Norwest Boulevard for approximately 230 metres from its junction with Elizabeth Macarthur Drive. Any works that would impact the SHR curtilage of the Bella Vista Farm would need to be the subject of an application under section 60 of the Heritage Act.

Under section 170 of the Heritage Act, all state government agencies must keep and administer a database of heritage assets called a Section 170 Heritage and Conservation Register.

The proposal extends to the intersection of Old Windsor Road, which is listed on the Roads and Maritime s170 State agency heritage register (No. 4301011). No impacts are anticipated to the key elements of the Old Windsor Road precinct as identified in the Old Windsor Road CMP (Clive Lucas Stapleton, 2005),

Further details of impacts to heritage-listed items are discussed further in **Section 6.6** and **Appendix I**.

4.2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) commenced on 25 August 2017 and repealed the *Threatened Species Conservation Act 1995*, the *Nature Conservation Trust Act 2001* and parts of the *National Parks and Wildlife Act 1974*. The BC Act introduces a Biodiversity Assessment Method (BAM) and Biodiversity Offsets Scheme (BOS). The BC Act lists a number of threatened species, populations or ecological communities to be considered in deciding whether a development or activity "likely to significantly affect threatened species". A development or an activity is likely to significantly affect threatened species if:

a) it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3 (of the BC Act), or

b) the development exceeds the BOS threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, or

c) it is carried out in a declared area of outstanding biodiversity value.

Tests of significance were carried out for the following listed threatened flora, fauna and ecological communities listed under the BC Act and potentially present within the proposal area:

- *Eucalyptus scoparia*
- Shale Sandstone Transition Forest
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Little Eagle (*Hieraaetus morphn*oides)
- Spotted Harrier (*Circus assimilis*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Powerful Owl (*Ninox strenua*)
- Eastern Coastal Freetail-bat (*Micronomus norfolkensis*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
- Southern Myotis (*Myotis macropus*)

The tests of significance concluded that 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. Further information is provided in **Section 6.1** and **Appendix H**.

The BOS does not apply to development that is an activity subject to environmental impact assessment under Division 5.1 of the EP&A Act unless the proponent chooses to opt into the BOS. As described above, the proposal is not likely to significantly impact threatened species or ecological communities or their habitats, and also does not meet the condition thresholds for Roads and Maritime offsets. Therefore, the proposal would not include the provision of biodiversity offsets.

4.2.4 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is the primary statutory control dealing with Aboriginal heritage in New South Wales. It is administered by the Environment, Energy and Science Group (EESG) of the Department of Planning, Industry and Environment (DPIE) (former NSW Office of Environment and Heritage (OEH)).

Under the NPW Act, a person must not harm, knowingly or unknowingly, an Aboriginal object or declared Aboriginal place. Sections 86, 87 and 90 of the NPW Act require consent

from the EESG (former OEH) for the destruction or damage of Aboriginal objects. The NPW Act provides a defence against prosecution for harming an Aboriginal object if the defendant exercised due diligence.

An Aboriginal archaeological survey report was prepared in December 2017, with an addendum report prepared in January 2020, fulfilling the due diligence requirements under section 87(2) of the NPW Act. No Aboriginal archaeological objects or potential archaeological deposits were identified within the study area during a site walk over with a representative of the Deerubbin Local Aboriginal Land Council, and the area was found to be extensively disturbed by modern land use practices.

The potential for unexpected items of Aboriginal heritage or Aboriginal archaeological remains to be present within the proposal area is considered low. The Roads and Maritime Standard Management Procedure - Unexpected Heritage Items would be followed in the event that an unknown or potential Aboriginal object, including skeletal remains, is found during construction. Further information is provided in **Section 6.7**.

4.2.5 Biosecurity Act 2015

The *Biosecurity Act 2015* and its subordinate legislation commenced on 1 July 2017. The *Biosecurity Act 2015* replaces, in whole or in part 14 separate pieces of biosecurity related legislation including the *Noxious Weeds Act 1993*. Under the *Biosecurity Act 2015* all plants including weeds are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

The *Biosecurity Act 2015* and Regulations provide specific legal requirements for high risk activities and State level priority weeds. If present, priority weeds on the site would be assessed and controlled to fulfil the General Biosecurity Duty and minimise biosecurity risks.

One priority weed was recorded within the proposal area, *Senecio madagascariensis* (Fireweed). There are no specific management measures for this species in The Hills LGA. The duty under the *Biosecurity Act 2015* is that this species must not be imported into the State or sold. The weed control measures in the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011) would be used to control this weed species.

4.2.6 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates activities which may result in pollution impacts (eg land, air, water and noise pollution). Under Part 3.2 of the POEO Act, the carrying out of scheduled development work as defined in Schedule 1 – road construction (meaning the construction, widening, or re-routing of roads) is relevant to the proposal.

Road construction is a scheduled activity under Schedule 1 of the POEO Act if it results in four or more traffic lanes (not including bicycle lanes or lanes used for entry or exit), where the road is classified or proposed to be classified as a main road for at least three kilometres of its length in the metropolitan area. This does not apply to the proposal, therefore the proposal is not considered a scheduled activity.

The construction contractor and Transport for NSW are obliged to notify the EPA if a pollution incident occurs that causes or threatens material harm to the environment.

Transport for NSW and/or the construction contractor would implement a number of safeguards and management measures to minimise and manage the risk of any potential adverse impacts arising from the proposed work on the surrounding environment (see **Chapter 7**).

4.2.7 Land Acquisition (Just Terms Compensation) Act 1991

The proposal would require Transport for NSW to acquire strips of land within the proposal area to accommodate the proposed road upgrade. All land acquisitions 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** and **Section 6.5.3**.

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 **Section 6.4** of the REF.

Under the strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015, a referral is not required for proposed road activities that may affect nationally listed threatened species, endangered ecological communities and migratory species.

4.3.1.1 Findings – matters of national environmental significance

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

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

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. **Section 6.4** of the REF describes the safeguards and management measures to be applied.

4.4 Confirmation of statutory position

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

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 undertaken to date for the proposal and the consultation proposed for the future.

This chapter provides an overview of the consultation activities that have been, and would continue to be, carried out for the proposal. Community and stakeholder consultation carried out so far has supported the options assessment. Consultation would continue as the proposal progresses through the display of the concept design and this REF.

5.1 Consultation strategy

A Communication and Stakeholder Engagement Plan (CSEP) was developed at the start of the options assessment and concept design stage, which described the communication and consultation approach and activities to be carried out.

The objectives of the Communication and Stakeholder Engagement Plan (CSEP) include:

- To develop stakeholders', customers and the community understanding of the proposal and its objectives
- To gain input and support for the proposal from stakeholders, customers and the community
- To provide clear information about the proposal status and progress
- To ensure that community and stakeholder enquiries about the proposal are managed and resolved in an effective and timely manner
- To ensure that proposal information is distributed in an effective and timely manner.

The CSEP outlines the key messages for engagement and the range of engagement tools and activities to be used prior to and throughout the proposal (such as a dedicated phone line, letterbox drops, community events and public display of the REF). These tools and activities would ensure that proposal information is distributed to the community appropriately as well as to receive feedback from stakeholders and the local community.

Key stakeholders identified in the CSEP include:

- Local community including residents, road and transport users, community groups
- State Member of Parliament (MP) for Baulkham Hills
- The Hill Shire Council
- Local businesses
- Bus companies
- Sydney Metro
- Emergency services
- Utility providers.

The CSEP would be revised as the proposal progresses to ensure that stakeholders are kept informed throughout.

5.2 Consultation tools and activities

The following communication and engagement activities and tools were used to provide information about the proposal and to gather community and stakeholder feedback on the preferred option.

Webpage

A dedicated web page was established on the Transport for NSW's website as a source of information about the proposal, which has been and would continue to be updated regularly throughout the proposal's life cycle. The dedicated website for the proposal is: https://www.rms.nsw.gov.au/projects/norwest-boulevard-bella-vista

Mail

A postal address to receive written feedback was established for the duration of the proposal at Norwest Boulevard Upgrade Project Team, Roads and Maritime Services, PO Box 973, Parramatta NSW 2124.

Information phone line

A telephone information line, 1800 577 277 was established for the duration of the proposal as a direct communication channel for community members and stakeholders to contact the proposal team.

Email address

Community members and stakeholders were invited to provide their comments or questions via the proposal email address: norwestboulevardupgrade@rms.nsw.gov.au.

The email address would remain for the length of the proposal lifecycle as a channel for formal submissions to be made during public display periods as well as a direct communication channel for general community enquiries outside of display periods.

Meetings and briefings

Meetings and briefings have been held with key government agencies, local councils and key stakeholders to explain specific details of the proposal and gather feedback. Opportunities for meetings and briefings with stakeholders would continue throughout the life of the proposal.

Workshops

Two value management workshops were held in June 2017 and December 2019, which was attended by technical experts, key stakeholders as well as Hills Shire Council. The workshop was to assess the design options against agreed criteria such as safety, constructability, traffic efficiency and environmental impacts.

Business surveys

Online surveys were sent to business owners and/or managers located around the proposal in January 2020 to better understand local business perspectives and concerns. Five businesses participated in the survey.

5.3 Community involvement

Four out of five businesses suggested that the proposal would have a 'negative' or 'significantly negative' impact to their business due to potentially limited vehicle access and dust generated during construction. Key issues raised by surveyed business owners are shown in **Table 5-1.**

Due to the COVID-19 pandemic, no further consultation has been carried out since March 2020. Consultation is expected to continue once pandemic restrictions are eased and social distancing orders have been lifted.

Table 5-1 Key issues raising by businesses

Group	Issue raised	Response/where addressed in REF
Local Business	• Concern over telecommunication cables being interfered with during construction • Amenity (noise, vibration and dust impacts) • Access for business employees, customers and deliveries during construction	• Utility impacts are discussed in **Section 3.5**, noting that some cables would be relocated • Potential amenity impacts and proposed management measures are discussed in Section 6.2 (Noise and vibration) and Section 6.11 (Air quality) • Access impacts during construction are discussed in Section 6.1 (Traffic, transport and access) and Section 6.5 (Socio-economic, property and land use)

5.4 Aboriginal community involvement

The proposal has been considered against the requirements of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime, 2011b). This procedure is generally consistent with the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (Department of Environment, Climate Change and Water, 2010). An outline of the procedure is presented in **Table 5-2**.

Table 5-2: Summary of Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial Transport for NSW assessment Desktop assessment to determine whether a Transport for NSW proposal is likely to harm Aboriginal cultural heritage, and whether further assessment or investigation is required.
Stage 2	Site survey and further assessment Further assessment and a survey with specific Aboriginal stakeholders and an archaeologist to assess whether a project would impact Aboriginal cultural heritage.
Stage 3	Formal consultation and preparation of a cultural heritage assessment report. Aboriginal parties must be involved in the preparation of these reports in accordance with legislative requirements and the Aboriginal cultural heritage consultation requirements for proponents 2010 (Department of Environment, Climate Change and Water, 2010).
Stage 4	Implement environmental impact assessment recommendations Undertake salvage and/or project implementation in accordance with an Aboriginal Heritage Impact Permit (AHIP) and/or recommendations included in the cultural heritage assessment report (Stage 3), for projects where planning approval has been obtained under the EP&A Act.

An Aboriginal archaeological survey report was prepared in December 2017 in accordance with the Stage 2 PACHCI requirements (refer to **Appendix J**). There are no Native Title holders/claimants currently registered for the study area however, the Deerubbin Local Aboriginal Land Council (DLALC) participated in the archaeological survey of the study area in September 2017. Following the survey, the DLALC provided Transport for NSW with a

survey and cultural assessment report which stated that the DLALC have no objection to the proposal.

An additional walkover of the study area was conducted in November 2019 and an Aboriginal Archaeological Assessment Addendum Report was prepared. Although not a formal requirement of the due diligence process under the Due Diligence Code of Practice (Department of Energy, Climate Change and Water, 2010), the DLALC was notified of the additional areas being surveyed since the walkover in 2017. Based on the results, undertaking PACHCI Stage 3 and Stage 4 is not required.

5.5 ISEPP consultation

Relevant to the proposal, Transport for NSW has consulted with the Hills Shire Council (in accordance with the requirements specified in Division 1, Part 2 of the ISEPP) in relation to the following:

- Potential impacts on council-related infrastructure and services, including stormwater management services provided by council, excavation adjacent to roads for which council is the roads authority (clause 13(1) of the ISEPP).

Appendix C contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been met.

A letter was sent to Council on 22 June 2020, which provided information on the proposal and requested input in terms of any issues or concerns. No response was received from Council on the ISEPP consultation however the Hills Shire Council has been engaged on an ongoing basis during design development as described in the section below.

5.6 Government agency and stakeholder involvement

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

- Hills Shire Council
- ResMed
- Woolworths Property Group
- Norwest Association/Mulpha
- Bus operators.

Transport for NSW has consulted on an ongoing basis with stakeholders and government agencies to ensure stakeholder issues and concerns are understood, documented and addressed. Consultation has included emails and face to face meetings onsite.

Issues that have been raised as a result of consultation with these agencies and stakeholders are outlined below in **Table 5-3**.

Table 5-3 Issues raised through government agency and stakeholder consultation

Agency	Issue raised	Response/where addressed in REF
Hills Shire Council	• No objections to the proposed bus stop changes however Council would be in charge of relocation of the bus stop on Lexington Drive.	• Transport for NSW to liaise with Council to acquire relevant approvals from the traffic committee and potentially Transport for NSW on changes to bus stop locations.
ResMed	• Utility and geotechnical investigations would be undertaken largely at night, near ResMed, some potholing would need to be undertaken at the corner of Norwest Boulevard and Elizabeth Macarthur Drive. • Potential displacement of red bark and small grass shrubs during investigations.	• Given the non-destructive nature of the utility investigation, ResMed considers the potholing activity to be acceptable. Transport for NSW would bring a few bags of red bark to replace any bark that may be displaced during utility potholing and geotechnical investigation shifts. Some impact to small grass shrubs is acceptable. • Transport for NSW geotechnical and utility project teams would contact ResMed at least 24 hours prior to any investigations taking place
Woolworths Property Group	• Utility and geotechnical investigations would be undertaken on some areas of Woolworth's property • Geotechnical works would follow the investigation once utilities have been cleared • Woolworths land on which the investigations would take place is not owned by Woolworths • Traffic conditions at Woolworths property would be impacted. In particular the line marking of Lexington Drive roundabout to dual right turn lanes needs to be considered by Transport for NSW Network Integration team	• Woolworths provided verbal approval for above ground utility investigations in Woolworths property in the meantime • Woolworths has suggested that property access would be provided for geotechnical works, after the utilities have been cleared • Woolworths to provide Transport for NSW with land owner contact details and provide formal property access approval for geotechnical works once utilities have been cleared • A working group has been set up with Council and Transport for NSW to • discuss the proposed short term changes to the area. Line marking of Lexington Drive roundabout to dual right turn lanes would need consideration by Transport for NSW Network Integration team.
Norwest Association/ Mulpha	• Main concern regarding the retention of landscaping within the median to ensure the 'Boulevard' context is preserved • Norwest Association, Mulpha Norwest and Council requested upgrading the footpaths to shared paths in the Business Park in the short to medium term. The shared path design should work with the proposed upgrade footprint to prevent too much rework. Shared paths are preferred on the southern side of Norwest Boulevard and western side of Lexington Drive.	• Landscaping and urban design principles would be considered during concept design and consultation with Norwest Association (see **Section 3.2.5**) • A 2.5 m shared path has been provided on the southern side of Norwest Boulevard and western side of Lexington Drive and Elizabeth Macarthur Drive.

Agency	Issue raised	Response/where addressed in REF
CDC Bus and Busways	• Safety concerns about collision between traffic turning left into the Woolworths driveway and stopping buses. Bus stop should be relocated to after the Woolworths driveway, opposite the westbound bus stop on Norwest Boulevard. Bus operators requested the following: • Inclusion of a bus jump start for eastbound buses (only used by busways at 20 minute intervals) due to heavy AM peak traffic • An indented bus bay for eastbound departure side of the signalised intersection due to the inclusion of the bus jump start • An online bus stop in front of Bella Vista Farm in westbound carriageway • Moving the bus stop in Lexington Drive further northern out of the proposed scope of works.	• Traffic modelling does not show any benefits in providing an eastbound bus jump start. Following meetings with the bus operators and Transport for NSW Network Safety, Network Development and Bus Planning the following changes to bus provisions are proposed: • Bus stops to be kerbside, not indented at the request of bus operators • Eastbound bus stop on Norwest Boulevard to be located before the Woolworths Driveway • Westbound bus stop on Norwest Boulevard to be located in diverge of third through lane with sufficient space to allow storage of two buses • Southbound bus stop located in Lexington Drive is proposed to be moved further north (outside of Bella Vista Hotel) – proposal supported by Woolworths • Northbound bus stop located on Elizabeth Macarthur Drive is proposed to be retained in its current position. The shared path has been extended to meet the bus stop.

5.7 Consultation during REF exhibition

On 25 March 2020, the NSW Government introduced the COVID-19 Legislation Amendment (Emergency Measures) Bill 2020, which made changes to the EP&A Act. The COVID-19 Legislation Amendment (Emergency Measures) Bill 2020 removed the requirement for planning decision makers (such as councils) to display physical copies of some documents. These documents would now be available online via the NSW Planning Portal or local council website.

This document would be on public display in August 2020 for a minimum of 28 days. The display provides a detailed assessment of proposal benefits and potential proposal impacts. During the REF exhibition, the community, government agencies and other interested parties are invited to make written submissions on the proposal.

Following public display, submissions would be reviewed and the issues raised by the respondents would be considered by Transport for NSW before determining whether to proceed with the proposal.

If Transport for NSW decide to proceed with the proposal, a submissions report would be prepared which would include the key impacts identified in this REF, demonstrate how Transport for NSW considered issues raised during the public display period, and include a summary of mitigation measures proposed to minimise the impacts of the proposal. The submissions report would be made available to the public via the Transport for NSW website.

5.8 Consultation during construction stages

Should the proposal proceed to construction, the proposal team would continue to consult the community, as well as internal and external stakeholders where required, to ensure they are informed about the proposal and have opportunities to provide feedback to the proposal team. Key involvement activities and tools would include:

- Meetings with individual landowners likely to be impacted by noise during and/or after construction to discuss potential impacts and mitigation measures
- Development and implementation of a detailed construction communications plan
- Notification of upcoming construction work (including targeted letterbox drops)
- 24-hour toll-free proposal information phone line
- Transport Management Centre (TMC) communication channels; radio crosses and interviews, variable message signs throughout the Bella Vista road network
- Live Traffic and Transport Info websites and TMC 24-hour Traffic Information Line (132 701)
- Complaints management process
- Regular updates to the proposal website
- Newsletters, information brochures and fact sheets
- Clear signage at construction sites
- Media releases and proposal advertisements in local and metropolitan papers
- Construction updates (including for councils, emergency services and bus operators).

6 Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

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

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

6.1 Traffic, transport and access

The potential benefits and impacts of the proposal on traffic, transport and access are assessed in the Traffic Impact Assessment (Bitzios Consulting, 2020), which is provided in **Appendix D**. A summary of the assessment is presented in this section.

6.1.1 Methodology

The traffic and transport assessment included:

- Detailing the current traffic and transport conditions along Norwest Boulevard
- Developing, calibrating and validating a 2017 base year microsimulation model replicating existing traffic conditions within the study area
- Estimating traffic volumes along Norwest Boulevard in 2026 and 2036
- Developing 2026 and 2036 'Do nothing' traffic models to test and compare the proposed upgrade (the proposal)
- Evaluating the performance of the proposal for the intersection of Norwest Boulevard and Lexington Drive (and nearby locations if needed).

Study area

The traffic and transport assessment investigated an area larger than the REF proposal area, extending about two kilometres between the M7 Motorway and Solent Circuit. The investigation area for the traffic and transport assessment included the following intersections:

- Norwest Boulevard / Greenhill Drive
- Norwest Boulevard / Old Windsor Road
- Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive
- Norwest Boulevard / Edgewater Drive / Westwood Way
- Lexington Drive / Irvine Place.

Data collection

The following data was also collated to inform model development and impact assessment:

- Intersection turn counts by vehicle class collected in September 2017 at the following intersections:
  - Norwest Boulevard / Greenhill Drive
  - Norwest Boulevard / Old Windsor Road
  - Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive
  - Lexington Drive / Irvine Place / Woolworths Way
  - Norwest Boulevard / Edgewater Drive / Westwood Way
- Tube counts, collected between Old Windsor Road and Lexington Drive collected in September 2017
- Travel time surveys
- SCATS Intersection Diagnostic Monitor (IDM) signal data from the roundabout metering signals at the Norwest Boulevard / Lexington Drive roundabout
- Aerial photography
- Population and employment projections from Transport Performance and Analytics travel zones
- Site observations.

Traffic modelling and forecasting

Transport modelling is a fundamental component of the methodology used to evaluate traffic impacts of future land use and assess the quantitative impacts of the proposal on the road network. The traffic modelling assessment process for the proposal involved the following:

- Development of a base condition traffic model for Norwest Boulevard between the M7 Motorway and to the west of Solent Circuit under existing traffic conditions (the 2017 base case)
- Development of future year (2026 and 2036) forecasts for the study area and testing of the proposed upgrade in the micro simulation traffic model.

Traffic modelling been developed using the VISSIM modelling platform and all existing (2017 base case) and future year (2026 and 2036) scenarios have been calibrated and validated. The proposal was then added in the 2026 and 2036 ‘Do nothing’ scenario models to create a ‘proposed upgrade’ scenario model. The details of this calibration and validation are provided in the Base Model Calibration and Validation Technical Note (see Appendix B of the Traffic Impact Assessment (**Appendix D**)).

The following peak periods were chosen for modelling of the study area:

- 6:00 am-10:00 am for the morning peak
- 3:30 pm-6:30 pm for the evening peak

The Sydney Strategic Transport Model (STM) has been used for the calculation of forecast traffic demands. The STM includes a number of planned developments within the vicinity of the study area that are expected to contribute to a substantial increase in traffic volumes between these future years. Further information on the considered developments is provided in **Appendix D**.

Performance criteria

The traffic assessment used the following criteria to assess the performance of each modelled scenario:

- Intersection Level of Service (LOS)
- Travel times
- Overall Network Statistics.

Level of service

The 'Level of Service' (LoS) is the standard measure used to assess the operational performance of the network and intersections. Level of services is ranked from LoS A to LoS F with LoS A representing the best performance and LoS F the worst. The assessment of intersection operation is based on criteria outlined in **Table 6-1**.

Table 6-1 Level of Service criteria

Level of Service (LoS)	Average delay per vehicle (sec)	Description
A	≤ 15	Good operation
B	15 to 29	Good with acceptable delays and spare capacity
C	29 to 43	Satisfactory
D	43 to 57	Operating near capacity
E	57 to 70	At capacity
F	> 70	Unsatisfactory

Travel times

Travel times and travel speeds provide an alternative means of assessing the functional performance of a road under interrupted flow conditions. For the purpose of this assessment, the travel time route along Norwest Boulevard between M7 Motorway in the west and Solent Circuit in the east has been divided into five sub sections:

- Section 1: M7 to Greenhill Drive
- Section 2: Greenhill Drive to Old Windsor Drive
- Section 3: Old Windsor Drive to Lexington Drive
- Section 4: Lexington Drive to Edgewater Drive
- Section 5: Edgewater Drive to west of Solent Circuit.

Overall network statistics

The various network statistics assessed included:

- Average Delay per Vehicle (seconds): This indicates the average delay experienced by all vehicles in the network
- Average Network Speed (km/h): This indicates the average travel speed of vehicles within the network

- Vehicle Kilometres Travelled (VKT): This represents the total distance travelled by all vehicles in the network and of those that have already exited within the assessment period
- Vehicle Hours Travelled (VHT): This represents the total travel time of vehicles within the network and of those that have already exited within the assessment period
- Stops: This represents the average number of stops per vehicle within the network
- Completed Trips (Vehicles Arrived): This represent the total number of vehicles which have reached their destination within the assessment period
- Incomplete Trips (Vehicles Active): This represents the total number of vehicles in the network at the end of the assessment period
- Unreleased Vehicles (Latent Demand): This represents vehicles which were not able to enter the network at the end of the assessment period and were stuck at the vehicle inputs or parking lots.

6.1.2 Existing environment

Existing travel characteristics

The study area is situated in the Blacktown and The Hills Shire Local Government Areas (LGA). Based on the 2016 Household Travel Survey, there were on average a total of 1,095,000 and 670,000 trips per year for each LGA respectively. Work trips including business trips make up 25 per cent of all trips. This is followed by social / recreation and shopping trips (21 per cent and 15 per cent respectively), and education or childcare-related trips (10 per cent of all trips).

Based on 2016 Census data, there were 16,228 people employed within the travel zones adjacent to the proposal. Of all work trips to the area, 93 per cent are made by car, as driver or passenger, six per cent are by public transport and one per cent are walking trips. For trips from the broader study area, private vehicles constitute 75 per cent of trips, with a higher proportion of travellers using public transport, for outbound trips compared to inbound trips, at 22 per cent. This is expected with outbound trips commuting to public transport-accessible locations such as the Sydney CBD.

Bus routes

The study area is serviced by the following bus services:

- 715 – Norwest Business Park to Seven Hills
- 745 – St Marys to Castle Hill via Stanhope Gardens
- 730 – Blacktown to Castle Hill via Glenwood & Norwest Business Park
- 664 – Rouse Hill Station to Parramatta via Kellyville.

These services provide connections between the residential areas surrounding Norwest Boulevard and the commercial/business sectors of Norwest as well as connections to other major business hubs including Parramatta, Blacktown, Castle Hill, Rouse Hill and the City. Several stops are located on both sides of Norwest Boulevard and there are high-frequency services during peak periods. **Figure 6-1** shows the bus routes throughout the study area.

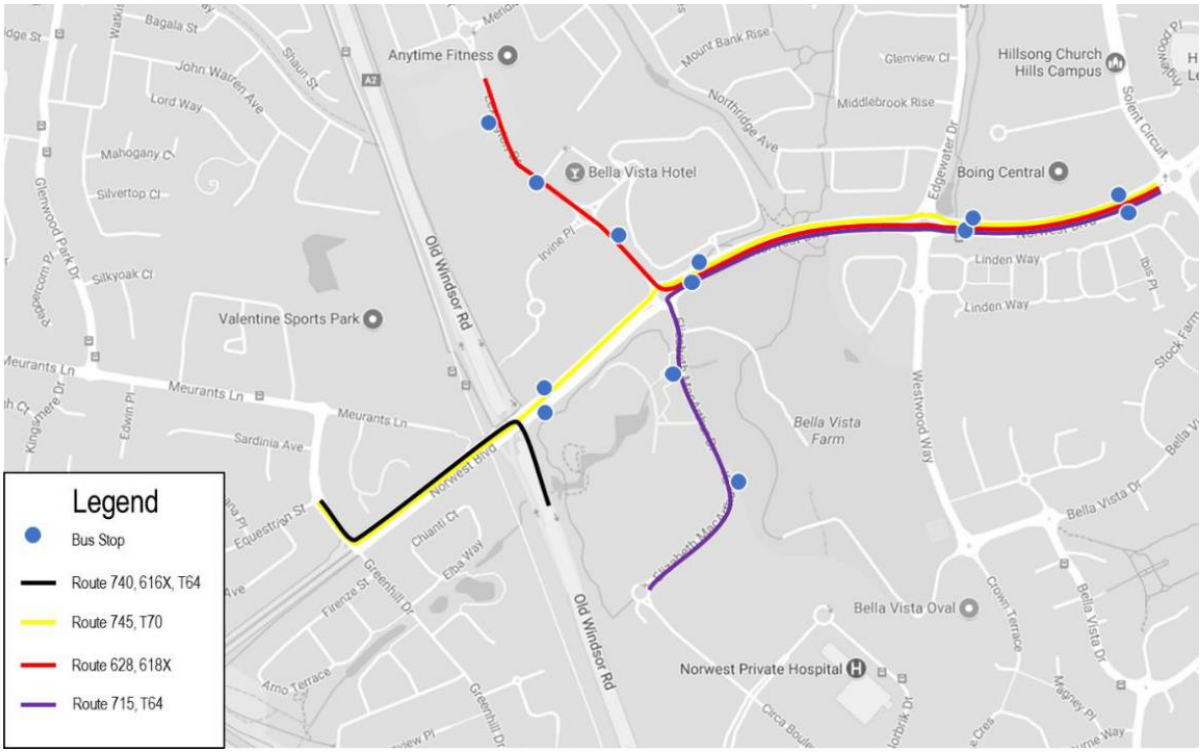


Figure 6-1 Bus services within the study area

Existing active transport

Norwest Boulevard includes extensive pedestrian networks on both sides of the corridor which facilitates pedestrian connectivity along and across wider area. Cycling facilities are located along Norwest Boulevard west of Old Windsor Road in the form of a shared path. A short section on the western approach to Edgewater Drive also provides shared path facilities for cyclists.

Existing traffic volumes

Tube count surveys were conducted in September 2017 during morning and evening peaks to obtain a snapshot of traffic volumes between Lexington Drive and Edgewater Drive. The existing traffic volumes during the morning and evening peak in each direction along Norwest Boulevard are shown in **Table 6-2.**

Between Lexington Drive and Edgewater Drive, the daily two-way traffic flow on Norwest Boulevard reached 42,000 vehicles per day. The two-way hourly traffic volumes on Norwest Boulevard vary between 2,900 and 3,200 vehicles per hour.

Table 6-2 Existing traffic volumes

Network statistic	2017 Morning Peak	2017 Evening peak
Eastbound	1,000	850
Westbound	1,830	1,190
Total	2,830	2,040

Existing traffic performance observations

The longest representative queues during a one-hour period during the 2017 morning and evening peaks (8:00 am to 9:00 am and 4:30 pm to 5:30 pm) is presented in **Figure 2-8** and **Figure 2-9.**

In the morning peak, queues on the eastbound approach extend back to the Old Windsor Road Interchange, past Greenhill Drive intersection and back towards the M7 off-ramp. The westbound approach experiences queues in both the morning and evening peaks. Queues from this approach extend back to Edgewater Drive towards Solent Circuit. The Lexington Drive approach also experiences substantial queues in the evening peak. The queues extend back to the Woolworths Way roundabout, impacting throughput from this approach.

Existing intersection performance

The morning and evening peak performance of each intersection within the corridor is summarised in **Table 6-3**. The existing intersection performance demonstrates the following:

- Traffic at Norwest Boulevard / Lexington Drive experiences delays during both morning and evening peak periods. In the morning peak, the roundabout operates at LoS F with substantial delays and queues on both the Norwest Boulevard approaches.
- The evening peak is more spread, hence the network is generally less congested than the morning peak, with the most delays occurring along Norwest Boulevard westbound. Traffic exiting from the Woolworths Way – Lexington Drive approach experiences substantial delays trying to enter the roundabout, with long queues observed on this approach.
- The Norwest Boulevard and Edgewater Drive roundabout also shows long delays in both peak periods due to heavy westbound flows on Norwest Boulevard.
- Traffic delays shown at Norwest Boulevard / Greenhill Drive are mainly due to congestion at Norwest Boulevard / Lexington Drive and consequential queueing effects. In the morning peak, eastbound queues on Norwest Boulevard extend all the way to the M7 Motorway off-ramp.

Table 6-3 Existing intersection LoS – morning and evening peak

Norwest Boulevard Intersections	LoS (delay,secs) AM Peak	LoS (delay,secs) PM Peak
Greenhill Drive	E (66)	C (36)
Old Windsor Road	C (41)	D (52)
Lexington Drive / Elizabeth Macarthur Drive	F (96)	F (348)
Edgewater Drive / Westwood Way	F (84)	E (62)
Lexington Drive / Woolworths Way	B (16)	D (50)

Existing travel time and speed

In the eastbound direction (towards Norwest), the morning peak travel time is substantially longer than in the evening peak by around 5.5 minutes. During the critical peak hour, the difference was up to 11.5 minutes (see **Figure 6-2**). In the westbound direction, travel times are similar in both the morning and evening peak periods. The Norwest Boulevard and Lexington Drive roundabout acts as a pinch point for eastbound traffic in the morning peak and for the westbound traffic during both peaks (see **Figure 6-3**).

In the morning peak, the average travel time on Norwest Boulevard between the M7 Motorway and Lexington Drive (about one kilometre) is around seven minutes. In the westbound direction, between Solent Circuit and Lexington Drive (about 900 metres) the average travel time is over four minutes.

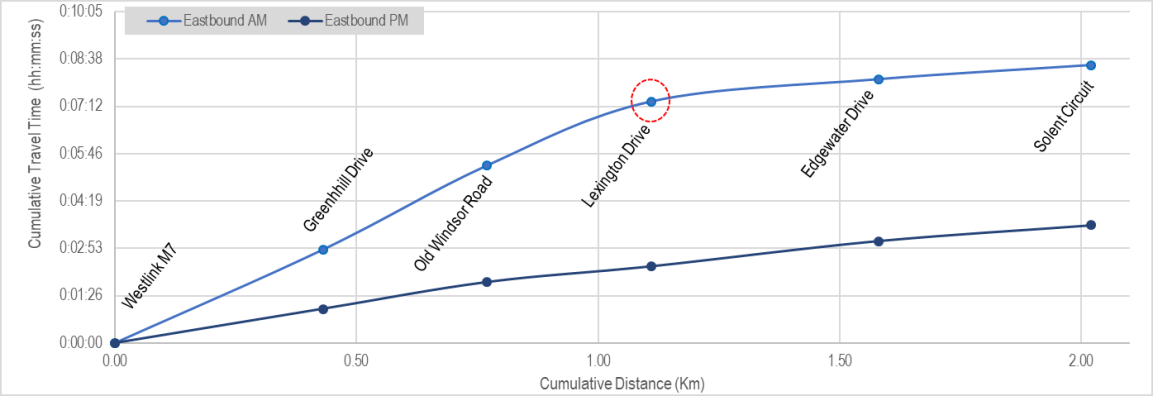


Figure 6-2 Existing eastbound travel time on Norwest Boulevard

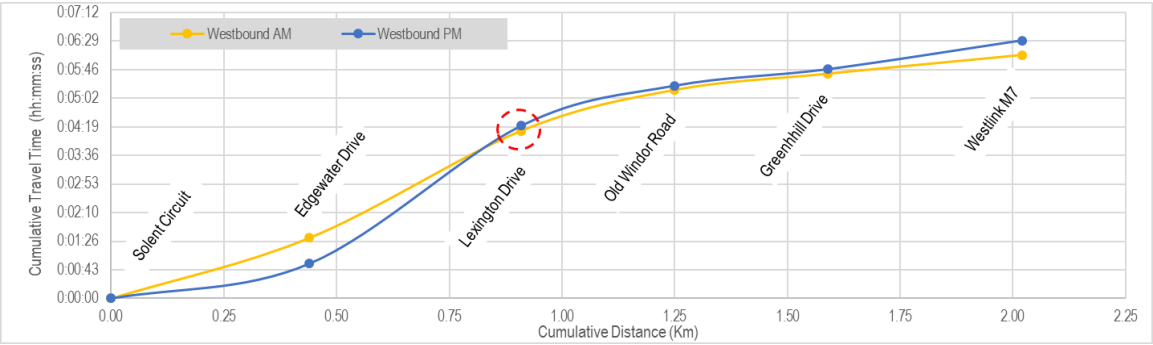


Figure 6-3 Existing westbound travel time on Norwest Boulevard

Existing overall network statistics

The existing (2017) network statistics are provided in **Table 6-4**. As discussed above, the network is generally less congested in the evening peak than in the morning peak.

Table 6-4 Existing network Statistics during morning and evening peaks

Network statistic	2017 Morning Peak	2017 Evening peak
Average Delay (s)	64	46
Average Network Speed (km/h)	40.3	45.3
VKT	61,903	40,016
VHT	1,619	1,158
Stops	96,250	60,085
Completed Trips	32,240	22,498
Unreleased Vehicles	0	0
Incomplete Trips	250	350

Existing road safety trends

Between 2014 and 2018, a total of 49 crashes occurred along Norwest Boulevard between (and including) Solent Circuit and Greenhill Drive. Of the 49 crashes, 26 crashes resulted in injuries (no fatalities) and the remainder were non-casualty (damage only) crashes. The 26 crashes resulted in 30 casualties.

On average, about 10 crashes occurred per annum, with the majority of crashes occurring at the Lexington Drive and Edgewater Drive roundabouts. Over one third (35 per cent) of the 49 crashes were rear-end collisions and 12 per cent of crashes occurred when changing lanes.

A total of 65 vehicles were involved in the 49 crashes. Of these, 70 per cent were light vehicles (car and light trucks), 22 per cent were heavy vehicles and 8 per cent were motorcycles. The percentage of heavy vehicles involved in crashes is high compared to the proportion of heavy vehicles in the total vehicle volumes.

Crash data shows approximately 20 per cent of crashes occurred in wet surface conditions, 31 per cent of the crashes occurred when there was no daylight and 23 per cent of the crashes were caused by speeding.

6.1.3 Potential impacts

6.1.3.1 Construction

The majority of traffic generated during the construction stages would be from plant, equipment and material deliveries, and removal of excess spoil. Most of this traffic would likely travel via Norwest Boulevard eastbound to Windsor Road and westbound to Old Windsor Road.

Construction activities would be staged (see **Section 3.3**) to minimise impacts on road capacity through the course of construction. Construction impacts on traffic through the proposal area would be minimised through the staging of construction, allowing the existing operating speed to be maintained throughout most construction activities.

During construction, two lanes in each direction of Norwest Boulevard would be operational at all times, with all existing exit and entry movements maintained. This enables road user delay to be kept to a minimum and allows vehicles to maintain their normal travel patterns through the construction area.

The implementation of a roadwork speed limit may be required on a periodic basis when works under traffic control are being undertaken, where works must be carried out under live traffic, or where night works are required in or near live traffic. Traffic control may be implemented in these situations. It is proposed that traffic is slowed from 70 kilometres per hour to 60 kilometres per hour through work areas. The speed restriction enables a reduction in edge clearances to temporary road safety barriers and provides improved safety by reducing traffic speed around the construction site. The reduction of speed is not expected to cause substantial work site delays as the current speed of vehicles negotiating the roundabout is already less than the 70 kilometres per hour posted speed.

The arrival and departure of workers at shift rotations may result in increased traffic demand through the construction zone and turning manoeuvres to / from the site access points. However, the start and finish of work shifts would most likely occur outside peak traffic periods (ie 6:00 am to 10:00 am and 3:30 pm to 6:30 pm).

Overall, the proposal would have minimal impacts on local roads and access in the investigation area during construction.

The proposed construction staging allows all bus stops to remain operational. If required, alternative temporary bus stops would be provided with appropriate signage to direct commuters. Safe access would be provided in accordance with relevant safety and accessibility standards.

Pedestrian facilities would be maintained on existing footpaths until completion of the new shared paths and footpaths. Where necessary, safe alternative routes for pedestrians and cyclists would be provided in accordance with relevant safety and accessibility standards.

6.1.3.2 Operation

The traffic model simulated operation of the proposal in the future road network to compare against the ‘do nothing’ scenario. Under the ‘do nothing’ scenario, the traffic and transport assessment assumed that there would be no changes to the existing road network and that the existing signal-metering at the Norwest Boulevard and Lexington Drive roundabout would continue. A summary of the assessment is provided in the following sections.

Intersection performance

Intersection performance for 2026 and 2036 with the proposal is shown in **Table 6-5**. The key findings are:

- The intersection performance would improve with the proposal when compared to ‘do nothing’ scenario for 2026 and 2036
- The proposed layout has substantial spare capacity
- While the proposed upgrade at the Lexington Drive intersection would substantially improve intersection capacity, the constraints associated with the limited capacity of the Edgewater Drive roundabout would limit the performance of the study section. Therefore, upgrades at the Norwest Boulevard intersection with Edgewater Drive would be critical to servicing the 2026 and 2036 demand traffic within the corridor.

Table 6-5 Future intersection LoS (delay in seconds) with the proposal

Intersection	LoS – 2017	2026		2036	
		LoS –Do nothing	LoS – with proposal	LoS –Do nothing	LoS – with proposal
Morning peak					
Lexington Drive / Elizabeth Macarthur Drive	F (96)	F (76)	C (38)	F (82)	C (42)
Evening peak					
Lexington Drive / Elizabeth Macarthur Drive	F (348)	F (596)	C (38)	F (523)	D (45)

Travel times

During 2026, traffic modelling identified the following:

- During the morning peak, eastbound travel time would be reduced (by over 8 minutes) with the proposal. The reduction in travel time is associated with the increased intersection throughput. This suggests that delays and queues associated with the Lexington Drive roundabout 'pinch point' would be substantially reduced. The assessment identified a substantial improvement in the eastbound travel time between M7 Motorway and Greenhill Drive.
- The proposal would also reduce the evening peak westbound travel time when compared to the 'do nothing' scenario. The reduction is mainly associated with the substantial improvement in travel time between Edgewater Drive and Lexington Drive. This is due to capacity improvements at the Lexington Drive intersection.
- The average speed during the morning peak would improve substantially with the proposal, with the proposal showing an increase in speeds of 50 per cent from 25 kilometres per hour to over 37 kilometres per hour.

For 2036, traffic modelling showed the following:

- The proposal would improve the morning peak eastbound travel time by over eight minutes compared to the 'do nothing' scenario
- During evening peak, the proposal would continue to provide travel time benefits in the westbound direction beyond 2026 to 2036. However, both options are influenced by limitations at the Edgewater Drive roundabout.

Unreleased trips

There is an increase in the number of overall vehicles through the network with the proposal (i.e. more capacity). The increase in capacity that would be achieved with the proposal would result in a substantial reduction in unreleased trips in 2026 and 2036, compared to the 'do nothing' scenario (see **Table 6-6**).

Table 6-6 Future unreleased trips with the proposal

Scenario	2026		2036	
	AM	PM	AM	PM
Do nothing	1,319	1,734	4,722	4,449
With proposal	823	633	2,016	2,616

Overall network statistics

The proposal would reduce the average network delay and improve the average network speed compared to the 'do nothing' scenario (see **Table 6-7**).

Table 6-7 Future network statistics under Option 1 and Option 2

Network statistic	2017	2026		2036	
		Do nothing	With proposal	Do nothing	With proposal
Morning peak					
Average Delay (s)	64	186	90	311	105
Average Network Speed (km/h)	40.3	24.7	37.9	17.0	35.7
VKT	61,903	67,755	69,967	71,629	81,270
VHT	1,619	2,867	1,866	4,266	2,321
Stops	96,250	287,427	151,494	474,733	159,684
Completed Trips	32,240	42,020	43,359	44,269	48,633
Unreleased Vehicles	0	1,319	823	4,722	2,016
Incomplete Trips	0	751	495	1,426	575
Evening peak					
Average Delay (s)	46	237	144	256	162
Average Network Speed (km/h)	45.3	21.8	30.0	20.1	27.9
VKT	40,016	39,400	41,649	43,274	46,820
VHT	1,158	1,890	1,421	2,255	1,706
Stops	60,085	235,063	128,967	292,860	171,777

Network statistic	2017	2026		2036	
		Do nothing	With proposal	Do nothing	With proposal
Completed Trips	22,498	24,424	25,588	26,951	28,911
Unreleased Vehicles	0	1,734	633	4,449	2,616
Incomplete Trips	0	680	471	817	662

Future traffic performance observations

For 2026 and 2036, the proposal would result in the following queuing:

- With the proposal, the long morning peak queues along Norwest Boulevard eastbound would be substantially reduced as a result of the upgrade of the Lexington Drive / Norwest Boulevard intersection. The proposal would continue to provide the benefit of shorter eastbound queues beyond 2036.
- With the proposal, long queues on the Norwest Boulevard westbound approach at the Edgewater Drive roundabout during both morning and evening peaks would continue, indicating a need to upgrade this intersection to remove these effects.
- Modelling shows that with the proposal both the northbound and southbound exit ramps at Old Windsor Road would provide acceptable traffic performance in 2026 and 2036.
- With the proposal, queuing on Woolworths Way during the core peak period (4.30 pm to 5.30 pm) would persist however this would dissipate relatively quickly.

Crash reduction

The proposal would improve the carrying capacity and performance of the section of Norwest Boulevard between M7 Motorway and Edgewater Drive. The existing pinch point at Lexington Drive roundabout would also be removed, resulting in less stop-start conditions and unexpected queues. Therefore, there would be a reduction in the likelihood of rear-end crashes.

The introduction of signalised pedestrian crossings on all approaches to the Lexington Drive/ Norwest Boulevard intersection would also improve pedestrian and cyclist safety. The introduction of shared paths on Norwest Boulevard and Lexington Drive would also improve active transport users' safety.

The proposal would continue to provide operational benefits between 2026 and 2036.

Impacts on public transport

The proposal would benefit bus services 745, 730, 664 and 715 which pass through the Lexington Drive intersection by increasing traffic capacity and reducing traffic congestion. Benefits would prevail until and beyond 2036.

Impacts on active transport

Pedestrian and cycle facilities would be improved the proposal, with the introduction of signalised crossings on all four approaches to the Lexington Drive intersection. The proposal would provide a shared path on the southern side of the Norwest Boulevard and on the eastern side of Lexington Drive.

Summary of findings

Overall the proposal would provide:

- A substantial increase in intersection capacity would improve the 2026 and 2036 morning and evening peak traffic flows in both the eastbound and westbound directions. In particular, the morning peak eastbound queues would reduce and no longer influence the M7 Motorway
- The configuration has additional spare capacity to service future traffic growth beyond 2036
- Some queues are shown on the Lexington Drive approach to Norwest Boulevard during the 2036 evening peak. However, this only happens during the 'core' of the peak period when there is a surge of employees exiting Woolworths Way and would dissipate relatively quickly
- When compared to the 'do-nothing' scenario, the average network speed would increase substantially with the proposal by between 8 kilometres per hour and 13 kilometres per hour in 2026 and between 17 kilometres per hour and 19 kilometres per hour in 2036
- The proposal would adequately service the 2036 traffic demands with queues generally contained within the proposed turn bay lengths.

6.1.4 Safeguards and management measures

Safeguards and management measures for potential noise and vibration impacts of the proposal are listed in **Table 6-8**.

Table 6-8 Safeguards and management measures – Traffic, transport and access

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will 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 will include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • 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	Contractor	Detailed design/ Pre-construction	Section 4.8 of QA G36 Environment Protection

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• 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.			
Impacts to local traffic and access	Requirements for any changes to local traffic and access arrangements will be confirmed during detailed design in consultation with Transport for NSW, Hills Shire Council and any affected landowners, including any temporary alternative access arrangements as required.	Contractor	Detailed design	
Haulage vehicles	Where practicable, movements of haulage vehicles will be planned to minimise movements on the road network during the morning and evening peak periods where practicable.	Contractor	Pre-construction/ Construction	
Impacts to pedestrian and cyclists	Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements would be provided following consultation with affected residents, Transport for NSW and Hills Shire Council.	Contractor	Pre-construction/ Construction	
Impacts to bus services	Access for public transport services will be maintained. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community. If required, alternative temporary bus stops will be provided with appropriate signage to direct commuters. Safe access will be provided in accordance with relevant safety and accessibility standards.	Contractor	Pre-construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
Impacts to business	A signage strategy will be prepared as part of the TMP to provide appropriate signage for businesses where existing signage is obscured or no longer visible or where customers are required to use alternative access to reach the businesses during construction.	Contractor	Pre-construction	

6.2 Noise and vibration

The potential noise and vibration impacts of the proposal are assessed in the Construction and Operational Noise and Vibration Assessment (Renzo Tonin, 2020), which is provided in **Appendix E**. A summary of the assessment is presented in this section.

6.2.1 Methodology

General methodology related to noise and vibration is included in the sections below. Full details of the methodologies, criteria and guidance used are included in **Appendix E**.

Noise catchment areas

Noise catchment areas (NCAs) were delineated to provide an assessment of areas exposed to construction noise impacts during standard construction hours and out of hours work (OOHW) periods. Description of each NCA are provided in **Table 6-9**. Maps of each NCA are provided in **Section 6.2.3**.

Table 6-9 Noise catchment areas during standard construction hours and OOHW

NCA	Description
Standard construction hours (S)	
NCA S_1	NCA predicted to be Highly Affected and exposed to $L_{Aeq\ (15\ min)}$ construction noise levels greater than 75 dB(A).
NCA S_2	NCA predicted to be exposed to $L_{Aeq\ (15\ min)}$ construction noise levels >20 dB(A) above the applicable NML.
NCA S_3	NCA predicted to be exposed to $L_{Aeq\ (15\ min)}$ construction noise levels that are between 10 dB(A) and 20 dB(A) above the applicable NML. This NCA would typically be behind rows of buildings.
NCA S_4	NCA predicted to be exposed to $L_{Aeq\ (15\ min)}$ construction noise levels that are <10 dB(A) above the applicable NML. This NCA would typically be behind rows of buildings and well removed from the proposal area.
Outside of standard work hours (OOHW)	
NCA OOHW_1	NCA predicted to be exposed to $L_{Aeq\ (15\ min)}$ construction noise levels >25 dB(A) above the applicable construction noise management level (NML)
NCA OOHW_2	NCA predicted to be exposed to $L_{Aeq\ (15\ min)}$ construction noise levels that are between 15 dB(A) and 25 dB(A) above the applicable NML.
NCA OOHW_3	NCA predicted to be exposed to $L_{Aeq\ (15\ min)}$ construction noise levels that are between 5 dB(A) and 15 dB(A) above the applicable NML. This NCA would typically be behind rows of buildings.

NCA	Description
NCA OOHW_4	NCA predicted to be exposed to $L_{Aeq\ (15\ min)}$ construction noise levels that are <5 dB(A) above the applicable NML. This NCA would typically be behind rows of buildings and well removed from the proposal area.

Noise monitoring methodology

To determine existing background (L_{90}) and traffic noise levels in the vicinity of the project, noise monitoring was undertaken at three locations (see **Table 6-10** and **Figure 6-4**). The equipment used for noise measurements was a Brüel & Kjær Type 2250 precision sound level analyser which is a Class 1 instrument having accuracy suitable for field and laboratory use.

Long term (unattended) noise monitoring was conducted over a one week period at two locations (M1 and M2) between Tuesday 26th November and Tuesday 3rd December 2019. The noise monitoring position was selected to be representative of the nearest potentially impacted residential receivers.

In addition, short term (attended) measurements were also conducted at one location (S1) on Tuesday 26th November 2019 from 11:30am to 12:15pm on the footpath on the southern side of Norwest Boulevard. These measurements were conducted to determine existing traffic noise levels on Norwest Boulevard and for traffic noise model validation.

A manual traffic classification survey was carried out along Norwest Boulevard concurrently with the short term (attended) measurements. The traffic data obtained was used to validate the traffic noise prediction model and predict the noise impact on sensitive receivers caused by the intersection upgrade.

The results of the noise monitoring were processed to exclude noise identified as extraneous (e.g. aeroplane noise; barking dogs) and/or data affected by adverse weather conditions (such as strong wind or rain) so as to establish representative noise levels in each area.

Table 6-10 Noise monitoring locations

Receiver	Address	Description
M1	24 Waterfall Crescent, Bella Vista	Noise monitor was located in the free field in the backyard of the property, facing Norwest Boulevard. Noise environment dominated by traffic noise from Norwest Boulevard.
M2	4 Macarthur Ridge Way, Bella Vista	Noise monitor was located in the free field in the backyard of the property, facing Bella Vista Farm. Noise environment dominated by distant traffic and general neighbourhood noise and considered representative of the residential receivers surrounding the site.
S1	Southern side of Norwest Boulevard carriageway	Noise measurements conducted on the footpath in the free field in front of the property, facing Norwest Boulevard. Noise environment dominated by traffic noise from Norwest Boulevard.

Construction noise assessment

Construction noise has been assessed in accordance with the Interim Construction Noise Guideline (ICNG) (DECC 2009), and with reference to the Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime, 2016). Construction road traffic noise has been assessed in accordance with the NSW Road Noise Policy (RNP) (NSW EPA, 2011).

Noise management levels

The rating background level (RBL) is used when determining the Noise Management Levels (NMLs). The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard construction hours).

Table 6-11 Noise management levels at residential receivers

Time of day	Noise Management Level	Description
Recommended standard construction hours: Monday to Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard construction hours	Noise affected RBL + 5 dB(A)	A strong justification should typically be required for works outside the recommended standard construction hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

The ‘noise affected’ level represents the point above which there may be some community reaction to noise. Residential receivers are considered ‘noise affected’ where construction noise levels are greater than the NMLs identified in **Table 6-11** above. During standard construction hours, a highly affected noise objective of $L_{Aeq\ (15min)}$ 75 dB(A) applies at residences.

Where predicted and/or measured construction noise levels exceed NMLs, all feasible and reasonable work practices will be applied to meet the management levels.

For sensitive receivers other than residential dwellings, **Table 6-12** outlines noise management levels.

Table 6-12 Noise management levels at other noise sensitive land uses

Land use	Where objective applies	Noise management level $L_{Aeq\ (15\ min)}$
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Construction scenarios and modelling

Construction work is anticipated to be undertaken during standard construction hours and outside of standard construction hours.

Applying these construction scenarios and based on the use of standard construction plant and equipment, a concrete breaker has the highest L_{Aeq} sound power level during standard construction hours and a demolition saw has the highest L_{Aeq} sound power level outside of standard construction hours. For a conservative assessment, three items of equipment have been assumed to be used concurrently and have been used as the noise sources for the noise predictions:

- Standard construction hours – the concrete breaker, demolition saw and asphalt paver
- OOHW period 2 – demolition saw, asphalt paver and excavator (five to 20 tonnes).

Construction noise impacts and NCAs were assessed for standard construction hours (as described above in **Table 6-11**) and OOHW period 2, as follows:

Night (OOHW Period 2):

- 10pm to 7am, Monday to Friday
- 10pm to 8am, Saturday
- 6pm to 7am, Sunday and public holidays.

Modelling and assessment of airborne noise impacts from construction activities was carried out using a 3D Cadna-A computer noise model. Noise levels were calculated taking into consideration attenuation due to distance between the construction works and receiver locations and any intervening structures (ie topographical features, existing and receiver buildings).

Construction vibration assessment

Vibration from construction activities has been assessed in accordance with Assessing Vibration: A Technical Guideline, DEC, 2006 and DIN 4150:Part 3-1999 Structural vibration – Effects of vibration on structures (Deutsches Institute fur Normung, 1999).

BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2 (BSI, 1993) has been used in the assessment of vibration impacts (damage) to non-heritage sensitive structures. DIN 4150:Part 3-1999 Structural vibration – Effects of vibration on structures (Deutsches Institute fur Normung, 1999) has been used for the screening assessment of vibration impacts (damage) to heritage sensitive structures, if a structure is found to be unsound.

Further details on vibration criteria and minimum working distances is provided in **Appendix E**.

Sleep disturbance

A night-time sleep disturbance 'screening criterion' noise goal of Rating Background Level (RBL) +15 dB(A) is used to identify the receivers where there is potential for sleep disturbance.

Where the sleep disturbance screening criterion is exceeded, further assessment is conducted to determine whether the 'awakening reaction' level of L_{Amax} 65 dB(A) would be exceeded and the likely number of these events. The awakening reaction level is the level above which sleep disturbance is considered likely.

Operational noise

Operational road traffic noise impacts have been assessed in accordance with guidance provided in the NSW Road Noise Policy (RNP) (NSW EPA, 2011) and with reference to the Noise Criteria Guideline (NCG) and the Noise Mitigation Guideline (NMG) (Roads and Maritime, December 2014).

Noise modelling was undertaken using the Road Traffic Noise Module in the Cadna-A noise modelling software. This noise modelling software is recognised and accepted by both Transport for NSW and the NSW EPA.

6.2.2 Existing environment

Sensitive receivers

The sensitivity of receivers to noise and vibration is dependent upon the occupancy type and the nature of the activities performed within the affected premises. Sensitivity to noise is a subjective response varying for different individuals and can depend on the existing noise environment.

The proposal is surrounded by commercial premises, a commercial headquarters (ResMed) and Bella Vista Farm. Residential receivers north and south of Norwest Boulevard are located beyond the extent of the proposed work to the east.

The properties outlined in **Table 6-13** and shown on **Figure 6-4** were identified during a site inspection and are considered to be representative of the worst affected receivers.

Table 6-13 Sensitive receiver locations

Receiver	Address	Type	Description
R1	4 Cloverhill Grove, Bella Vista	Residential	Single storey residential property located approximately 75 m from the carriageway of Norwest Boulevard and the proposed works.
R2	12 Cloverhill Grove, Bella Vista	Residential	Double storey residential property located approximately 37 m from the carriageway of Norwest Boulevard and the proposed works.
R3	24 Waterfall Crescent, Bella Vista	Residential	Double storey residential property located approximately 15 m from the carriageway of Norwest Boulevard and 75 m from the proposed works.
R4	15 Observatory Rise, Bella Vista	Residential	Double storey residential property located approximately 15 m from the carriageway of Norwest Boulevard and 80 m from the proposed works.
R5	18 Macarthur Ridge Way, Bella Vista	Residential	Double storey residential property located approximately 40 m from the carriageway of Norwest Boulevard and 68 m from the proposed works.
R6	14 Macarthur Ridge Way, Bella Vista	Residential	Double storey residential property located approximately 75 m from the carriageway of Norwest Boulevard and 85 m from the proposed works.
R7	Bella Vista Farm - Norwest Boulevard and Elizabeth Macarthur Drive, Bella Vista	Passive recreation	Passive recreation area located approximately 205 m from the carriageway of Norwest Boulevard, and 135 m from the carriageway of Elizabeth Macarthur Drive and the proposed works.
R8	ResMed – 1 Elizabeth Macarthur Drive, Bella Vista	Commercial	Multi-storey building located approximately 18 m from the carriageway of Norwest Boulevard and 15 m from the proposed works.

Ambient noise surveys and monitoring locations

Existing background and ambient noise levels measured at location M1 and M2 are presented in **Table 6-14** for the ICNG daytime, evening and night-time periods.

Ambient noise is the all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far. Background noise describes the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed.

Table 6-14 Measured existing background (L_{90}) and ambient (L_{eq}) noise levels, dB(A)

Monitoring location	Background L_{90} Noise Levels			Ambient L_{Aeq} Noise Levels		
	Day	Evening	Night	Day	Evening	Night
M1	49	46	32	55	55	50
M2	34	36	30	56	59	46

Existing traffic noise levels for Norwest Boulevard as measured during the short term measurements (at S1) are presented in **Table 6-15**.

Table 6-15 Measured existing LAeq traffic noise levels, dB(A)

Monitoring location	Location	$L_{Aeq, 1\ hour}$ Traffic Noise Levels, dB(A)
S1	Southern side of Norwest Boulevard carriageway	74

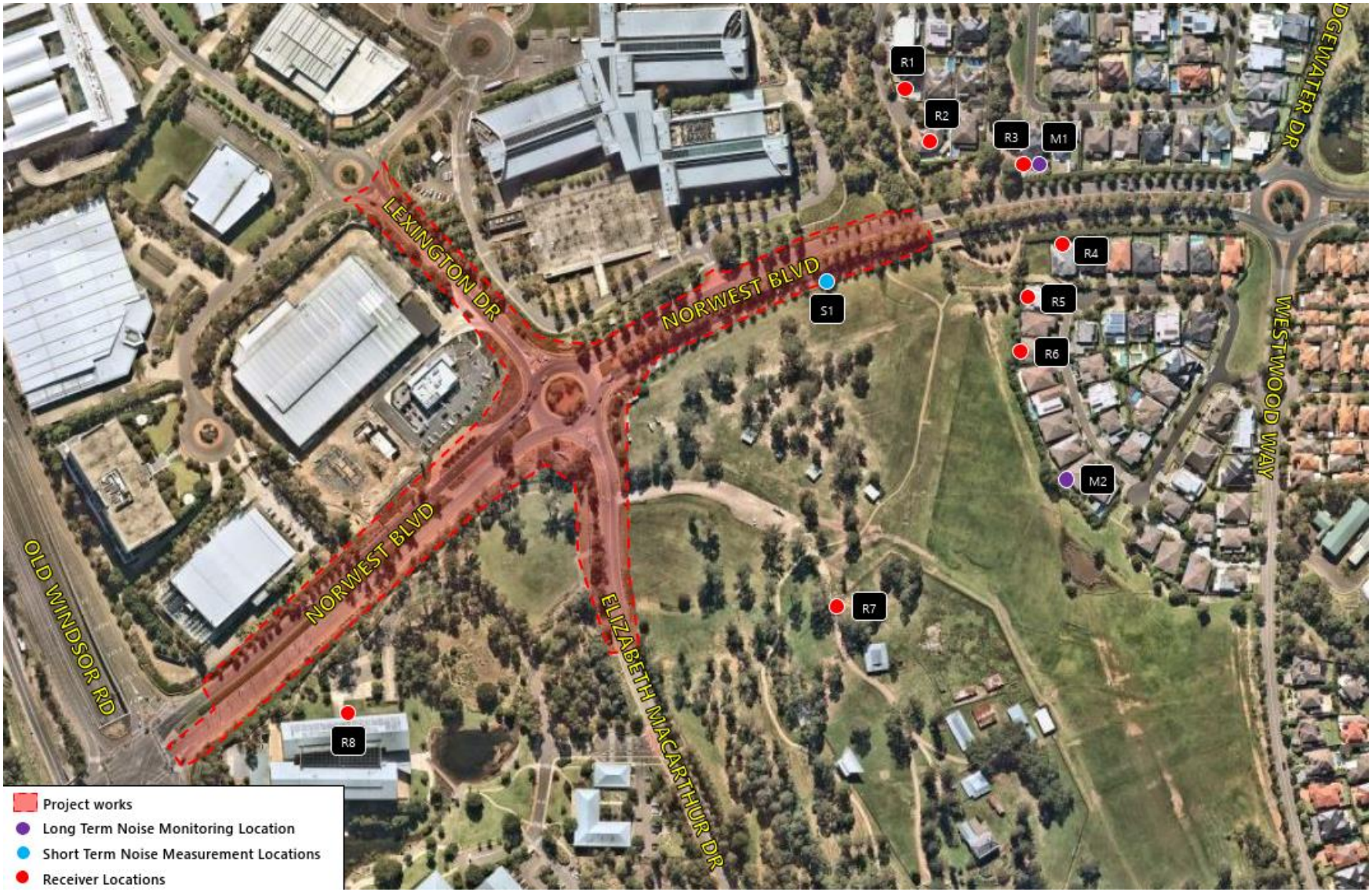


Figure 6-4 Monitoring locations and sensitive receiver locations

6.2.3 Potential impacts

6.2.3.1 Construction

Noise management levels

Table 6-16 presents the construction NMLs established for the nearest affected noise sensitive residential receivers based upon the noise monitoring results outlined in **Table 6-14**, the proposed construction hours and the above ICNG requirements. For a conservative assessment, noise management levels are based on monitoring location M2.

Table 6-16 Construction noise management levels, dB(A)

Receiver location	Assessment period	Noise management level $L_{Aeq(15\ min)}$
All residential receivers (R1-R6)	Daytime (standard construction hours)[1]	35[4] + 10 = **45**
	Evening (outside standard construction hours)[2]	35[5] + 5 = **40**
	Night (outside standard construction hours)[3]	30 + 5 = **35**
ResMed (R7)	When in use	**65**[6]
Bella Vista Farm (R8)	When in use	**60**
Commercial premises	When in use	**70**
Industrial premises	When in use	**75**

Notes: 1. Day period represents the construction hours from 7am to 6pm

2. Evening period represents the construction hours period from 6pm to 10pm

3. Night period represents the construction hours period from 10pm to 7am

4. In accordance with Noise Policy for Industry (NPfI 2017) the minimum RBL value is 35 dB(A) during the day period.

5. In accordance with Noise Policy for Industry (NPfI 2017) for the basis of establishing the noise management levels, the RBL for evening should not be greater than the RBL for daytime.

6. External noise level - For the purposes of this assessment, a minimum (conservative) outside-to-inside attenuation of 20 dB can be assumed.

Construction noise contours and impacts

Construction would be carried out primarily during standard construction hours however as discussed in **Section 6.2.1**, some works would be carried out during OOHW period 1 and 2.

Areas affected by construction noise (above the NMLs listed above) have been identified using noise contour maps to delineate the NCAs (described above in **Table 6-9**) for construction activities during standard construction hours (see **Figure 6-5**) and OOHW period 2 (see **Figure 6-6**).

Based on predicted construction noise levels and the corresponding NCAs, a feasible and reasonable approach towards noise management measures is to be applied to reduce noise levels as much as possible to manage the impact from construction noise. Safeguards and management measures are described in **Section 6.2.4**.

Sleep disturbance

In addition to the above predicted $L_{Aeq(15min)}$ noise levels for the corresponding NCAs, areas where the L_{Amax} noise levels at residential receivers during night time works would cause sleep disturbance (i.e. greater than 65 dB(A)) are presented in **Figure 6-7**. In accordance with the ICNG the sleep disturbance assessment is only applicable where construction works are planned to extend over more than two consecutive nights. Based on a worst-case scenario about five residential receivers may be potentially impacted by construction noise levels that are likely to exceed sleep disturbance threshold.

Maximum noise level predictions have been based on the demolition saw to provide a conservative assessment as this activity will have the highest L_{Amax} noise source level.

Construction vibration

Based on the proposed plant items vibration generated by construction plant was estimated and potential vibration impacts are summarised in **Table 6-17**. The assessment is relevant to the identified residential and commercial type buildings.

Recommendations for reduction of potential vibration impacts, including minimum working distances for construction plant are provided in **Section 6.2.4**.

Table 6-17 Potential vibration impacts for residential receivers

Approx. distance to nearest buildings from works	Type of nearest sensitive buildings	Assessment on potential vibration impacts	
		Structural damage risk	Human disturbance
5 to 15 m	Residential	Medium risk of structural damage from construction works	High risk of adverse comment as a result of construction works
15 to 30 m	Residential	Low risk of structural damage from construction works	Medium risk of adverse comment as a result of construction works
30 to 50 m	Residential	Very low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works
Greater than 50 m	Residential	Very low risk of structural damage from construction works	Very low risk of adverse comment as a result of construction works

Heritage structures

Table 6-18 identifies the heritage-listed structures close to the proposal and an assessment of potential construction vibration impacts. Overall the risk of vibration impacts to heritage structures is considered low.

Table 6-18 Potential vibration impacts for heritage structures

Name	Address	Significance	Approx distance	Potential impact
Bella Vista Farm / Bella Vista Homestead Complex	Elizabeth Macarthur Drive, Bella Vista	Local / State	• Less than 5 metres (post and rail fencing) • 40 metres (picnic table)	If required, the rail fencing would be removed and replaced after the works. Low risk of structural damage to the picnic table from construction works
Old Windsor Road Meurants Lane Alignment	Eastern carriageway of Old Windsor Road	Local	Less than 5 metres	Given this alignment is presently utilised by public traffic including heavy vehicles, there is a low risk of structural damage from construction works
Old Windsor Road and Windsor Road Heritage Precincts	Western side of Old Windsor Road	Local	80 metres	Very low risk of structural damage from construction works

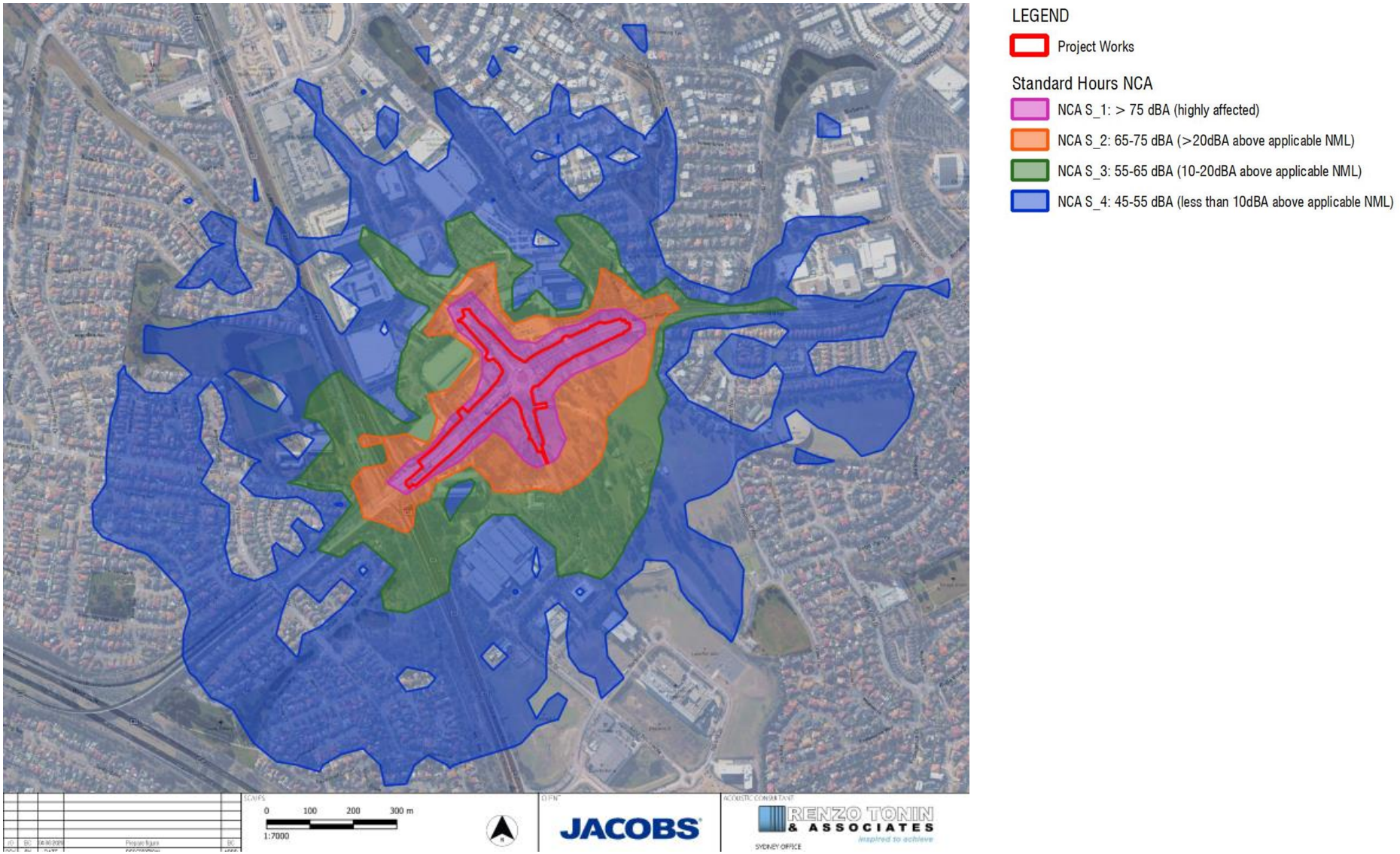


Figure 6-5 Construction noise impacts during standard construction hours

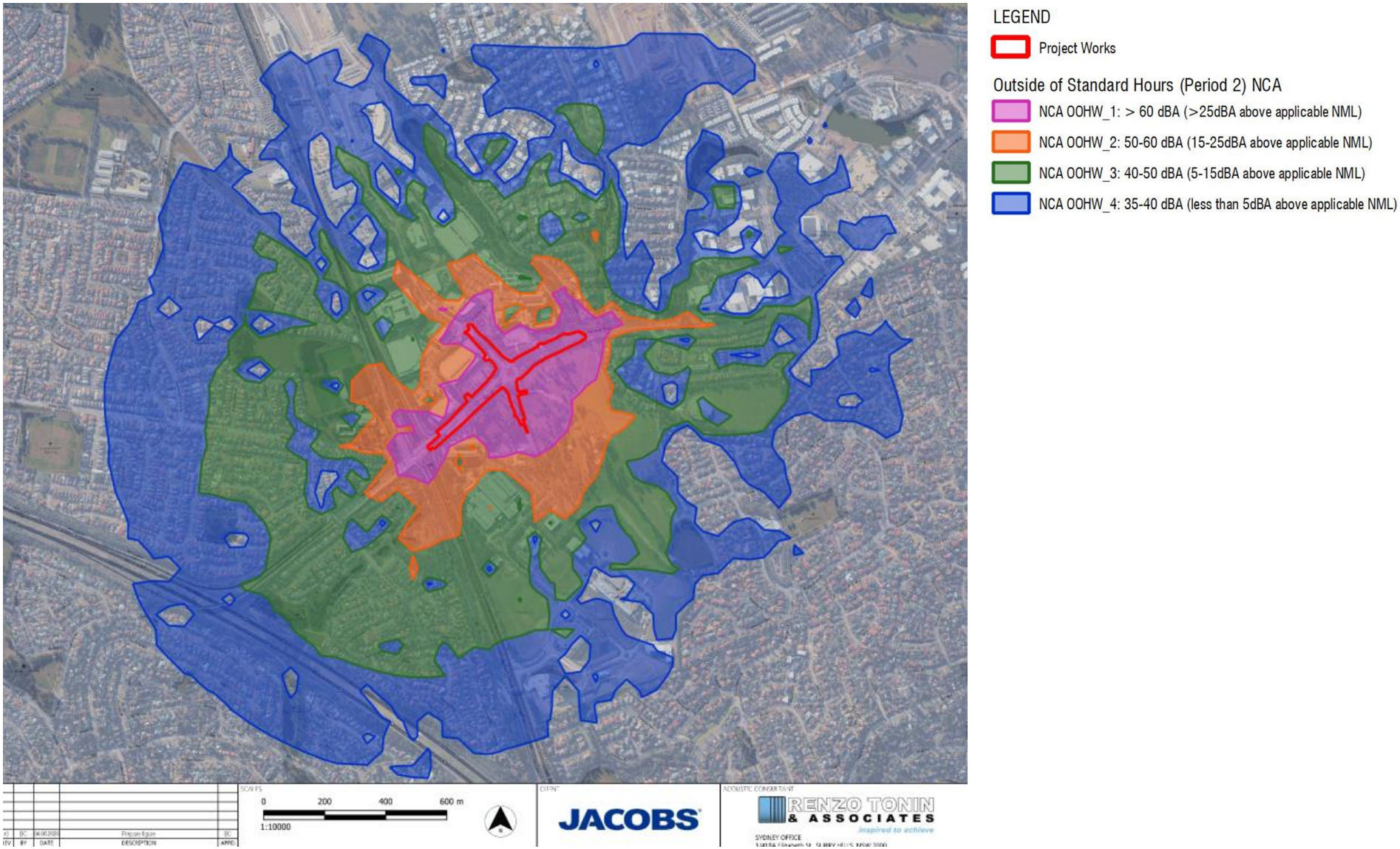


Figure 6-6 Construction noise impacts during OOHW period 2

Figure 6-7 Sleep disturbance

6.2.3.2 Operation

The predicted noise levels provided in **Table 6-19** show that at the year of opening (2026) the worst affected residential receivers are predicted to incur an increase in traffic noise levels of up to 1.5 dB(A) as a result of the upgraded intersection ('build' scenario) compared to if it was not upgraded ('no-build' scenario). This is less than the 2.0 dB(A) increase allowance presented in the NCG and NMG. Therefore no additional noise mitigation measures are required for any residential properties.

Table 6-19 Predicted traffic noise levels, dB(A) during proposal operation (2036)

Receiver	$L_{Aeq(15\ hour)}$ Noise Level					
	Day (2026)			Night (2026)		
	No build	Build	Difference	No build	Build	Difference
R1	56.2	57.6	1.4	49.3	50.6	1.3
R2	66.3	67.3	1.0	59.5	60.5	1.0
R3	69.6	70.9	1.3	62.8	64.1	1.3
R4	71.5	73.0	1.5	64.8	66.2	1.4
R5	64.7	66.1	1.4	58.0	59.3	1.3
R6	61.2	62.5	1.3	54.5	55.8	1.3
R7	56.5	57.7	1.2	49.5	50.7	1.2
R8	63.8	64.6	0.8	56.9	57.7	0.8

In addition, the proposal would include the installation of audio-tactile push buttons to pedestrian crossing traffic control signals to provide improved accessibility for hearing and visually impaired people. The assessment identified that the installation of audio-tactile push buttons at pedestrian crossings would comply with the 60 dB(A) noise goal, as predicted for the nearest residents during the night time period.

6.2.4 Safeguards and management measures

Appendix C of the CNVG provides details of additional noise mitigation measures to be applied when there are still exceedances of the NMLs after all the appropriate standard mitigation measures (from Appendix B of the CNVG) have been applied. Based on the NCAs presented in **Figure 6-5** and **Figure 6-6,** the appropriate additional mitigation measures for each NCA are shown in **Table 6-20**.

Table 6-20 Additional noise mitigation measures for NCAs

NCA	NML, dB(A)	Predicted Noise Level dB(A)	Recommended additional mitigation measures
Standard construction hours (S)			
NCA S_1	45	75	N, V, PC, RO
NCA S_2	45	65	N, V
NCA S_3	45	55	N, V
NCA S_4	45	45	-
Outside of standard work hours (OOHW Period 2)			
NCA OOHW_1	35	60	AA, V, IB, N, PC, SN, R2, DR
NCA OOHW_2	35	50	V, IB, N, PC, S, R2, DR
NCA OOHW_3	35	40	V, N, R2, DR
NCA OOHW_4	35	35	N

Note: N = Notification, V= Verification, PC = Phone call, RO = Respite offer, AA = Alternative accommodation, SN = Specific notification, R2 = Respite period 2, DR = Duration respite

Safeguards and management measures for potential noise and vibration impacts of the proposal are listed in **Table 6-21**. These measures would be reviewed and refined during detailed design.

Table 6-21 Safeguards and management measures – Noise and vibration

Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim *Construction Noise Guideline* (ICNG) (Department of Energy and Climate Change, 2009) and identify: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account standard treatments as outlined in Appendix B of the CNVG, and *Beyond the Pavement: urban design policy, process and principles* (Roads and Maritime, 2014a). • A monitoring program to assess performance against relevant noise and vibration criteria	Contractor	Detailed design/ Pre-construction	Section 4.6 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.			
Noise and vibration	All sensitive receivers (eg schools, local residents) likely to be affected will be notified at least five days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The planned construction activities • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information.	Contractor	Detailed design/ Pre-construction	
Sleep disturbance	Attended noise measurements will be undertaken at the nearest affected receivers once equipment is introduced on site at the beginning of night works to establish and quantify actual L_{Amax} noise levels on site. Where measured L_{Amax} noise levels exceed the sleep disturbance limit, then a reasonable and feasible approach towards noise management, in accordance with the CNVG should be considered to reduce noise levels as much as possible to manage the impact from construction noise during night time periods.	Contractor	Construction	
Construction vibration	Site-specific minimum working distances should be determined whenever significant vibration generating plant will be working close to or within the CNVG recommended minimum working distances.	Contractor	Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	The structural damage site-specific minimum working distances should be determined based on the DIN4150-3 limits.			
	Where construction activity occurs in close proximity to sensitive receivers, vibration testing of actual equipment on site will be carried out prior to commencement of site operations, to determine acceptable buffer distances to the nearest affected receiver locations.	Contractor	Construction	
Vibration monitoring	Further attended vibration monitoring will be conducted whenever significant vibration generating plant items are operating close to or within the determined minimum working distances. Locations for vibration monitoring during particular works will be determined by the construction contractor. Where vibration is found to be excessive, management measures will be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones, and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.	Contractor	Construction	
Structural damage	Dilapidation surveys will be conducted at residential receivers determined, by the contractor, to be sensitive to vibration impacts.	Contractor	Construction	

6.3 Landscape character and visual impacts

The potential benefits and impacts of the proposal on landscape character and visual amenity are assessed in the Urban Design, Landscape Character and Visual Impact Assessment (LCVIA) (Tract, 2020), which is provided in **Appendix F**. The LCVIA follows the Roads and Maritime Guideline for Landscape Character and Visual Impact Assessment EIA-N04 (Roads and Maritime, 2013). A summary of the assessment is presented in this section.

6.3.1 Methodology

Landscape character impact assessment

Contextual analysis involved identification of Landscape Character Zones (LCZ) based generally on areas of similar spatial or character properties. The proposal is assessed in terms of its impacts on these character zones and the impact ranked in terms of sensitivity to change.

Visual impact assessment

The visual impact assessment involves an assessment of the visibility of the proposal and considers the following:

- Visibility: The extent from which receptors can view the proposal area is referred to as the 'view catchment'
- Adjoining observer: Receptors that adjoin the road corridor (i.e. residential receivers)
- Commuter viewer: Receptors that travel along the road corridor or adjacent to it (i.e. vehicles, pedestrian or cyclists).

Impact grading matrix

Table 6-22

Table 6-22 shows the landscape character and visual impact grading matrix used to quantify impacts, and uses the following terminology:

- Sensitivity refers to the qualities of an area, the type number and type of receivers and how sensitive the existing character of the setting is to the proposed change. For example a pristine natural environment would be more sensitive to change than a built up industrial area.
- Magnitude refers to the nature of the proposal. For example a large interchange would have a very different impact on landscape character to a localised road widening in the same area.

Table 6-22 Landscape character and visual impact grading

Sensitivity	Magnitude				
		High	**Moderate**	**Low**	**Negligible**
	High	High Impact	High-Moderate	Moderate	Negligible
	Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
	Low	Moderate	Moderate-Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

6.3.2 Existing environment

Background

The proposal is in Sydney's North West, about 26 kilometres from Sydney CBD. It is located on Norwest Boulevard, a primary feeder road for traffic into and out of the Norwest Business Park from either Old Windsor Road or Windsor Road.

Norwest Business Park comprises 377 hectares for specialised business park, bulky goods retail, retail, residential, park lands and open space. About half of this total area is for specialised business park, bulky goods retail and retail. The employment population within the Norwest Business Park is currently over 25,000 (Norwest Association Limited). Low density residential development is located at the eastern edge of the proposal. The recent addition of a Metro rail line has added a new mode of public transport to the Norwest Business Park.

Bella Vista Farm, a remnant pastoral and farming property that is listed on the State Heritage Register, adjoins and overlooks the south eastern corner of the Norwest Boulevard/ Lexington Drive intersection.

The vegetation along the corridor is primarily a cultural construct associated with the development and marketing of the Norwest Business Park, comprised largely of median and verge planting. The landscape has been well managed and is a key element of the character and identity which the park projects.

The alignment of Norwest Boulevard is undulating but generally rises to the east from Old Windsor Road to its intersection with Windsor Road which is some 30 metres higher, at an elevation of 112 metres.

A McDonalds restaurant has recently opened, and a Shell service station will open in 2020, on the north west corner of the Norwest Boulevard/Lexington Drive intersection. Both of these new uses have a high profile frontage in which they seek to establish a strong visual presence with the road. While their typical development style has been refined and presents a more subdued address than is their norm, this site differs from all other uses along the corridor.

Landscape character zones

The proposal area was divided into five LCZs, including the road corridor. A description of each LCZ is provided in Table 6-23 and the location of each is shown in **Figure 6-8**.

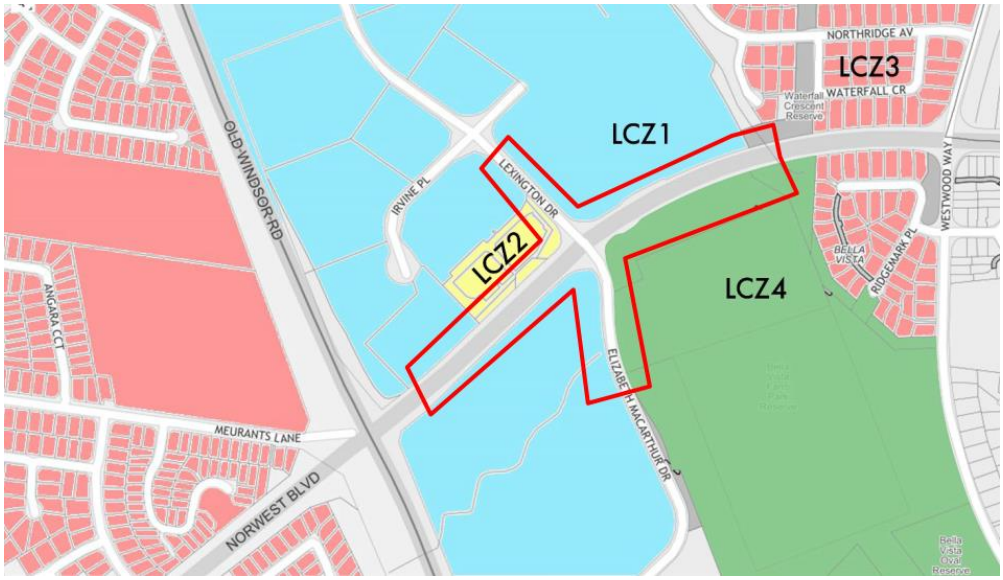


Figure 6-8 Landscape character zones within proposal area

Table 6-23 LCZ description and sensitivity

LCZ	Imagery	Description	Sensitivity
LCZ 1 – Business park landscape		This is the dominant landscape type which defines most portions of the corridor. Included within this landscape type are the ResMed Development – south western corner of Elizabeth Macarthur Drive; Woolworths Group Office – north eastern corner of Lexington Drive, and Norwest Boulevard. These sites present a landscape context to the built form which is setback from the road and is accessed from side roads and so has only a pedestrian address to the road corridor. This typically is a minor element of the development with a focus on car usage.	**Low** The landscaped settings of the sites combined with relatively deep offsets from the road frontage mean they have a relatively low sensitivity to change.
LCZ 2 – Retail Landscape		The newest and evolving character within the alignment has been the establishment of a new McDonalds restaurant and Shell service station. These bring a retail focus which is dependent on the interaction of the site with the passing traffic. It differs from the business park landscape in that it seeks to access passing trade as well as act as a destination. The key difference is the visibility and presentation of the site from Norwest Boulevard.	**High** The overall sensitivity of these users are dependent on the landscape response which is implemented within the road corridor. Visual connection between the passing traffic and the road corridor are critical. Their sensitivity to change is consequently considered high.

LCZ	Imagery	Description	Sensitivity
LCZ 3 – Residential landscape		The residential precinct is located to the south east and north/ north-east of the study area and backs onto Norwest Boulevard with no direct access. Despite this several properties overlook the study area, and so has seen this precinct incorporated into the assessment.	**Moderate** As a residential precinct the area is considered to have a moderate sensitivity to change. This ranking is considered due the rear of the residential properties facing Norwest Boulevard and therefore having less exposure to the corridor.
LCZ4 – Open Space / Recreation / Heritage Landscape – Bella Vista Farm		Located on the southern side of the alignment east of Elizabeth Macarthur Drive, Bella Vista Farm presents as a large open space with the heritage structure setback beyond view of Norwest Boulevard. Bella Vista Farm has significance from both its spatial relationship to the road but also its heritage. It is often used for community events and forms a key gathering place for the Norwest and Bella Vista communities, as well as those from further afield.	**High** As a listed heritage item of significance to the broader community both for its heritage and recreational functions it is considered to have a high sensitivity.

LCZ	Imagery	Description	Sensitivity
LCZ – Road corridor		The road corridor is the element which unites and connects the disparate character zones. It provides a distinct character and definition to the public realm which is stretched between Old Windsor Road and Windsor Road. Key elements of this is a well-managed and manicured landscape comprising a combination of large canopy trees, lower understorey shrubs, predominately low to medium height hedging and feature shrubs of a low to medium height within the median to delineate the corridor and the character of the broader estate precinct.	**High** The corridor is experienced by the majority of the users of the Norwest Business park and as such is a key element in establishing the identity of the precinct, as such it has a high sensitivity to change.

Visual impact assessment

The view catchment for the proposal is largely contained by the built form and vegetation of the corridor and relates to the Norwest Boulevard corridor itself. Sixteen viewpoints within the view catchment were selected (see **Figure 6-9**). Regional views are generally not experienced from within or to the corridor.

Visual receptors within the corridor consist of the recreational users of Bella Vista Farm, business users, and commuter traffic in all its forms. Residential impacts are largely absent with the nearest residential development located beyond the eastern limit of the proposed works site. The experience of the viewers varies according to the length and nature of exposure to the proposal.

Of the adjoining observers it is the recreational users who would be most sensitive to change. Businesses would experience a similar response to those recreating adjacent the corridor but would be less sensitive to the changes as their expectation and interest in the outlook is less.

Of the commuter viewer it is the pedestrian and cyclists who would be most sensitive to the changes due to the longer exposure to the changes and their more intimate connection to the environment in which they are travelling.

The sensitivity of each viewpoint to change is described in **Table 6-25**.

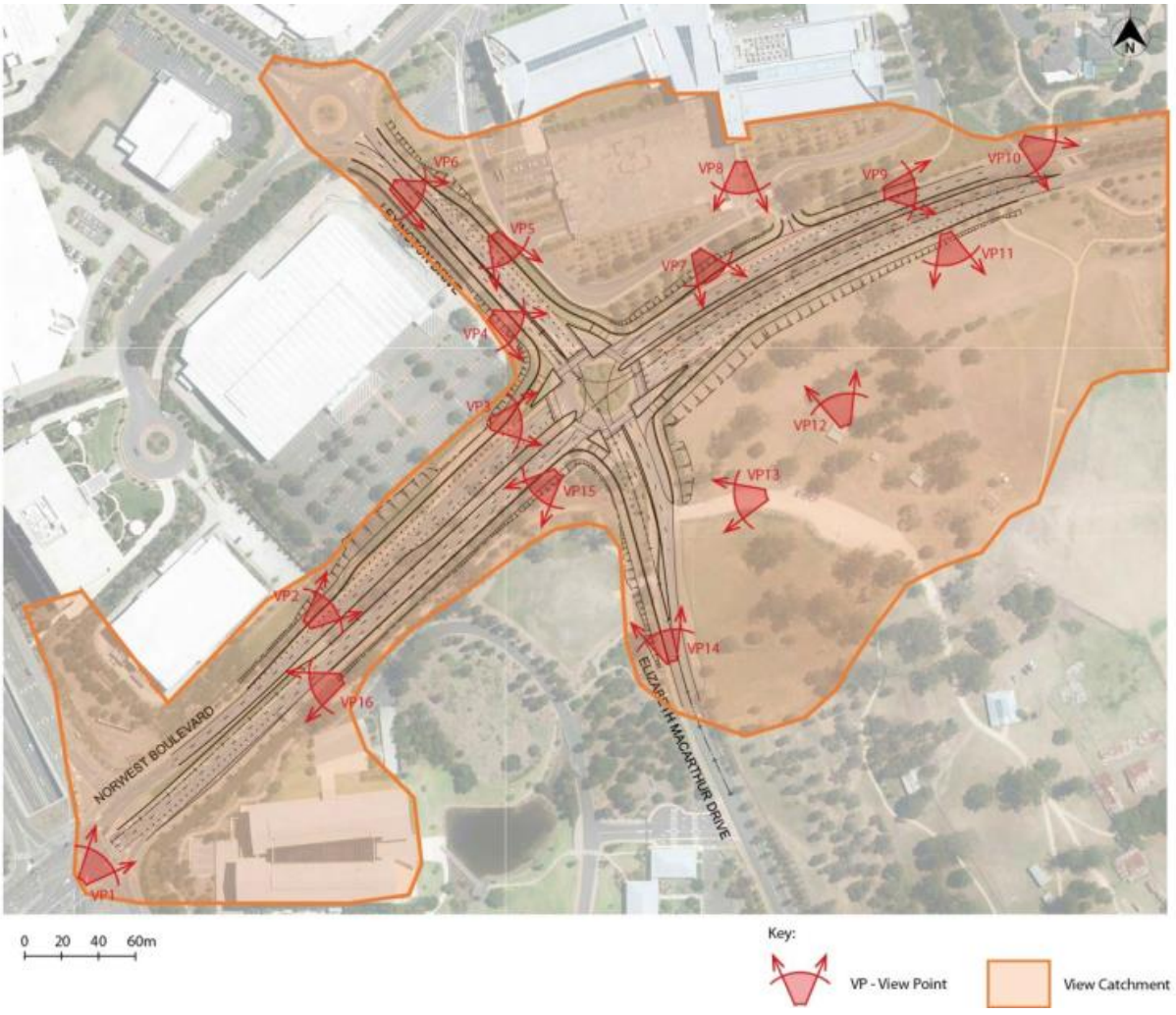


Figure 6-9 View catchment and viewpoints

6.3.3 Potential impacts

6.3.3.1 Construction

Landscape character impact

Potential impacts would be mitigated where possible through appropriate siting of infrastructure, materials and finishes of sheds and hoardings, and management of increased traffic in the study area. An Urban Design Plan would be prepared to minimise landscape character and visual impacts, and detail and guide the implementation of landscape features to be installed as part of the proposal, including re-vegetation requirements (outlined in **Section 6.3.4**). This detailed landscape plan would provide details of measures to be taken to reduce potential adverse impacts on landscape character as a result of construction works.

Visual impact

Construction activities and potential ancillary facilities may result in temporary visual impacts on the existing landscape. Four potential viewpoints have been assessed for construction impacts at the potential ancillary facilities (see **Figure 6-10**)

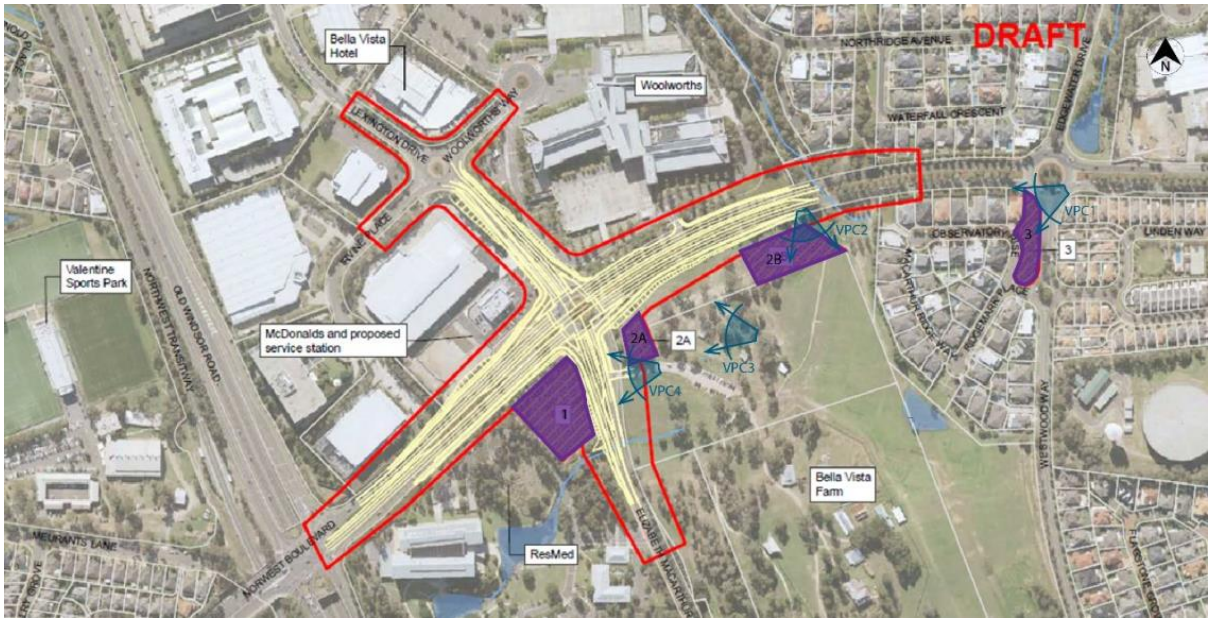


Figure 6-10 Viewpoints for potential ancillary facilities

The assessment concluded the following visual impacts for the potential ancillary facility locations:

- VPC1: High impact as ancillary facility 3 would be located in an established residential area
- VP2: Low - Moderate impact as ancillary facility 2B would form part of the overall construction impact in terms of its visual context
- VPC3: High impact, reflecting the passive nature of the space and the level of change proposed by the location of ancillary facility 2A
- VPC4: Low – Moderate impact, reflecting the additional impact of ancillary facility 1 over and above that of the proposal.

The decision on which ancillary facility to progress would be determined at the detailed design phase, however the assessment identified that the potential ancillary facility within the

ResMed site (subject of VPC1) offers the least overall visual impacts to receivers, as the views to it are already compromised by the proposed works.

6.3.3.2 Operation

Landscape character impact

During operation, there would be an impact on the LCZs within the proposal area, ranging from neutral to high (see **Table 6-24**).

Table 6-24 Landscape character impact during operation of the proposal

LCZ	Sensitivity	Magnitude	Impact
LCZ 1 – Business park landscape	Low	Moderate The magnitude of change sees some minor acquisition to properties with subsequent loss of vegetation.	Moderate-Low
LCZ2 – Retail Landscape	High	Low The magnitude of the change as part of the proposal sees an increase in the road footprint and subsequent widening across the frontage. The magnitude of change is considered to be low as screen vegetation is largely absent along the frontage and the road corridor change in relation to the frontage is minor.	Moderate
LCZ 3 – Residential landscape	Moderate	Negligible Magnitude of change is considered to be neutral as works are outside the immediate interface with this LCZ.	Neutral impact
LCZ4 – Open Space / Recreation / Heritage Landscape – Bella Vista Farm	High	Moderate The widening of the corridor would see some impact to the boundary interface of the parklands. Its impact is consequently considered to be moderate as the overall scale spatially is not significant.	Moderate- High
Road corridor	High	High The scale of the proposed works has a considerable impact on the scale and extent of the LCZs surrounding the road corridor. Its impact is considered high.	High

Visual impact

A range of visual impacts across the study area are anticipated during proposal operation. A summary of the visual impacts during operation for each of the 16 viewpoints is provided in **Table 6-25**.

The visual assessment reveals that Norwest Boulevard has been developed to a high level of amenity. Typically the viewers were assessed to have a moderate sensitivity to the changes. Where the exposure is more focused or for a longer duration this has been assessed as lifting the sensitivity to high.

The magnitude has been assessed as predominantly high due to the extensive and wide reaching impact the proposal has on the existing landscape within the corridor. The majority of the roadside and median landscape would be cleared, resulting in a complete re-visioning of the road corridor.

Consequently the majority of the viewpoints have been assessed as moderate to high in terms of impact due to the duration of exposure and impact on the existing corridor. Management measures are outlined in **Section 6.3.4** to use vegetation and landscaping to break down the overall scale of the proposal and reduce overall impact during operation.

Table 6-25 Visual impact assessment during operation

Viewpoint	Sensitivity	Magnitude	Impact
VP1	Low	Moderate	Low – Moderate
VP 2	Moderate	High	Moderate – Moderate
VP 3	High	High	High
VP 4	Moderate	High	Moderate – Moderate
VP 5	Moderate	High	Moderate – Moderate
VP 6	Moderate	High	Moderate – Moderate
VP 7	High	High	High
VP 8	Low	Moderate	Low – Moderate
VP 9	Moderate	High	Moderate – Moderate
VP 10	Low	High	Moderate
VP 11	Moderate	Low	Low – Moderate
VP 12	High	High	High
VP 13	Low	High	Moderate
VP 14	Moderate	High	Moderate – Moderate
VP 15	Moderate	High	Moderate – Moderate
VP 16	Moderate	High	Moderate – Moderate

6.3.4 Safeguards and management measures

Safeguards and management measures for potential impacts of the proposal on landscape character and visual amenity are listed in **Table 6-26**.

Table 6-26 Safeguards and management measures – Landscape character and visual impacts

Impact	Environmental safeguards	Responsibility	Timing
Landscape character and visual impact	An Urban Design Plan will be prepared to support the final detailed proposal design and implemented as part of the CEMP. The Urban Design Plan will 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 will 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 • Procedures for monitoring and maintaining landscaped or rehabilitated areas. The Urban Design Plan will be prepared in accordance with relevant guidelines, including: • *Beyond the Pavement* urban design policy, process and principles (Roads and Maritime, 2014a) • Landscape Guideline (RTA, 2008b) • Bridge Aesthetics (Roads and Maritime 2012) • Noise Wall Design Guidelines (RTA, 2006) • Shotcrete Design Guideline (RTA, 2005).	Contractor	Detailed design/ Pre-construction
General Design Integration - standard proposal safeguards	Ongoing integrated proposal development will follow Transport for NSW integrated proposal development processes, including with urban designers as part of the proposal team.	Contractor	Detailed design
	The need for a masterplan for the entire corridor to achieve a consistent and strong identity is recommended, prior to detailed design.	Transport for NSW/ Contractor	Prior to detailed design
	Roads and Maritime Urban Design Policy (*Beyond the Pavement*) and Roads and Maritime Urban Design Guidelines will be used to guide future design development of the proposal.	Contractor	Detailed design

Impact	Environmental safeguards	Responsibility	Timing
	The urban design objectives, principles and concept design strategy presented in the urban design report (**Appendix F**) will form the basis for future design development and consultation with stakeholders.	Contractor	Detailed design
Structures – limit visibility of built elements	Retaining wall design - simple, refined, integrated structure which sits comfortably within the landscape, consideration of textures and finishes will be a key element in terms of achieving an integrated response	Contractor	Detailed design
	Minimise footprint and impacts to adjoining properties/services	Contractor	Detailed design/ Construction
Earthworks	Integrate with adjoining landform through adoption of appropriate grades, avoiding sharp transition in profile	Contractor	Detailed design
	Stabilise/revegetate as works progress to limit erosion and visual impacts through early integration with surrounding vegetation	Contractor	Construction
Retention of existing vegetation	Design the proposal to avoid impact to adjoining trees Investigate opportunities for transplant of existing deciduous trees dependant on construction timing and service constraints. Clearance extent will be minimised where possible	Contractor	Detailed design
	Clearly define clearance limits and exclusion zones to protect vegetation cover	Contractor	Pre-construction
Revegetation	Plant species to respond to existing species used within the corridor and landscape character Maximise canopy planting within verge to provide strong definition to the corridor, reinforce the character of the adjoining road corridor and to limit visibility of the proposal from adjoining residential properties	Contractor	Detailed design
	Progressively implement revegetation works to limit erosion and to establish vegetation. Utilise cleared material as part of revegetation works	Contractor	Construction
Minimise road furniture and signage	Provide minimum signage requirements and limit structural elements to provide and open and permeable setting in which landscape is dominant	Contractor	Detailed design
	Look for opportunities to minimise designed signage and fencing	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
Lighting	Maintain character of the overall lighting and potential for light spill	Contractor	Detailed design
	Limit night works and provide lighting which minimises spill	Contractor	Construction
Landscape character	Design would be responsive to the principles and objectives established for the Norwest Business Park, its landscape palette and management objectives Engagement with the Norwest Association would continue throughout detailed design.	Transport for NSW/ Contractor	Detailed design
View management	Provide visual screening within the road corridor to limit the visual impact of the proposal in areas identified as moderate or high impact Provide sense of space and openness associated with the heritage parkland landscape of Bella Vista	Contractor	Detailed design
	Retain vegetation beyond the footprint to retain any existing screening	Contractor	Construction
Ancillary facilities	Setout ancillary facilities to limit impacts, consider screening and location of key structures which provide the greatest impact	Contractor	Detailed design
	Maintain ancillary facilities in a tidy and well-presented manner. Provide and maintain screening	Contractor	Construction
	Progressively throughout the work, where feasible and reasonable, the ancillary facility sites will be returned to at least their pre-construction state	Contractor	Construction

6.4 Biodiversity

6.4.1 Methodology

Background research

Database searches and review of literature were undertaken for records of Commonwealth and State listed threatened species, migratory species, endangered populations and threatened ecological communities. This research was undertaken to collect and review information on the presence or likelihood of occurrence of:

- Threatened flora and fauna species and their habitat
- Endangered populations
- Threatened ecological communities
- Important habitat for migratory species
- Critical habitats.

Searches were conducted within a 10 kilometre by 10 kilometre search area and included the following databases, which were accessed in November 2019:

- BioNet – the website for the Atlas of NSW Wildlife and Threatened Species Profile Database
- the federal Department of the Environment and Energy Protected Matters Search Tool (PMST)
- the NSW DPIE register of Areas of Outstanding Biodiversity Value
- Commonwealth Department of the Environment and Energy:
  - Public Register of Critical Habitat
  - Directory of important wetlands
  - Flying Fox camp database
- DPIE vegetation information system (VIS) database
- DPIE Vegetation Types Database
- Commonwealth Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems
- Coastal Management SEPP mapping.

Preliminary listings for threatened species, populations and ecological communities under the BC Act and nominations under the EPBC Act were also considered. Available reports and other information sources relevant to the proposal area were reviewed including:

- Available regional vegetation mapping including Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands (NSW Department of Environment & Climate Change, 2010); The native vegetation of the Cumberland Plain, western Sydney (Tozer, 2003); and Bushland Survey - Baulkham Hills Shire VIS_ID 2236 (Office of Environment and Heritage, 2010a)
- Soil landscapes of the Sydney 1:100,000 sheet map (Chapman et al., 2009)
- Sydney 1:100 000 Geological Sheet 9130 (Herbert, 1983)
- Aerial photography for the proposal area.

The database searches focused on identifying and listing the threatened flora and fauna species, populations and ecological communities previously recorded within the locality and assessing their likelihood to occur within the proposal area. This assessment was further refined by reference to 2017field surveys, which assessed habitat presence and habitat quality.

Field survey

A site inspection of the area was previously undertaken on 17 November 2017 by an experienced terrestrial ecologist to identify flora and fauna, determine the nature of the vegetation and habitats present, and the likely impact of the works on biodiversity values. The site inspection focused on the 2017 proposal area.

The purpose of the field assessment was to ground-truth the results of the background research and habitat assessment undertaken in 2017, and:

- Identify flora species, populations and ecological communities, detailing suitability of habitat to support threatened fauna species
- Assess and document important fauna habitat and condition (including hollow bearing trees, nectar producing plants, logs and bush rock) within the proposal area to be retained, mitigated or avoided. The habitat assessment was carried out with

emphasis on species considered to have a high or moderate likelihood of occurrence (as identified in the background research)

- Map the distribution and condition of native vegetation communities, where present, with particular regard to identifying threatened ecological communities in the proposal area
- Identify the extent of weed invasion including noxious and 'high threat' weeds.

The likely presence of threatened species was determined through habitat assessment, taking a precautionary approach likely to include species that are difficult to detect (ie cryptic species). A species was assumed to be present if suitable habitat was observed in the proposal area, and if that species was known to occur regionally.

Since the proposal area has remained largely unchanged since 2017, a field assessment was not deemed necessary in 2019. Database searches were revised to ensure no new threatened flora species, populations and ecological communities had been sighted in the proposal area.

Vegetation surveys

Much of the vegetation within the proposal area has been planted (ie street trees and landscape plantings) and naturally occurring vegetation is restricted to individuals and small patches of remnant trees, a few shrubs and occasional individuals of native grasses and herbs within otherwise introduced groundcover vegetation. Consequently, no detailed floristic plots were undertaken during the survey.

The length of the proposal area was visually inspected in order to record the vegetation present. Areas of interest directly adjacent to the proposal area were also investigated where possible.

The location of any threatened species of plants, vegetation patches, and any other ecological factors were recorded with a GPS receiver. Digital mapping of vegetation communities was conducted using ArcGIS software. A combination of field data and aerial photograph interpretation were used to locate areas of vegetation.

Targeted flora surveys

The following threatened plants were considered likely to occur within the proposal area as these species are commonly planted as street trees in Sydney, and were targeted as part of the flora survey:

- *Eucalyptus nicholii* (Narrow-leaved Peppermint) listed as vulnerable under both the BC Act and EPBC Act
- *Eucalyptus scoparia* (Wallangarra White Gum) identified as endangered under the BC Act and vulnerable under the EPBC Act
- *Syzygium paniculatum* (Magenta Lilly Pilly) identified as endangered under the BC Act and vulnerable under the EPBC Act.

Other threatened plant species known or predicted to occur in the locality were also targeted during the survey in the few locations where potential habitat (one small area with some remnant understorey vegetation which is not frequently slashed or mown). Most of the habitat in the proposal area is not considered likely to support the species due a lack of native understorey vegetation and frequent mowing (see **Appendix H**).

The length of the proposal area was traversed on foot to cover the maximum possible area to identify threatened plants (known as the random meander technique (Cropper, 1993).

Targeted fauna surveys

A targeted survey was undertaken for two threatened snail species:

- *Meridolum corneovirens* (Cumberland Land Snail)
- *Pommerhelix duralensis* (Dural Land Snail).

Due to the floristic composition and highly modified state of the vegetation of the proposal area, the potential of the habitat to support these snail species was considered low. Surveys for these species were undertaken as a precaution as they are sedentary and would therefore be at higher risk of impact, if present.

Surveys were not undertaken for other threatened animals which were considered to have a moderate or high potential (ie Powerful Owl, Grey-headed Flying-fox, Little Lorikeet and three threatened microbats) to occur as these species are all highly mobile and only likely to utilise the site intermittently. As such, these species were assumed to be present.

Impact assessment

The assessment has been written in accordance with the following guidelines:

- Biodiversity Guidelines: Protecting and Managing Biodiversity on Roads and Maritime Projects (Roads and Maritime, 2016).
- Roads and Maritime Unexpected Threatened Species Find Procedure in the Biodiversity Guidelines, Guide 1 (pre-clearing process) (Roads and Maritime, 2011d)
- Environmental Impact Assessment Practice Note: Biodiversity Assessment (EIA-N06) (Roads and Maritime, 2011a).

Tests of significance were conducted for threatened species, populations and communities that were recorded in the proposal area during field survey or were identified as having a moderate or higher potential to occur in the proposal area based on the presence of habitat. Tests of significance were carried out for seven threatened fauna, one planted threatened flora species and one threatened ecological community. These threatened species are outlined in **Table 6-27** The complete assessments of significance is provided in **Appendix H**.

Threatened Species Assessment Guidelines: The Assessment of Significance (Department of Environment and Climate Change, 2007) has been used in preparing these tests of significance and in determining whether there is likely to be a significant effect to a threatened species, population or ecological community listed under the BC Act.

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment, 2013). One significance assessment was carried out for one threatened fauna and one planted threatened flora species.

Table 6-27 Threatened species and communities subject to Tests of Significance

Species	BC Act	EPBC Act
Flora		
Eucalyptus scoparia	E	V
Ecological communities		
Shale Sandstone Transition Forest	CE	CE[1]

Species	BC Act	EPBC Act
Fauna		
Little Lorikeet (*Glossopsitta pusilla)*	V	-
Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)	V	-
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V
Powerful Owl (*Ninox strenua*)	V	-
Eastern Coastal Freetail-bat (*Micronomus norfolkensis*)	V	-
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	V	-
Southern Myotis (*Myotis macropus*)	V	-

V = Vulnerable, E = Endangered, CE = Critically Endangered

Note 1: Although listed on the EPBC Act, the vegetation within the proposal area doesn't meet the minimum threshold for the EPBC Act listing. This is discussed further below in ***Section 6.4.3****. Therefore, a significance assessment in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment, 2013) has not been prepared for this EEC.*

Limitations

The list of flora and fauna species recorded from this study should not be seen to be fully comprehensive, but rather an indication of the species present at the time of the survey. A period of several seasons or years would be needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (eg orchids, annual herbs and grasses, or migratory birds). Some species require specific weather conditions for optimum detection. The conclusions of this report are based upon available data and the field surveys, and are therefore merely indicative of the environmental condition of the proposal area at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, could change with time. To address this limitation, a precautionary approach has been used which aimed to identify the presence and suitability of the habitat for threatened species.

6.4.2 Existing environment

The proposal area is located within the Cumberland sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995) and the Cumberland Plain Mitchell Landscape as mapped by the NSW National Parks and Wildlife Service (2002) and described by the NSW Department of Environment and Climate Change (2008).

Geological mapping for the study area indicates that the site is likely to be at the boundary between areas of differing underlying geology including the following geopolitical formations; Ashfield Shale, Minchinbury Sandstone and Bringelly Shale (NSW Department of Mineral Resources 2001).

The local topography consists of an undulating plateau dissected by a branching drainage network on alluvial or quartz sandstone substrate. There is also likely to be areas of fill soils due to the long history of disturbance and development in the locality.

The locality is highly urbanised, and the proposal area has been largely cleared of native vegetation. Subsequent landscape planting includes exotic species, native species which are not indigenous to the locality, and some locally indigenous species.

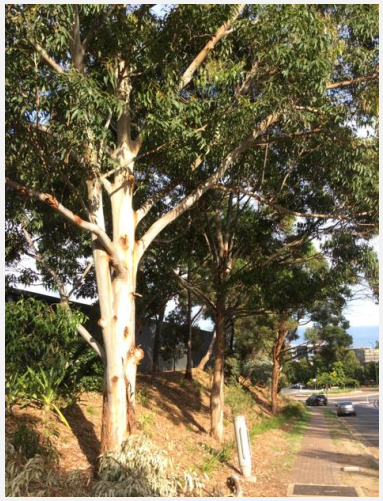
Terrestrial flora

Vegetation assemblages

Much of the vegetation of the proposal area is characterised by landscape plantings, street trees and gardens (see **Table 6-28** and **Figure 6-11**) and has been cleared of native vegetation. Opportunistic vegetation (ie weeds) has established in a few areas. Much of the proposal area is maintained by regular mowing. However, some remnant native trees, a few shrubs and occasional native grasses and herbs occur within and immediately adjacent to the proposal area.

Remnant trees and shrubs within the proposal area form an occurrence of a threatened ecological community; Shale Sandstone Transition Forest in the Sydney Basin Bioregion. This is discussed further in the section below.

Table 6-28 Vegetation assemblages within the proposal area

Vegetation assemblages	Description	Image
Native tree landscape plantings	Planted vegetation containing trees native to NSW with an understorey and ground layer containing both native and exotic species shrubs is found in the median and other roadside areas through much of the proposal area. This vegetation is a mixture of locally indigenous native species (eg *Corymbia maculata, Eucalyptus saligna, Callistemon citrinus, Lomandra longifolia* and *Dianella caerulea*). This vegetation also contains species which are native to NSW but do not occur naturally in the region such as *Grevillea robusta, Eucalyptus microcorys* and *Eucalyptus scoparia*. The ground layer in this vegetation comprises a small number of commonly planted native species and a variety of exotic species. There is no evidence to suggest that any of this vegetation is naturally occurring and the vegetation does not resemble any naturally occurring PCT.	
Native shrub and groundcover plantings	This vegetation consists of dense landscape plantings of native shrubs, grasses and forbs. It includes locally indigenous species (eg *Lomandra longifolia*), species which are native to NSW but not native to the local region (eg *Callistemon viminalis*), and Australian native species that are not native to NSW (eg *Grevillea cultivars*). There is no evidence to suggest that any of this vegetation is naturally occurring and the vegetation does not resemble any naturally occurring PCT.	

Vegetation assemblages	Description	Image
Mixed landscape planting	This vegetation consists of a mixture of exotic shrubs and groundcover plants (eg Juniperinus *horizontalis, Photinia sp., Trachelospermum jasminoides*) and native species (eg *Callistemon cultivars, Lomandra longifolia, Doryanthes excelsa*). There is no evidence to suggest that any of this vegetation is naturally occurring and the vegetation does not resemble any naturally occurring PCT.	
Exotic tree plantings	Areas of planted exotic trees with an understorey and ground layer containing both native and exotic species shrubs are found in the roundabout and other roadside areas through much of the proposal area. The trees in this vegetation comprise is a mixture of exotic species (eg *Liquidambar styraciflua, Robinia pseudoacacia, Ulmus parvifolia*). The ground layer in this vegetation comprises a small number of commonly planted native species and a variety of exotic species. There is no evidence to suggest that any of this vegetation is naturally occurring and the vegetation does not resemble any naturally occurring PCT.	

Vegetation assemblages	Description	Image
Bulrush patch	A small (about six square metres) patch of Bulrush (*Typha orientalis*) is found on the eastern side of a first order waterway that crosses the proposal area by way of a culvert. There is no distinct channel leading into this location. It appears that an area of impeded drainage was formed during road construction and subsequently colonised by this opportunistic, wind-dispersed native plant species. Other plants in the vicinity include a variety of wasteland weeds including grasses (e.g. *Paspalum dilatatum*), herbs (e.g. *Echium vulgare, Verbena bonariensis*) and occasional shrubs (*Ricinus communis*). While *Typha orientalis* has naturally colonised the area, this species alone, in absence of other associated native species, does not resemble any naturally occurring PCT.	

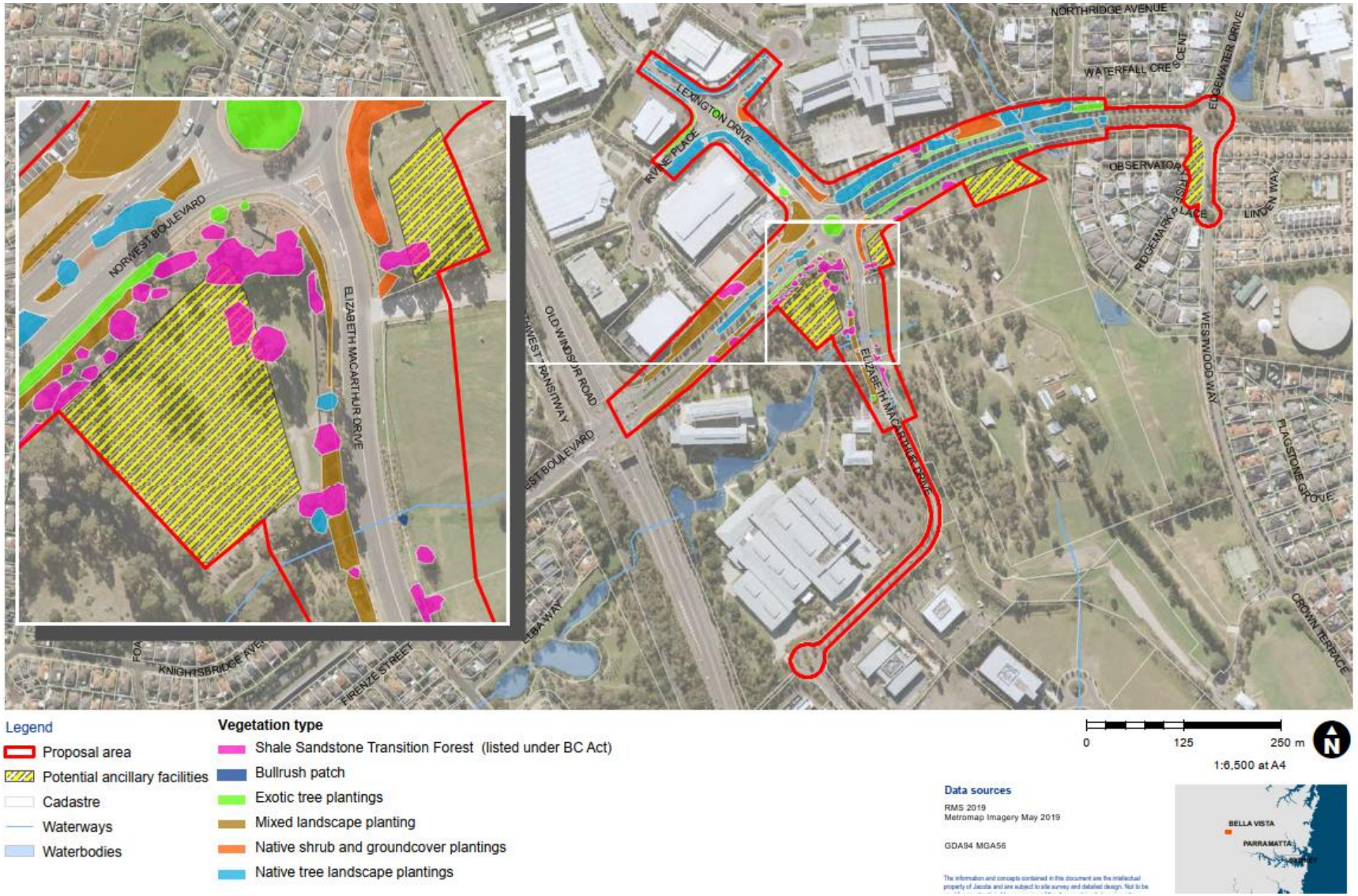


Figure 6-11 Vegetation in the proposal area

Threatened ecological communities

The remnant trees and shrubs form an occurrence of a threatened ecological community; Shale Sandstone Transition Forest in the Sydney Basin Bioregion. This vegetation community within the proposal area is about 3416 m^2 and comprised of large mature remnant trees, smaller regrowth trees, saplings and occasional shrubs (see **Figure 6-12**). The most numerous remnant canopy tree species in the proposal area is *Eucalyptus crebra* but is also accompanied by smaller numbers of *Eucalyptus fibrosa, Eucalyptus eugenioides, Eucalyptus moluccana* and *Eucalyptus tereticornis*.

The subcanopy layer of this community is very sparse but is represented by saplings of the canopy species, a single specimen of *Allocasuarina torulosa* and a single specimen of *Acacia implexa*. The shrub layer is almost non-existent but consists of a single specimen of *Kunzea ambigua* and three specimens of *Leucopogon juniperinus*.

The ground layer in this vegetation type is dominated by exotic species, with perennial grasses such as *Paspalum dilatatum, Briza subaristata* and *Cenchrus clandestinus* constituting greater than 80 per cent of perennial vegetation cover. Scattered individuals of disturbance-tolerant native groundlayer species such as *Glycine tabacina, Dichondra repens, Einadia spp., Wahlenbergia stricta* and *Aristida spp.* are found in this community.

Shale Sandstone Transition Forest in the Sydney Basin Bioregion is listed as critically endangered under the BC Act. There are no condition thresholds for inclusion of vegetation in the community as described in the NSW Scientific Committee determination. Therefore, any vegetation with floristic characteristics recognisable as consistent with community description is considered to be part of the critically endangered ecological community listed under the BC Act.

Shale Sandstone Transition Forest in the Sydney Basin Bioregion is also listed as critically endangered under the EPBC Act however the community is required to meet certain diagnostics related to conditions class. The vegetation within the proposal does not meet the minimum threshold for the EPBC Act listing as native plants make up less much less than 30 per cent of the perennial understorey vegetation present in the patches of Shale Sandstone Transition Forest.

Figure 6-12 Shale Sandstone Transition Forest on the east side of Elizabeth Macarthur Drive, Bella Vista.

Threatened flora species

Twenty-five threatened flora species have been previously recorded or with the potential to occur in the locality (see **Appendix H**).

Among the planted street trees in the proposal area, there are 12 individuals of one threated species, *Eucalyptus scoparia* (listed as Endangered under the BC Act, Vulnerable under the EPBC Act) (see **Figure 6-13**).

The trees are located in the median strip of Norwest Boulevard south west of the existing roundabout. This species has been planted and is not in its natural habitat. Such planted individuals are of little conservation value to the wild populations of the species.

Due to the absence of any remnant understorey or undisturbed topsoil, and the failure of field survey to locate any threatened species, with the exception of *Eucalyptus scoparia*, it is very unlikely that any other threatened species of plant occurs in the proposal area.

Figure 6-13 *Eucalyptus scoparia* within the proposal area

Priority weeds

Senecio madagascariensis (Fireweed) is the only priority weed that was found on site. There are no specific management measures for this species in The Hills LGA. The duty under the Biosecurity Act 2015 is that this species must not be imported into the State or sold. The weed control measures in the Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects (RTA, 2011) would be used to control this weed species.

6.4.2.1 Terrestrial fauna

Fauna habitat and condition

The majority of natural fauna habitats in the proposal area have been removed or highly modified during residential and infrastructure development in all of the vegetation assemblages however some habitat remains suitable for some common disturbance-adapted native species and more mobile flying species; including several threatened species of birds and bats. These are described in **Table 6-29**.

Table 6-29 Habitat condition and values

Vegetation assemblages	Habitat values	Potential threatened species habitat
Shale Sandstone Transition Forest	Foraging resources (eg nectar, seeds) and potential nesting and roosting opportunities (tree hollows and more secluded nesting sites) for birds, arboreal mammals and bats. The large remnant, in some cases hollow-bearing, trees within this vegetation are of particular habitat value. The lack of substantial shrub cover, leaf litter or woody debris limits the diversity of animals likely to utilise this vegetation. Aerial foraging habitat for various microbats and birds. A large hollow is present, but given the level of surrounding disturbance, it is unlikely to be used by the Powerful Owl.	Moderate potential be used by: • Wide-ranging threatened birds (eg Little Lorikeet, Powerful Owl). • Some threatened bats (Grey-headed Flying-fox, Eastern Bent-wing Bat, Eastern Free-tail Bat, Yellow-bellied Sheathtail-bat).
Native tree landscape plantings	Foraging resources (eg nectar, seeds) and marginal nesting sites for non-hollow-dependent birds. Likely to be dominated by urban adapted birds (eg Noisy Miner, Rainbow Lorikeet). Habitat for urban adapted small reptiles (eg Dark-flecked Garden Sun-skink).	Moderate potential to be occasionally used, for foraging only, by threatened birds (eg Little Lorikeet) and Grey-headed Flying-fox.
Native shrub and groundcover plantings	Foraging resources (eg nectar, seeds) for urban adapted birds (eg Noisy Miner, Rainbow Lorikeet). Habitat for urban adapted small reptiles (eg Dark-flecked Garden Sun-skink).	Minimal
Mixed landscape planting	Limited foraging and/or nesting opportunities for urban adapted birds (eg Noisy Miner, Rainbow Lorikeet). Habitat for urban adapted small reptiles (eg Dark-flecked Garden Sun-skink).	Minimal
Exotic tree plantings	Limited foraging and/or nesting opportunities for urban adapted birds (eg Noisy Miner, Rainbow Lorikeet). Habitat for urban adapted small reptiles (eg Dark-flecked Garden Sun-skink).	Minimal
Bulrush patch	Foraging and breeding opportunities for urban adapted frogs and small reptiles (eg Striped Marsh frog, Common Eastern Froglet, Eastern Water Skink).	Minimal
Mown exotic grassland and other highly disturbed vegetation	Limited foraging opportunities for urban adapted birds (eg Australian Magpie, Magpie Lark). Aerial foraging habitat for various microbats (eg Gould's Wattled Bat) and birds (eg Welcome Swallow).	Minimal

Threatened fauna species

Based on regional records and habitat modelling, 47 threatened fauna species have been identified as having potential to occur in the locality, excluding fish and waterbirds for which the proposal area has no potential as habitat. This includes 15 mammals, 25 birds, five frogs and two snails. The proposal area does not contain suitable habitat for most of the species listed in **Appendix H** due to habitat degradation and fragmentation and in some cases a lack of associated vegetation types or other important habitat features (eg major waterways).

The mature eucalypts in the proposal area provide foraging habitat (flowers with abundant nectar) for the threatened Grey-headed Flying-fox and Little Lorikeet. Neither of these species are likely to breed in the vegetation of the proposal area as it lacks suitable structural characteristics and is subject to frequent human disturbance.

Three threatened microbat species may also utilise the proposal area for foraging and roosting; Eastern Bentwing-bat, Eastern Freetail-bat and Yellow-bellied Sheathtail-bat.

The Powerful Owl has been recorded frequently in the locality and may occasionally traverse the proposal area. The Powerful Owl may utilise trees within the proposal area as occasional roosting and foraging habitat but would mainly be restricted to nearby woodland/forest remnants in council reserves and vegetated gullies. Breeding is unlikely to occur in the proposal area as no suitable nesting trees (ie trees with very large hollows in areas isolated from regular human disturbance) are present.

Based on the habitat assessment and field survey, nine threatened fauna species were identified as having a moderate to high likelihood of occurring within the proposal area (see **Table 6-30**). Tests of significance were conducted for threatened species that were recorded in the proposal area during field survey or were identified as having a moderate or higher potential to occur in the proposal area based on the presence of habitat. The complete assessments of significance is provided in **Appendix H**.

Table 6-30 Habitat assessment and survey results

Common name	Scientific name	Status		Potential occurrence
		BC Act	EPBC Act	
Little Lorikeet	*Glossopsitta pusilla*	V	-	**Moderate.** Vegetation in proposal area may occasionally be used for foraging; rough-barked eucalyptus in an urbanised environment have low potential as breeding sites.
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	**Moderate.** Vegetation and spaces in proposal area may occasionally be used for foraging. Unlikely to roost or breed in the proposal area.
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	**Moderate.** Vegetation and spaces in proposal area may be used for foraging; roosting and breeding opportunities exist in the hollow-bearing trees.

Common name	Scientific name	Status		Potential occurrence
		BC Act	EPBC Act	
Southern Myotis	*Myotis macropus*	V	-	**Moderate.** Vegetation and spaces in proposal area may occasionally be used for foraging; roosting and breeding opportunities exist in the hollow-bearing trees.
Powerful Owl	*Ninox strenua*	V	-	**Moderate.** Vegetation in proposal area may occasionally be used for foraging. The species is unlikely to breed in the proposal area due to the degraded condition of vegetation, human disturbance and the lack of suitable tree hollows.
Grey-headed Flying Fox	*Pteropus poliocephalus*	V	V	**High.** Foraging habitat widespread. Unlikely to roost or breed in the habitat of the study area.
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	**Moderate.** Vegetation and spaces in proposal area may occasionally be used for foraging; roosting and breeding opportunities exist in the hollow-bearing trees.

V = Vulnerable, E = Endangered, CE = Critically Endangered

Wildlife connectivity corridors

There are no mapped areas of connectivity or corridors in the proposal area. Local habitat corridors are associated with streams and gullies in the locality. The vegetation within the proposal area may be used by local resident species passing through; however, it does not form part of a distinct habitat corridor.

Groundwater dependent ecosystems

It is unlikely that there are any aquatic or terrestrial groundwater dependent ecosystems in the proposal area, as indicated from the review of the Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems, and the lack of major waterways, floodplains or wetlands. No subterranean groundwater dependent ecosystems are mapped in NSW in the Atlas of Groundwater Dependent Ecosystems. The proposal is not in the location of a known aquifer and does not involve water extraction or substantial excavation. It is therefore unlikely to impact any subterranean ecosystem that may be present.

Matters of National Environmental Significance

Threatened ecological communities listed under the EPBC Act

The search of the PMST indicated that there are six nationally listed threatened ecological communities that are predicted to occur, are considered likely to occur or are known to occur within the search area which encompassed the proposal area with a one kilometre buffer.

As discussed above, it was confirmed during the field survey that none of these threatened ecological communities occur in the proposal area. The proposal area is likely to have previously been occupied Shale Sandstone Transition Forest of the Sydney Basin Bioregion community, but the remnants of this community present are not in suitable condition to be included in the Commonwealth-listed community.

Threatened species listed under the EPBC Act

According to the results of the PMST (which are based on habitat modelling), 15 threatened plants and 23 threatened fauna species, including nine birds, seven mammals, three frogs, two fish, one insect and one snail species, could potentially occur in the proposal area. The proposal area does not contain suitable habitat for most of these nationally listed species. Based on the field survey, the following threatened species listed under the EPBC Act have been recorded or are presumed to be present in the proposal area:

- *Eucalyptus scoparia* – present as planted street trees which are of little conservation significance for the species
- Grey-headed Flying Fox – potential foraging habitat present.

Migratory species

Sixteen migratory bird species were identified as potentially occurring in the locality based on regional records, the distributional range of the species and modelled habitat. These migratory species, along with their preferred habitat requirements and an assessment of their likely presence in the proposal area are listed in **Appendix H**. Only the Fork-tailed Swift (*Apus pacificus*) and White-throated Needletail (*Hirundapus caudacutus*) are considered moderately likely to occur in the proposal area, as they may fly over the proposal area but would not use it as habitat.

While some migratory species of bird are likely use the proposal area and locality, the proposal area would not be classed as an 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of the Environment, 2013).

The proposal would not substantially modify, destroy or isolate an area of important habitat for the migratory species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds. As such, there is a low risk of a significant impact to these migratory species from the proposal and impacts to migratory species are not considered any further in this report. In addition, based on the Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (Department of the Environment, 2015), the proposal area is neither large enough nor high enough quality for a referral under the EPBC Act.

6.4.3 Potential impacts

6.4.3.1 Construction

Removal of native vegetation

The design of the proposal has been an iterative process as described in **Section 2.3**. Where possible, the design has attempted to minimise vegetation removal. The proposal would require the removal of 1.4 hectares of native tree landscape plantings (or about 185 planted trees) located next to the existing roadway (see **Figure 6-11**). The native tree landscape plantings to be removed comprised primarily of the following species:

- *Corymbia maculata* – local native
- *Eucalyptus microcorys* – non-local native
- *Eucalyptus scoparia* – non-local native
- *Liquidambar styraciflua* – exotic.

Planted shrubs (where present) and groundcover vegetation, consisting of planted native and exotic species, would also be removed. Impacts associated with the removal of *Eucalyptus scoparia* are discussed below.

As most of the vegetation in the proposal area is planted and the habitat is generally poor quality for most species, the biodiversity impacts of the proposal are not as extensive as can be expected for a proposal in a more natural environment. However, planted vegetation is present, some of which is likely to be used occasionally as foraging habitat by some threatened fauna species (ie Grey-headed Flying-fox, Little Lorikeet, Powerful Owl and four microbat species).

Removal of threatened ecological communities

In addition to the 1.4 hectares of native tree landscape plantings, the proposal would also result in the loss of about 0.34 hectares of Shale Sandstone Transition Forest, listed under the BC Act as critically endangered ecological community (see **Figure 6-11**). This removal would be concentrated in the location of potential ancillary facility 1 and 2A. Although highly disturbed, this vegetation may provide roosting and breeding habitat for several threatened species of microbats in addition to its value as foraging habitat.

The test of significance concluded that due to the very small impact on the Shale Sandstone Transition Forest critically endangered ecological community and the poor quality of the vegetation to be removed there is unlikely to be a significant impact (see **Appendix H**).

As described above, the design has attempted to minimise vegetation removal, in particular in areas of Shale Sandstone Transition Forest. Impacts to the Shale Sandstone Transition Forest would be further refined during detailed design. Where feasible, ancillary facilities would be located to minimise or avoid removal of this threatened ecological community.

No other vegetation communities or PCTs would be removed by the proposal. Other impacts to vegetation are limited to planted trees and landscaping including shrubs and exotic groundcover. The groundcover is predominantly mown lawn grass.

Removal of threatened flora

There are 12 specimens of *Eucalyptus scoparia*, a planted threatened species, in the proposal area. The removal of trees would be determined during detailed design and it is likely that many trees can be retained.

The test of significance concluded that the *Eucalyptus scoparia* trees that may be impacted by the proposed works are planted roadside trees and are not part of a key source populations. These trees are outside of their natural occurrence range and the proposal is unlikely to impact an important population or habitat critical to the survival of this species. The proposal would not interfere with the recovery of *Eucalyptus scoparia* and would not contribute to the key threats to this species. Therefore, these trees are of little conservation significance to the species and the proposal is unlikely to result in a significant impact to *Eucalyptus scoparia* (see **Appendix H**).

Removal of threatened fauna habitat

About 1.4 hectares of native tree landscape plantings to be removed are native (local and non-local) trees representing marginal potential foraging habitat for threatened fauna. The 0.34 hectares of Shale Sandstone Transition Forest to be removed also provides moderate quality habitat, including possible roosting and breeding habitat for threatened species of microbats.

While all of these trees are potential habitat, many are marginal and unlikely to be important due to their relatively small area of potential habitat and peak flowering in summer when resources for blossom-feeding species are generally more abundant. The clearing of habitat would impact native fauna through a small loss of foraging resources.

The tests of significance concluded the threatened fauna species with a moderate to high likelihood to use the proposal area (see **Table 6-27**) are unlikely to be significantly affected by the proposal because:

- These species would suffer a small reduction in extent of suitable or marginal foraging habitat from the proposal
- No nesting habitat, likely breeding sites or other important habitat (including Grey-headed Flying-fox camps) would be impacted by the proposal
- The proposal is unlikely to reduce the population size of these species or decrease its reproductive success.
- The proposal would not interfere with the recovery of these species or contribute to the key threats to these species.

The complete assessment is provided in **Appendix H**.

Injury and mortality

Fauna injury or death has the greatest potential to occur during vegetation clearing and the extent of this impact would be proportionate to the extent of vegetation that is cleared. The majority of fauna species that are likely to occur within the proposal area are mobile species, such as birds, and may be able to move away from the path of clearing and are unlikely be killed or injured unless they are nesting. However, other species that are less mobile (e.g. ground dwelling reptiles) may find it difficult to move rapidly when disturbed and are more vulnerable. No threatened species are likely at risk of injury or mortality during clearing before construction. Entrapment of wildlife in any trenches that are dug is a possibility if the trenches are deep and steep sided.

Avoidance, minimisation and mitigation measures designed to reduce an injury and death of fauna are provided in **Section 6.4.4**.

Invasion and spread of weeds

Proliferation of weed species is likely to occur as vegetation is removed, soil is disturbed and machinery moved about the site. Vegetation in the proposal area is dominated by roadside planted trees with a mown grass understorey and proliferation of weed species would be confined to man-made areas such as grassy areas, vegetated median strips and gardens. These areas likely already contain a high abundance of weeds and the potential for invasion and spread as a result of the proposal is considered low.

During construction there is potential to disperse seeds and plant material from exotic species already present within the site into adjoining areas of vegetation or off site. The most likely causes of weed dispersal are associated with clearing of vegetation and stockpiling of contaminated mulch and topsoil during earthworks, and movement of soil and attachment of seed (and other propagules) to construction vehicles and machinery.

Mitigation measures designed to limit the spread and germination of noxious weeds are provided in **Section 6.4.4**.

Invasion and spread of pathogens and disease

Several pathogens known from NSW have potential to impact on biodiversity as a result of their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- Dieback caused by Phytophthora (Root Rot; EPBC Act and BC Act)
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)

- Introduction and establishment of exotic *Rust Fungi* of the order *Pucciniales* on plants of the family *Myrtaceae* (BC Act).

While these pathogens were not observed or tested for in the proposal area the potential for pathogens to occur would be treated as a risk during construction.

Mitigation measures to deal with the potential introduction and spread of pathogens are provided in **Section 6.4.4**.

Noise, light and vibration

Impacts on biodiversity through increased noise, light or vibration during construction are not considered likely due to the context of the proposal area, which is urbanised and subject to traffic noise, light from street lights, light from vehicles, and light from buildings. There are no areas of intact PCTs or habitats in the proposal area and therefore no edge effects are anticipated.

6.4.3.2 Operation

Wildlife connectivity and habitat fragmentation

No large contiguous areas of native vegetation are present within or around the proposal area. Therefore, no additional impact to the already low connectivity value of the vegetation around the proposal area is expected.

The proposal would not result in edge effects on adjacent native vegetation and habitat.

Noise, light and vibration

Increased noise, light or vibration from the proposal are not considered likely to result in any notable impacts on native wildlife or habitat, due to the urbanised context of the proposal area.

6.4.3.3 Conclusion on significance of impacts

As discussed above, tests of significance were conducted for threatened species and communities. The complete assessments of significance are provided in **Appendix H**. Based on the results of these assessments, 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*. 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*.

6.4.4 Safeguards and management measures

Safeguards and management measures for potential biodiversity impacts of the proposal are listed in **Table 6-31**.

Table 6-31 Safeguards and management measures – Biodiversity

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	A Construction Flora and Fauna Management Plan will be prepared in accordance with Roads and Maritime's *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011) and implemented as part of the CEMP. It will 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, 2008b) • Pre-clearing survey requirements • Procedures for unexpected threatened species finds and fauna handling in accordance with Roads and Maritime *Unexpected Threatened Species Find Procedure in the Biodiversity Guidelines, Guide 1* (pre-clearing process) (Roads and Maritime, 2011d) • Procedures addressing relevant matters specified in the *Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries Fisheries, 2013) • Protocols to manage weeds and pathogens.	Contractor	Detailed design/ Pre-construction	Section 4.8 of QA G36 Environment Protection
Removal of native vegetation	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible. Where feasible, the ancillary facilities would be located to minimise or avoid removal of Shale Sandstone Transition Forest.	Contractor	Detailed design/ Pre-construction	

6.5 Socio-economic, property and land use

The potential socio-economic, property and land use benefits and impacts of the proposal are assessed in the Socio-economic Impact Assessment (Jacobs, 2020b), which is provided in **Appendix G**. A summary of the assessment is presented in this section.

6.5.1 Methodology

The methodology for the socio-economic assessment is guided by the Environmental Impact Assessment Practice Note: Socio-economic assessment (EIA-N05) (Transport for NSW, 2020) and involved:

- Analysing existing socio-economic conditions and values of the study area, including population, social infrastructure, and local businesses
- Identifying and assessing potential socio-economic impacts of the proposal's construction and operation, including on local amenity, access and connectivity, social infrastructure and local community values
- Assessing the significance of potential impacts based on the evaluation of significance framework
- Identifying safeguards and management measures to mitigate or manage the identified impacts.

6.5.2 Existing environment

The suburb of Bella Vista is an emerging economic hub for the Greater Sydney region. It is undergoing substantial transformation, as part of investment and development associated with the Sydney Metro Northwest. The Bella Vista Station Precinct forms part of the Sydney Metro Northwest Priority Urban Renewal Corridor, which aims to create new urban and business centres around the Sydney Metro Norwest Stations.

The suburb of Bella Vista comprises a mix of residential, industrial and large-scaled commercial land. Some key features of the suburb include Bella Vista Farm Park, Bella Vista Oval, Norwest Private Hospital and Norwest Business Park.

6.5.2.1 Population and demographics

The Bella Vista suburb currently has a residential population of 8148 (Profile ID, 2020). The population of the suburb is forecast to grow to about 8320 people by 2036.

Socio-economic characteristics of the study area are based on the ABS 2016 Census of Population and Housing, and shown in **Table 6-32**. Communities in the study area are generally characterised by:

- A median age and proportions of children similar to NSW, proportions of working aged people above the NSW average, and lower proportions of older people
- A culturally diverse population with relatively high proportions of people born overseas and people who speak a language other than English at home
- Lower levels of people in need for assistance in one or more of the three core activity areas of self-help, mobility or communication due to disability, a long-term health condition or old age, compared to NSW.

As shown in **Table 6-32**, the overall demographic profile of the proposal area indicates a resident population skewed toward working families with above-average household incomes, school-age children living at home, and a high reliance on private vehicles as the primary mode of transport.

Table 6-32 Socio-economic characteristics of the study area, 2016

Demographics	Bella Vista	NSW
Total population*	7837	8,117,976
Median age	38	38
0-14 years (%)	18.2	18.5
65 years or over (%)	10.6	16.2
Aboriginal and Torres Strait Islander (%)	0.2	2.9
Overseas born (%)	48.8	34.5
Households where only English is spoken at home	49.0	68.5
Total private dwellings	2321	3,059,599
People with need for assistance (%)	2.6	5.4
Households with no vehicle (%)	1.0	9.2
Households with two or more vehicles (%)	81.4	50.8
Travel to work by car (as driver or passenger) (%)*	69.1	64.6
Travel to work by public transport (%)*	18.6	16.0
Median weekly household income	$2942	$1486
Unemployment rate (%)	4.2	6.3

*Notes: *includes people that travel to work by more than one mode of transport. Source: Based on ABS Census, 2016*

Future Growth

Under the Greater Sydney Regional Plan, planning priorities and actions for Bella Vista are set out in the Central District Plan (Greater Sydney Commission, 2018a), a 20-year plan to manage growth and enhance Greater Sydney's liveability, productivity and sustainability into the future. The plan proposes transforming Norwest into a transit-oriented, vibrant and diversified centre with higher employment densities and a mix of residential uses and supporting services.

The Hills LGA is expected to have a population surge of 100,000 by 2036, with the number of households expecting to double in this time.

The government's plan to introduce high density development around the new metro stations on the north west line, including the Norwest and Bella Vista stations, is expected to place increasing pressure on the local and regional road network.

6.5.2.2 Economic profile

The latest report from the Department of Employment Small Area Labour Markets (December 2019) show that the study area had relatively high rates of workforce participation and low levels of unemployment compared to the rest of NSW. The labour force in the study area was around 12,904, representing 0.3 per cent of the total NSW labour force. The unemployment rate in the study area was at 1.7 per cent, compared to 4.5 per cent in NSW.

At the 2016 census, the top three industries of employment in the study area were health care (4.4 per cent), banking (3.5 per cent) and computer system design and related services (2.9 per cent). Health care as the top industry is likely a factor of proximity to The Hills Private Hospital and the ResMed campus, both of which are located within the study area.

The median weekly household income in Bella Vista was near double the NSW average at the 2016 census. During this census, low income households (i.e. $650 gross weekly income per week) comprised about 7.2 per cent of households. This is compared to 19.7 per cent in NSW. Nearly half of households had a gross weekly income of more than $3000, compared to 18.7 per cent in NSW.

6.5.2.3 Land use and property

As described in **Section 4.1.2**, the Hills Local Environmental Plan 2012 (the LEP) applies to land within The Hills LGA. The proposal area comprises of business park zones, public recreation zones and infrastructure zones (see **Figure 4-1**).

Most of the proposal area occupies the business park zone (B7) which lies to the north and south of Norwest Boulevard and west of Elizabeth Macarthur Drive. The business park contains business and commercial developments such as Woolworths Metro Norwest, Woolworths Group Head Office, ResMed, SWEP Australia, Bella Vista Hotel, a McDonalds restaurant and Shell service station (under construction).

South east of the proposal is zoned public recreation (RE1) where Bella Vista Park is located. The park contains barbecue facilities, picnic tables, walking tracks and restrooms facilities. The park is open to the public and can be hired for private functions. The infrastructure zone (SP2) is located north east of the study area and contains Elizabeth Macarthur Creek. The creek is used mainly for drainage purposes. East of the proposal is a medium density residential zone.

The potential ancillary facilities would be located in the following land use zones:

- Ancillary facility 1: B7 – Business Park
- Ancillary facility 2A: RE1 – Public recreation
- Ancillary facility 2B: RE1 – Public recreation
- Ancillary facility 3: RE1 – Public recreation.

6.5.2.4 Local business and industry

The local business and industry around the proposal comprises mainly of a business park which contains commercial developments, located on the northern side of Norwest Boulevard. These businesses include Woolworths Metro Norwest, Woolworths Group Head Office, a 24-hour McDonald's restaurant, SWEP Australia (industrial equipment supplier), Bella Vista Hotel and a Shell service station which is currently under construction. Located on the southern side of Norwest Boulevard is the ResMed corporate headquarters.

Consultation has confirmed the buildings are used during regular office hours and no sleep clinic facilities are currently in operation at ResMed.

Bella Vista Farm is an intact historic farm complex of cultural state significance, popular for events and recreation, that is owned by The Hills Council.

6.5.2.5 Access and connectivity

Households in the study area demonstrated a high level of reliance on private vehicle, with relatively high proportions of households with two or more vehicles and proportions of uses who use a private vehicle for travel to work (refer to **Table 6-32**).

Major roads located within or near the proposal include Norwest Boulevard, Lexington Drive, Elizabeth Macarthur Drive, Old Windsor Road and the M7 Motorway. Norwest Boulevard is a key transport route connecting the M7 Motorway with the Norwest Business Park and Old Windsor Road. Woolworths Group Head Office and Woolworths Metro Norwest relies on Norwest Boulevard for access for its employees as well as for daily deliveries, however alternate access is available via Lexington Drive and Woolworths Way. Commercial properties associated with the Sky City Business Park and Lexington Corporate business estate are located along Norwest Boulevard, east of Lexington Drive. These properties can be accessed via Lexington Drive and off Old Windsor Road.

Elizabeth Macarthur Drive provides access to the ResMed facility, Bella Vista Farm and the Norwest Private Hospital (via Norbrik Drive).

Bus routes that operate within the proposal include routes to Parramatta, Chatswood, Seven Hills, Rouse Hill and Sydney City. Two bus stops are located on the northern side of Norwest Boulevard within the proposal area, one with a dedicated bus layover area and shelter, while one bus stop with a shelter is located on the southern side of Norwest Boulevard, about 40 metres from the intersection with Elizabeth Macarthur Drive and Lexington Drive. A footpath east of the intersection provides access from Norwest Boulevard to residential properties on Waterfall Crescent and Cloverhill Grove.

On-street parking in the proposal area is limited to unrestricted kerbside parking on both the north and southbound sides of Elizabeth Macarthur Drive. Additional parking for the recreational users of Bella Vista Farm is accessed from Elizabeth Macarthur Drive. There is no on-street parking within the proposal area in Norwest Boulevard or Lexington Drive.

6.5.2.6 Social infrastructure

The Bella Vista Farm adjoins the proposal on the southern side. It is a historic farm complex listed as an item of local significance under the Hills LEP, and an item of state heritage significance on the State Heritage register. It is also listed on the non-statutory Register of the National Estate. It comprises a two-storey homestead, various farm outbuildings and walking tracks. The farm grounds include picnic and barbecue facilities and are open seven days per week from dawn to dusk. The heritage precinct, including homestead and farm buildings, is open in the morning of the first Sunday of every month.

Norwest Private Hospital is located at Norbrik Drive, about 800 metres south of the proposal area. The hospital provides a range of health and medical services and facilities, including inpatient services and 24-hour emergency department. The emergency department is located at Norbrik Drive, which connects to Old Windsor Road and Elizabeth Macarthur Drive to the north.

6.5.2.7 Community values

Areas near the proposal mainly comprise business, commercial and community uses, with residential uses to the east.

Bella Vista Farm is an important open space for residents and visitors. It contributes to the identity of the study area and is valued for its heritage, amenity, recreation and environmental values. The farm is also a focus of community networks, supported by the Friends of Bella Vista Farm, which is involved in the restoration and operation of the farm.

A number of greenway links are also located within the study area connecting open spaces and urban areas. These provide a high level of amenity for residents and workers. Established trees within the road corridor and adjoining properties also offer some landscaping and visual relief for motorists and occupants to surrounding properties.

Improved road safety, including for motorists, pedestrians and cyclists, is important for local communities and is identified as a goal in Council's community plan.

6.5.3 Potential impacts

6.5.3.1 Construction

Access and connectivity

During construction, potential impacts on local access and connectivity would generally be associated with increased construction traffic and temporary changes to road conditions at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive. These would include reduced speed limits, temporary lane closures and diversions, and temporary access changes. This may result in delays and disruptions and may impact perceptions of road safety for road users. It is noted that alternate access is available via Celebration Drive and Lexington Drive to the north, and Norbrik Drive and Elizabeth Macarthur Drive to the south.

Temporary relocation of existing bus stops at Norwest Boulevard near to construction works would also be required for the safety of bus commuters. This may result in some bus users being temporarily further from, or closer to, the nearest bus stop. Temporary delays and disruptions to some bus services may also result from changes to road conditions, impacting on some commuters. However, these impacts are expected to be minor and managed through notification to bus users and ongoing engagement with bus operators and the Hills Shire Council.

Access would be maintained for pedestrians and cyclists near to the proposed construction works, although temporary changes may be required for safety. This would include temporary diversion of footpaths along Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive.

The McDonalds drive-through located on the south west corner of the intersection of Norwest Boulevard and Lexington Drive is accessed via a private road off Lexington Drive for ingress and egress, located about 60 metres north of the intersection. Vehicles circulate and queue within the site. The proposal would not result in the loss of access to the drive-through but has the potential to generate delays for customers and staff accessing the restaurant during construction. If mitigation measures are implemented however, the access would be maintained.

Access for business employees, customers and deliveries during construction on Norwest Boulevard would occur mostly through Lexington Drive and Elizabeth Macarthur Drive. Where access is provided, this would be maintained during the construction phase. Any changes to property access, if required, would be temporary and short-term, and are not expected to impact on the operation of these facilities.

An assessment of potential construction traffic impacts on local access and connectivity is provided in **Section 3.3.6** and **Section 6.1**. Potential impacts on access and connectivity during construction would be mitigated through the implementation of safeguards and management measures outlined in **Section 6.1.4**

Property Impacts

The proposal would require the temporary lease of the land required for the four potential ancillary facilities during construction. This land would be reinstated to the landowners after construction is completed. In addition, some areas of the potential ancillary facilities fall within land that would be partially acquired for the operation of the proposal.

The properties that are subject to temporary lease is listed in **Table 6-33**.

Table 6-33 Properties subject to temporary lease

Lot and DP	Ancillary facility	Lease area	Total area	% leased	Ownership
Lot 6001 DP1036256	1	4700 m^2	120,000 m^2	4 per cent	Private property
Lot 3002 DP879664	2A	1100 m^2	70,900 m^2	1.6 per cent	Hills Shire Council
Lot 3002 DP879664	2B	3300 m^2	70,900 m^2	4.7 per cent	Hills Shire Council
Lot 25 DP1046638	3	1700 m^2	1700 m^2	100 per cent	Hills Shire Council

Social infrastructure

During construction, the proposal has the potential to impact on the following social infrastructure:

- Bella Vista Farm
- Norwest Private Hospital.

The impacts to each during construction of the proposal are discussed below.

The section of the farm grounds at Bella Vista Farm closest to Norwest Boulevard would be the site of potential ancillary facilities 2A and 2B during construction. These areas would be subject to a temporary lease, representing only 6.3 per cent of the total area of the Bella Vista Farm compound. This area is not used as heavily for recreation due to its proximity to Norwest Boulevard and its distance from the heritage precinct. Impacts would therefore be minimal.

This section of the Bella Vista Farm (i.e. closest to Norwest Boulevard and the northern end of Elizabeth Macarthur Drive) may be impacted by increased construction noise, dust and traffic. This may adversely change local amenity and impact on some peoples' use and enjoyment of these areas. These impacts are likely to be minimal however, as most amenities are located away from the roads, with the closest being the picnic area that is about 80 metres east from the proposal. Furthermore, the topography of the farm would likely shield the picnic area from any dust impacts. The social infrastructure associated with Bella Vista Farm are mostly used on weekends when works would be minimal.

The Bella Vista Farm heritage precinct, including homestead and farm buildings, is located about 300 metres from the proposed works on Norwest Boulevard, and would not be affected by physical works or vibration. As the heritage precinct is only open on the first Sunday of each month, when no construction work is proposed, construction noise is not expected to impact on staff or visitor amenity. Further heritage impacts are discussed in **Section 6.6.**

Elizabeth Macarthur Drive provides access from Norwest Boulevard to the Norwest Private Hospital from the north. Temporary changes to local road conditions at Norwest Boulevard and Elizabeth Macarthur Drive may delay access to the hospital for some users or emergency vehicles. Direct access to the hospital from Old Windsor Road via Norbrik Drive would be unaffected.

Potential impacts on social infrastructure, including amenity and access changes, would be managed through the implementation of safeguards and management measures outlined in **Section 6.5.5**.

Local business

The construction of the proposal would result in potential impacts to the following businesses:

- ResMed headquarters
- McDonalds
- Woolworths
- Shell service station development.

A potential ancillary facility is proposed to be located on vacant land at the southwest corner of Norwest Boulevard and Elizabeth Macarthur Drive, within the ResMed headquarters site. The ancillary facility would be located around 100 metres from buildings on the site and is not expected to impact on company operations at the headquarters. Establishment of the potential ancillary facilities and the strip property acquisition would require the removal of the ResMed signage and entrance feature on the corner of the intersection of Norwest Boulevard and Elizabeth Macarthur Drive, as well as fencing and tree plantings along the northern edge of the property. This would temporarily increase the exposure of the buildings and open space on the property to traffic on Norwest Boulevard, but is not expected to impact on the operation of the business.

McDonalds and the Shell service station development would be subject to potential access impacts due to the proposed tie-in works at the Lexington Drive left-in/left-out driveway to McDonalds, the relocation of the McDonalds sign, reinstating landscaping and the installation of a retaining wall. There would also be minor changes to business access during construction due to utility and pavement adjustments which may involve temporarily narrowing the driveway entrance.

During construction, there would also be potential impacts on the Woolworths Group offices within the Business Park north of Norwest Boulevard. This would include access impacts as a result of:

- Tie in work to the existing Woolworths internal road
- Removal/ relocation of access stairs from Lexington Dr southbound verge to Woolworths site
- Relocation of Woolworths Group masonry signs at north-east corner of the intersection and at the site access on Norwest Blvd eastbound
- Relocation of Woolworths service shed at north-east corner of the intersection
- Adjustment to Woolworths utilities including telecommunication, gas, power, water and irrigation services
- Adjustment of Woolworths private footpaths to tie into new works.

The above proposed work would result in minimal, temporary impacts to the business within the Business Park. During construction additional temporary signage may be beneficial in improving visibility of businesses that are still open.

The above businesses may experience short term access delays during construction, and changes to amenity resulting from increased construction noise and dust. The impacts are expected to be temporary and would be mitigated through the implementation of safeguards and management measures outlined in **Section 6.3.4** and **Section 6.5.5**.

Business owners indicated concerns with disruption to utilities, particularly telecommunication lines, during construction that may affect their business operations. Utility impacts are discussed in **Section 3.5**. The extent of utility impacts cannot be confirmed until detailed design is finalised, and Transport for NSW would continue to carry out ongoing consultation with all utility providers in the area to refine utility modifications and utility protection measures.

Amenity and community values

As discussed previously, the decision on which ancillary facility to progress would be determined at the detailed design phase, therefore the proposal has assumed a worst-case scenario of all four ancillary facilities operating during construction. One ancillary facility (AF1) would be located within property used for business, two ancillary facilities (AF2A, AF2B) would be within the Bella Vista Farm recreational area and one ancillary facility (AF3) would be located adjacent to the residential area by the roundabout which connects to Westwood Way. Ancillary facility 3 would result in increased amenity impacts including visual, noise, dust, construction traffic, general disturbance and disruption to the adjacent residences, because of its residential setting. The cumulative impact of all four ancillary facilities operating under a worst-case scenario would be low-moderate due to the distance between the locations.

Increased construction noise, dust and construction traffic may have temporary adverse impacts on amenity for some businesses and users of community facilities closest to construction activities. Local amenity changes are likely to have the greatest impact on businesses that have outdoor or open customer areas or that are located closest to the proposed construction works. It is possible that the amenity of the picnic and barbecue facilities at Bella Vista Farm would be reduced during construction.

To minimise disruption to daily traffic and disturbance to surrounding land owners and businesses, it would be necessary to carry out some work outside of standard construction hours. Noise and lighting from these works may temporarily impact on night time amenity or disrupt sleeping patterns for some residents closest to the construction works, although given the extent of works required, potential impacts are generally expected to be minor.

Land uses surrounding the proposal area mainly comprise commercial or community uses, with residential uses limited to the eastern end of the proposal area. Impacts on night-time amenity may be experienced by these residents where out of hours work are required. These impacts are generally expected to be minor given the small number of residences potentially impacted and the location of the residential uses relative to the proposed construction works. Restricting the use of noise intensive equipment during out of hours work would also assist in minimising potential impacts on nearby residential receivers.

These impacts and possible management measures are discussed in the relevant sections of the REF including **Section 6.1** (Traffic, transport and access) **Section 6.2** (Noise and vibration) and **Section 6.3** (Landscape character and visual assessment). Additional mitigation measures to reduce the amenity impacts are outlined in **Section 6.3.4**.

6.5.3.2 Operation

Access and connectivity

Operation of the proposal would improve access and connectivity within and through the study area and assist in alleviating congestion along Norwest Boulevard. This would have beneficial impacts for motorists and bus commuters through improved travel times. The proposal would also improve the safety conditions for general traffic and pedestrians and cyclists.

The proposal would remove about 17 unrestricted on-road parking spaces on the southbound side of Elizabeth Macarthur Drive, with no replacement parking to be provided.

Alternative unrestricted on-road parking would be available in surrounding side streets, and in the nearby commercial areas. Parking is also provided within the business park and dedicated on-site parking is provided at most businesses in the area. This removal of parking is most likely to affect visitors to events at Bella Vista Farm. Overall, this impact is considered minor as alternative parking locations in and around the proposal would generally have capacity to accommodate the loss of the 17 parking spaces.

Property Impacts

The proposal would require the partial acquisition of both Council owned and privately-owned properties. These properties are listed in **Table 3-8**. The land acquisition area and property adjustment work detailed in this table are indicative only. The items are to be confirmed pending detailed design, discussions with stakeholders and review of the proposal requirements.

While the proposal would result in acquisition of private and Council owned land, this would be minimal and would not impact the operation of these facilities.

Social infrastructure

The proposal would result in partial acquisition of property associated with the Bella Vista Farm. This would not impact on the use of the Farm for recreational activities as this area represents only 2.9 per cent of the total area of the Bella Vista Farm. This area is not used as heavily for recreation due to its proximity to Norwest Boulevard and its distance from the heritage precinct. Impacts would therefore be minimal.

The proposal would support improved access to local and regional social infrastructure, such as Bella Vista Farm and Norwest Private Hospital through reduced traffic congestion, improved access and connectivity, and enhanced road safety for motorists and other road users travelling via Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive.

Local business

The partial acquisition of land on the adjacent properties, namely Norwest Business Park (particularly the McDonalds and Woolworths site) and ResMed, is not expected to impact on the ongoing operation or use of these businesses.

Benefits for local and regional businesses are likely to result from safer and improved access and efficiency for motorists within the study area. This includes commercial vehicles and customers of local businesses. The proposal would also assist in accommodating the projected growth in future jobs.

Amenity and community values

During operation, some businesses near the proposal may experience changes in amenity relating to changes in traffic noise and visual impacts, as a consequence of the added lanes of traffic and the widened road bringing the traffic slightly closer to roadside premises and the removal of existing landscaping and vegetation. Impacts to these are expected to be minor.

The proposal would require the removal of rows of established trees within the existing road reserve and adjoining properties. Where tree removal is required, Transport for NSW would provide replacement trees as part of an overall landscape and urban design plan as described in **Section 6.3**. This would be subject to confirmation with The Hills Shire Council.

6.5.4 Summary of level of significance impact assessment

A summary of the impact and significance with and without mitigation is presented in **Table** 6-34 based on the impacts listed above and the mitigation measures provided in **Table 6-35.** The implementation of mitigation measures has decreased the impacts for many of the issues discussed.

Table 6-34 Summary of impacts with and without mitigation

Impact	Significance (without mitigation)			Significance (with mitigation)		
	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Property impacts						
Acquisition of private property and temporary land lease	Moderate	Low	Moderate-low	Low	Low	Low
Construction impacts						
Local business and industry – impact on business amenity	Moderate	Low	Moderate-low	Moderate	Low	Moderate-low
Local business and industry – disruption to business access and parking	Moderate	Low	Moderate-low	Low	Low	Low
Amenity disruption to social infrastructure (dust and noise and vibration)	Moderate	Moderate	Moderate	Moderate	Low	Moderate-low
Emergency services access	Low	Low	Moderate-low	Low	Low	Low
Community values – impacts on local amenity due to increased construction noise, dust and out of hours work	Moderate	Moderate	Moderate	Low	Low	Low
Traffic delays and disruptions	High	Moderate	High-moderate	Moderate	Moderate	Moderate
Temporary changes to public transport services	High	Moderate	High-moderate	Moderate	Moderate	Moderate
Disruption to pedestrian and cycle access	High	Low	Moderate	Moderate	Low	Moderate-low

Impact	Significance (without mitigation)			Significance (with mitigation)		
	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Operational impacts						
Local business and industry – changes to parking conditions (other locations)	Low	Low	Low	Low	Low	Low
Community values – impacts to local amenity (removal of trees and amenity plantings)	Low	Low	Low	Negligible	Low	Negligible

6.5.5 Safeguards and management measures

Safeguards and management measures for potential socio-economic, property and land use impacts of the proposal are listed in **Table 6-35**.

Table 6-35 Safeguards and management measures – Socio-economic, property and land use

Impact	Environmental safeguards	Responsibility	Timing
Community engagement	A Communication and Stakeholder Engagement Plan (CSEP) will be prepared and implemented as part of the Construction environmental management plan (CEMP to help provide timely and accurate information to the community during construction. The CSEP will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, business owners and commuters including changed traffic and access conditions and amenity impacts • Mechanisms to provide details to managers of social infrastructure near to the proposed works (e.g. Bella Vista Farm) about potential construction activities, timing, impacts and management measures • Provide regular updates to emergency services on construction staging and potential delay issues	Contractor	Detailed design/pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	• Mechanisms to provide details about proposed changes to emergency services and managers of surrounding community facilities • Contact name and number for complaints. The CSEP will be prepared in accordance with the *Community Involvement and Communications Resource Manual* (RTA, 2008a).		
Property acquisition	Transport for NSW will continue to consult with directly affected property owners throughout the detailed design phase.	Transport for NSW	Detailed design
	All property acquisition will be carried out in accordance with *the Land Acquisition Information Guide* (Roads and Maritime, 2014c), the *Land Acquisition (Just Terms Compensation) Act 1991* and the NSW Government Land Acquisition Reform 2016.	Transport for NSW	Detailed design, pre-construction
Impact of potential ancillary facilities	The ancillary facility will be restored to pre-existing conditions or to a condition agreed with the land owner.	Contractor	Post-construction
Construction staff parking	The construction contractor will provide suitable off-street parking to accommodate workers that does not impact on local businesses. The Construction Traffic Management Plan (TMP) will include appropriate measures to prevent construction staff from utilising these public parking areas.	Contractor	Construction
Impacts to McDonalds and Shell Service Station operations	The construction contractor would consult with the operator of the McDonalds restaurant during the preparation of the TMP.	Contractor	Pre-construction
Impacts to business from strip acquisition	Opportunities to provide additional directional and promotional signage to businesses in the vicinity of the proposal during construction will be explored in consultation with the property owners and operators.	Transport for NSW	Detailed design
Impacts to social infrastructure – Norwest Private Hospital	Access will be maintained to Norwest Private Hospital for ambulance and hospital users on Norbik Drive.	Transport for NSW	Detailed design
Impacts of potential ancillary facility on ResMed site	The potential ancillary facility will be screened and secured from other operations on the ResMed site during construction and will be left clean and tidy at the end of each day.	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
Impacts from street tree, fencing and signage removal	During detailed design a landscaping design plan would be prepared that identifies opportunities for the replacement of street trees, landscaping, fencing and signage removed by the proposal.	Transport for NSW	Detailed design

6.6 Non-Aboriginal heritage

The potential impacts of the proposal on non-Aboriginal heritage within the proposal area are assessed in the Historical Heritage Assessment (Jacobs, 2017a), Statement of Heritage Impact (Jacobs, 2017b) and Historical Heritage Assessment Addendum (Jacobs, 2020c) which is provided in **Appendix I**. A summary of the assessment is presented in this section.

6.6.1 Methodology

The non-Aboriginal heritage assessment included:

- Background historical research, including a review of previous heritage assessments and aerial imagery to identify the potential for archaeological and heritage items to be present within the study area, to further define the scope of the field investigation
- A search of all available heritage registers on 4 October 2017 and 29 November 2019 to identify previously recorded non-Aboriginal heritage items in the study area, and the legislative obligations associated with these items
- A field survey to inspect all registered heritage items and identify any further unregistered heritage items within the study area (including potential archaeological sites) on 7 November 2017. An additional field survey was undertaken on 19 September 2019 of additional areas not captured in the 2017 assessment
- Identification and assessment of potential impacts of the proposal on non-Aboriginal heritage items, conservation areas and archaeology
- The development of measures to manage the proposal's potential impact on non-Aboriginal heritage items, conservation areas and archaeology through the application of the 'avoid, minimise and mitigate' hierarchy.

6.6.2 Existing environment

A search of the following heritage registers was undertaken:

- NSW State Heritage Register (SHR)
- s170 State Agency Heritage and Conservation Registers
- The Hills Local Environment Plan (LEP) 2012
- Commonwealth Heritage List
- National Heritage List
- World Heritage List
- Register of the National Estate (RNE).

Table 6-36 lists all of the known heritage items within the proposal area, based on listings from the above heritage registers. The locations of these items are shown in **Figure 6-14.**

Table 6-36 Heritage register search results

Item name	Heritage register	ID	Location	Proximity to proposal area
Bella Vista (also known as - Kings Langley, Stock Farm, Seven Hills Farm, Bella Vista Farm) / Bella Vista Homestead Complex	State Heritage Register	00754	Elizabeth Macarthur Drive, Bella Vista, NSW 2153/740-742 Esplanade	Proposal is within SHR and the Hills LEP boundary adjacent to Norwest Boulevard and Elizabeth Macarthur Drive.
	The Hills Local Environment Plan 2012	C2		
	Register of National Estate	2971		
Old Windsor Road and Windsor Road Heritage Precincts	Roads and Maritime s.170 State agency heritage register	4301011	Various in multiple Council areas	A small portion of the heritage precinct is located within the proposed works footprint in Norwest Boulevard. Boundary Stones 3430, 3429 and old road alignment 2837 located on opposite side of road to proposal area (between 50 m and 80 m to west and south west).
Original section of road and culvert (Old Windsor Road)	The Hills Local Environment Plan 2012	A2		Within the road reserve, Old Windsor Road

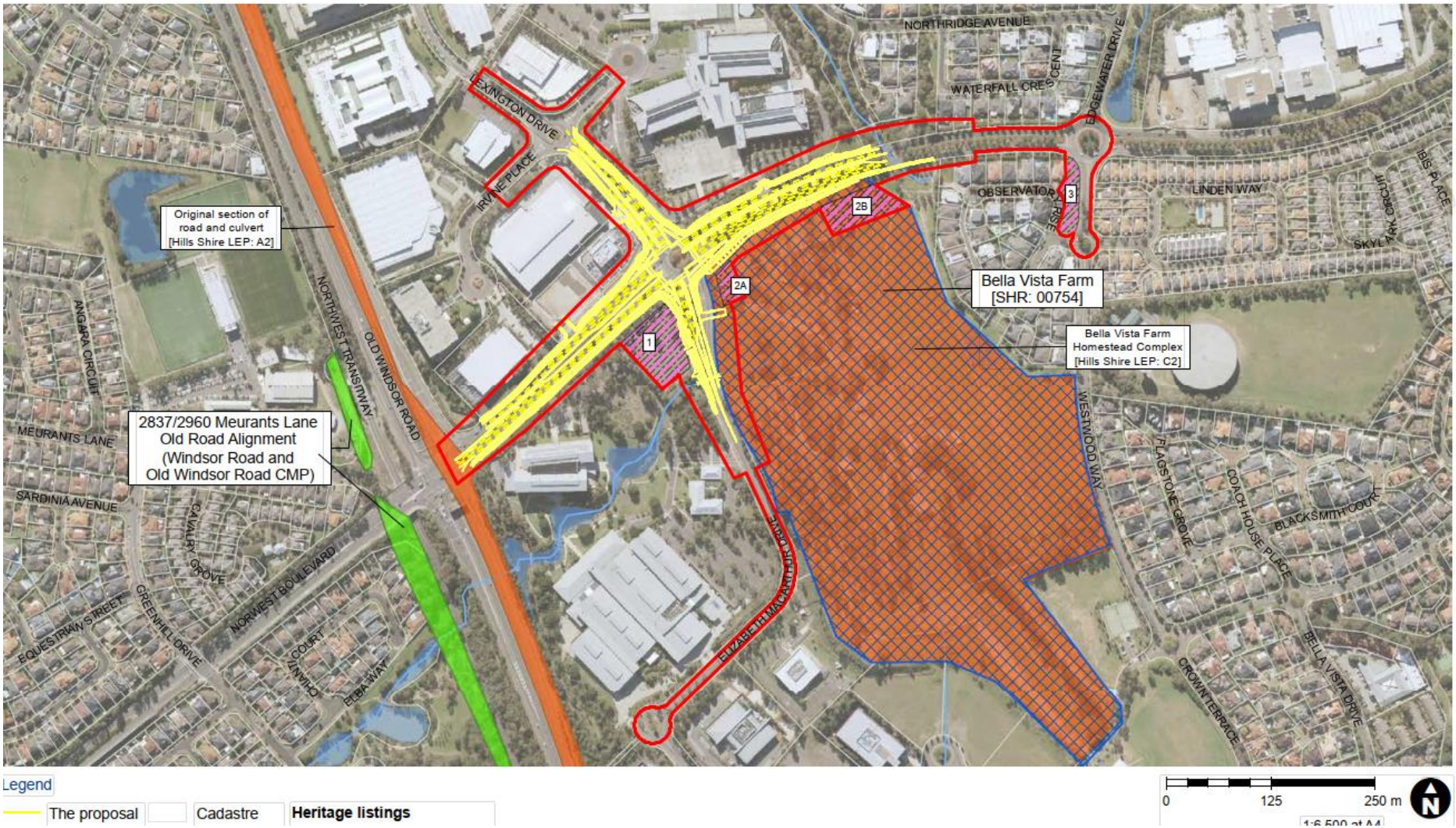


Figure 6-14 Non-Aboriginal heritage within the study area

6.6.2.1 Bella Vista Farm

A Statement of Heritage Impact (SoHI) has been prepared by Jacobs (2017) to support the development of this proposal, which would require the acquisition of a portion of Bella Vista Farm. The SoHI has been subsequently reviewed in 2019 due to the updated proposal area potentially requiring the use of a portion of the land within the Bella Vista Farm for potential ancillary facilities (2A and 2B). An addendum report has been prepared capturing this review (see **Appendix I**).

Bella Vista Farm is listed as an item of local significance on the Hills LEP, state significance on the SHR (item No. 00754; gazetted on 2 April 1999) and also on the non-statutory Register of the National Estate (RNE) (Item 2971; gazetted on 28 September 1982). The listings comprise the homestead, a collection of outbuildings and core of an historic farm including slab fencing, a series of paddocks, remnant mature indigenous vegetation, cultural plantings and driveways. The farm buildings are mostly timber slab construction, situated in a rural park like setting. The overall farm complex is a typical 1800s farming community virtually untouched. (Morris & Britton, 2000).

Historical background and development

There have been numerous developmental phases of the site. The following was adapted from the Bella Vista Farm Conservation Management Plan (CMP) (WorleyParsons, 2012).

Pre-European

The Aboriginal inhabitants of the Cumberland Plains were the Gundungurra, Wodi Wodi, Tharawal and Dharug Peoples. Many early recordings of Aboriginal people in the region came from government surveyors, early explorers or army officers who were travelling in the interior in search of pasture or water sources (Tench 1793, Hunter 1793; Barralier in 1802). There was limited contact between Aboriginal inhabitants and European settlers prior to 1810. It is estimated that fifty to ninety per cent of the local Aboriginal population of the Cumberland Plains died during a smallpox epidemic in 1779-1880. Governor Arthur Phillip began granting land in the area to settlers in 1791.

Stock Farm, Seven Hills Farm 1790's – 1820

Following exploration of the Cumberland Plain in 1788, land was subsequently divided and granted to European settlers. In particular, 960 acres of land known as Stock Farm were bestowed to Grimes and Foveaux in 1799 and encompassed the area which would later become known as Bella Vista Farm (Heritage Design Services, 2000). During this period, the property was used for fruit growing and shepherding (Graves, 1991). Later, in 1801 the property was purchased by John Macarthur and was, at this time, known as Seven Hills Farm. The property was run by the Macarthur family for agricultural purposes for the following 20 years (Heritage Design Services, 2000). Activities would have included the clearing of indigenous woodlands, fencing and probably the construction of slab huts.

Robertson's Farm 1820's – 1865

Following the Seven Hills farm, the Crown later subdivided the land and one grant of 500 acres was allotted to James Robertson's Farm and was subsequently named Robertson's Farm. Activities included mixed farming with orcharding and cattle grazing. The Pearce family acquired the land in 1842.

Bella Vista Farm 1865 – 1974

Many of the buildings on the property were constructed by Edward Henry Pearce. Some of these included the main house, the coach house, the kitchen wing, the implement shed, the barn, the cow shed, the stables, a wool packing shed and blacksmith's forge. This was followed by the construction of the dairy in the late 1930s by Toby Pearce and subsequently two thunder box privies and a piggery (Graves, 1991). Pearce eventually sold it to the North

Sydney Brick and Tile Company (Norbrick) in 1949 who leased it to the Jones family (Heritage Design Services, 2000). Brick making occurred at the site between 1950 and 2000.

Public Ownership 1974 – Present

The property was transferred to the Baulkham Hills Shire Council in 1974. From 1987, residential subdivisions took place on surrounding land part of the original farm site. The Norwest Business Park development was initiated in the early 2000's.

Statement of significance

Bella Vista Farm has been assessed against the State Heritage Register criteria to determine the level of significance and related statutory protection. The assessed significance is provided in **Table 6-37**.

Table 6-37 Assessment of Significance against the State Heritage Criteria

Criteria	Bella Vista Estate
Criterion (a) an item is important in the course, or pattern, of NSW cultural or natural history.	Bella Vista is a rare surviving record of rural development on Sydney's Cumberland Plain, with associations of Aboriginal occupation in the area from East Coast European settlement (1795) until recent times. It demonstrates the changing nature and structural organisation of Australian rural activity. The farm represents the evolution of farming activities typical of a class of land owners in Australia. (Howard Tanner 1987:40-42).
Criterion (b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW cultural or natural history.	Early land settlers John and Elizabeth Macarthur owned the lands and used them for grazing their Spanish 'merino' breed sheep. Three generations of the Pearce family owned the farm (direct descendants of Matthew Pearce the first settler in the Parramatta district) and were responsible for the development of the farm.
Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW.	Bella Vista comprises of an entire 1870s farming community including the large 19th century homestead, all virtually untouched for 100 years. The complex of farm buildings is prominently sited within a park-like rural landscape created by the cultural plantings and remaining indigenous trees. (Howard Tanner 1987:41)
Criterion (d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons.	It is representative of its original agrarians who were typical of the 19th century middle income earners. To ensure cash flow, the agricultural activities were adapted to suit changing markets.
Criterion (e) an item has potential to yield information that will contribute to an understanding of NSW cultural or natural history.	The late nineteenth century crude timber slab construction and masonry homestead enable comprehensive interpretation of bygone farming life and work.
Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW cultural or natural history.	The split timber slab farm buildings are rare surviving examples of rude timber construction in the Sydney Region

In addition, the following is taken directly from the SHR listing in relation to the archaeological significance of the site: "*Bella Vista Farm Park has a high and rare degree of potential scientific archaeological significance vested in data that can contribute to the understanding of the history of NSW and the locality, the rise and decline of stock farming and orchards in the district and, its associations with the Pearce family and to a lesser extent Joseph Foveaux, Charles Grimes, John Macarthur and James Robertson (though only Robertson appears to have developed or used the property in any way other than for the grazing of stock)*" (AMAC, 2005).

6.6.2.2 Old Windsor Road

Old Windsor Road is listed on the Roads and Maritime s170 State agency heritage register (No. 4301011). Additionally, the heritage precinct identified on the Hills LEP (ID A2) indicates that Old Windsor Road has archaeological potential, although there are no details as to what this potential might entail.

Old Windsor Road was part of the original Windsor Road, which opened in 1794 (RTA, 2010). This was the second main road built for the colony of Sydney to connect Parramatta and Windsor over a distance of 37.33 kilometres. The alignment defined aspects of the settlement pattern (such as the laying out of grants and the consolidation of services at Greenhills) and provided the region's primary overland transport route, vital to the settlement of the north-western Cumberland plain (Clive Lucas Stapleton, 2005). The northern section of Windsor Road and Old Windsor Road used to be continuous until 1812 when the new Windsor Road from Kellyville to Northmead was completed. As a result, the southern section of the original Windsor Road was renamed Old Windsor Road, and the northern section and the new Windsor Road became continuous. In 2007, the junction at Bella Vista was upgraded so that an underpass for Old Windsor Road could be constructed (Crofts and Crofts, 2013).

A number of items related to the original alignment of Windsor Road are reported in the Windsor Road and Old Windsor Road Conservation Management Plan (CMP) (Clive Lucas Stapleton, 2005) to be in the vicinity of the proposal. These include two boundary stones to the north west of the A2/Norwest Boulevard intersection, and the alignment of Meurants Lane to the south of the intersection which enabled an approach to Bella Vista Farm. Additionally, a sandstone culvert made of block stone with a clay pipe underlies Old Windsor Road allowing the egress of water from the Bella Vista Farm some 100 metres south of the intersection.

6.6.3 Potential impacts

6.6.3.1 Construction

Bella Vista Farm

The proposal involves the acquisition of between one and 20 metres of the curtilage of the Bella Vista Farm along Norwest Boulevard for approximately 230 metres from its junction with Elizabeth Macarthur Drive (about 2.9 per cent of the site, **Table 3-8**). This would involve the excavation of the existing batter up to five metres deep to allow the construction of earthworks along the Bella Vista Farm curtilage and Norwest Boulevard. The works will also require property adjustments to the surface of Bella Vista Farm to reshape drains and install landscaping.

In addition, two potential ancillary facility site options (2A and 2B) are proposed within the northern portion of the curtilage adjacent to Norwest Boulevard. These compounds would comprise about 1100 m^2 for ancillary facility 2A (about 1.6 per cent of the site) and about 3300 m^2 for ancillary facility 2B (4.7 per cent of the site) (see **Table 6-33**).

A summary of the potential impact these activities would have on key components within Bella Vista Farm is provided in **Table 6-38**.

Table 6-38 Summary of potential impacts on key components of Bella Vista Farm

Heritage component	Potential impacts
Remnant native woodland (significant trees)	The two potential ancillary site options within the Bella Vista Farm have the potential to involve loss or damage to remnant native vegetation.
Driveways (built)	The current proposal indicates the driveway from Elizabeth Macarthur Drive would be the primary access route for the proposed ancillary facilities located in the northern portion of Bella Vista Farm. As this driveway is unsealed it could be expected to experience substantial impact from heavy vehicular activity.
Pasture (landscape)	The proposed annexation of pasture adjacent to Norwest Boulevard and Elizabeth Macarthur Drive would further reduce the amount of pasture land which surrounds the Bella Vista Farm. The use of the land in either of the two ancillary facility options within the Bella Vista Farm curtilage has the potential to temporarily impact upon views to and from the heritage estate.
Replica post and rail fencing (built)	The proposed annexation of land adjacent to Norwest Boulevard and Elizabeth Macarthur Drive and use of this land for the proposal and either of the two potential ancillary facility sites would impact upon replica post and rail fencing in these locations. This fencing, although recent, adds to the cultural landscape significance of the site.
Views and curtilage (site aesthetics)	The proposal has the potential to impact upon views to and from the heritage item with respect to the placement of traffic signalling, plantings and signposting. The use of the land for ancillary areas has the potential to temporarily impact upon views to and from the heritage estate. The landscape character and visual impact assessment (**Section 6.3**) identified that during construction of the proposal, the inclusion of the ancillary facilities within the Bella Vista Farm would have a low-moderate impact for ancillary facility 2A, given the site would form part of the overall construction impact of the proposal. The assessment identified a high impact for ancillary facility 2B given the passive nature of the space and the level of change proposed. Impacts during construction would only be temporary in nature and would be managed via management measures outlined in **Section 6.3.4**.
Archaeologically sensitive soils (scientific)	The proposed annexation of land adjacent to Norwest Boulevard and Elizabeth Macarthur Drive has the potential to impact upon soils with archaeological sensitivity.

The decision on which ancillary facility to progress would be determined at the detailed design phase. Where feasible, the proposal would avoid the placement of ancillary facilities on Bella Vista Farm. Any works that would impact the SHR curtilage of the Bella Vista Farm, including acquisition and the installation of an ancillary facility, would need to be the subject of an application under section 60 of the Heritage Act as discussed in **Section 4.2.2**.

In the event that the ancillary facilities are located within the heritage curtilage for Bella Vista Farm, a number of safeguards are provided in **Section 6.6.4**. Further information about the

SHR listing and the section 60 approval requirements is provided in **Table 7-2** and **Appendix I**.

Old Windsor Road

As shown in **Figure 6-14**, the proposal extends to the intersection with Old Windsor Road at the western extent of works. In this area, the proposed works would include pavement reconstruction and the installation of a new concrete median. These activities would require an excavation of up to 0.8 metres below the existing ground and road surface level, meaning that the proposal would impact upon an area potentially containing features of the historical road alignment.

The Old Windsor Road precinct has limited archaeological research potential as a result of the heavy disturbance at the site over time. Any archaeological features present are likely to be of low integrity, owing to generic qualities, lack of stratification and association with ground disturbance and fill material. If there are any archaeological relics in the proposal area, they would most likely be rubble used as fill. As this area has been significantly disturbed and reworked as a result of land use practices over the last 200 years, the likelihood of these relics and works being present is low.

There are no anticipated impacts to the key elements of the Old Windsor Road precinct as identified in the Old Windsor Road CMP (Clive Lucas Stapleton, 2005), including the boundary stones, alignment of Meurants Lane and the sandstone culvert.

6.6.3.2 Operation

There would be no impacts to non-Aboriginal heritage or archaeology once the proposal is operational.

6.6.4 Safeguards and management measures

Safeguards and management measures for potential non-Aboriginal heritage impacts of the proposal are listed in **Table 6-39**.

Table 6-39 Safeguards and management measures – Non-Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage. The NAHMP will be prepared in consultation with the NSW Environment, Energy and Science.	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 Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or	Contractor	Detailed design/Pre-construction	Section 4.10 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.			
Non-Aboriginal heritage	Non-Aboriginal heritage awareness training must be provided for contractors prior to commencement of construction works to ensure understanding of potential heritage items and correct procedures to be undertaken in respect to unexpected finds and significant trees that may be impacted during the proposal.	Contractor	Pre-construction/ Construction	
Bella Vista Farm - Impact to remnant native woodland (significant trees)	The NAHMP must identify significant trees to be preserved. If it is not possible to avoid young remnant native woodland trees then this loss is to be offset by revegetating these species elsewhere on the property if possible.	Transport for NSW	Detailed design/Pre-construction	
Bella Vista Farm - Impact to driveways (built)	Measures must be taken to ensure the unsealed driveway from Elizabeth Macarthur Drive is maintained. If damage to its surface from heavy vehicular traffic is unavoidable then it shall be reinstated to its current state at the completion of the proposed proposal. Suggest using either track mats or a gravel layer prior to use and then reinstatement to original condition post use.	Contractor	Pre-construction/ Construction	
Bella Vista Farm - Impact to pasture (landscape)	Pasture is to be reinstated after the demobilisation of ancillary facilities (2A and/ or 2B).	Contractor	Construction	
Bella Vista Farm - Impact to replica post and rail fencing (built)	Prior to removal of the replica post and rail fencing, a photographic recording of the current fencing must be prepared.	Contractor	Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	The current post and rail fencing along Norwest Boulevard and Elizabeth Macarthur Drive must be reinstated to maintain the cultural landscape values of the site. It is not necessary to reinstate by using the existing fence materials however a fence of the same design and material must be reinstated.			
Bella Vista Farm - Impact to views and curtilage (site aesthetics)	Due consideration must be given to the maintenance of vistas to and from the Bella Vista Farm with respect to the placement of traffic signalling, plantings and signposting in the proposed intersection upgrade and material used in the ancillary facility.	Transport for NSW	Detailed design/Pre-construction	
Bella Vista Farm - Impacts to archaeologically sensitive soils (scientific)	Archaeological monitoring of the site shall be undertaken wherever soil disturbance occurs within the curtilage of Bella Vista Farm.	Contractor	Construction	
Old Windsor Road - Area of archaeological potential	If relics of the Old Windsor Road are identified during monitoring works then the Roads and Maritime *Standard Management Procedure: Unexpected Heritage Items* (Roads and Maritime, 2015) would be followed.	Contractor	Construction	

6.7 Aboriginal cultural heritage

The potential impacts of the proposal on Aboriginal cultural heritage within the proposal area are assessed in the Aboriginal Archaeological Survey Report (Kelleher Nightingale Consulting, 2017)) and Aboriginal Archaeological Assessment Addendum Report (Jacobs, 2020) which is provided in **Appendix J**. A summary of the assessment is presented in this section.

6.7.1 Methodology

The Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime, 2011b) outlines a four-stage process for investigating potential impacts on Aboriginal cultural heritage on Transport for NSW projects. The four stages of the PACHCI are designed to ensure compliance with statutory requirements and EESG policies, including the ACHCRP.

The four stages are as follows:

- Stage 1 – Initial Transport for NSW assessment
- Stage 2 – Further assessment and site survey with Aboriginal stakeholders
- Stage 3 – Formal consultation with Registered Aboriginal Parties and preparation of a cultural heritage assessment report
- Stage 4 – Implementation of proposal mitigation measures.

Following PACHCI Stage 1, an Aboriginal archaeological survey report was prepared by Kelleher Nightingale Consulting (KNC) in December 2017. The report was prepared in accordance with the Roads and Maritime PACHCI Stage 2 requirements, the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (Office of Environment and Heritage, 2010b) and Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (Office of Environment and Heritage, 2011).

As a part of the PACHCI Stage 2 process, a review of previous archaeological investigations was conducted. Following this, a representative of the Deerubbin Local Aboriginal Land Council (DLALC) and an archaeologist from KNC carried out a field survey on 26 October 2017. The field survey was a full coverage pedestrian survey of the study area aimed at recording any Aboriginal archaeological sites or areas with potential to contain Aboriginal objects. The findings from Stage 2 did not trigger Stage 3 or Stage 4 of the PACHCI.

An additional walkover of the study area was conducted by a Jacobs heritage specialist on 19 November 2019. The Deerubbin Local Aboriginal Land Council was notified of the survey and invited to attend however this offer was declined, as the land had already been surveyed and the LALC representatives were satisfied that no further survey was required.

The survey in November 2019 involved a visual survey of additional areas outside of the study area used in the 2017 report prepared by KNC which have now been included in the study area. These additional areas include the potential ancillary facility sites and the roundabout at Lexington Drive and Irvine Place. Following this, an Aboriginal archaeological assessment addendum report was prepared outlining the findings of the additional walkover.

The initial archaeological report prepared in 2017 and the subsequent addendum report are provided in **Appendix J.**

6.7.2 Existing environment

Landscape context

The study area is located in the north west of the Cumberland Plain, a gently undulating and generally low-lying physiographic region of the Sydney Basin. There are several tributaries of Caddies Creek in the vicinity including Elizabeth Macarthur Creek and Strangers Creek which flow to the north, and several unnamed tributaries of Toongabbie Creek which flow to south and southwest.

The underlying geology of the study area consists of Wianamatta Group geologies which are uppermost unit of the sedimentary sequence of the Sydney Basin and formed during the Middle Triassic period. The soil landscapes within the study area are tied to the topography and underlying geology. The residual Blacktown soil landscape is developed in situ on the gentle crests and slopes from underlying Bringelly Shale geology and is subject to minor erosion where surface vegetation is not maintained. Erosional soils of the Luddenham Soil Landscape are found on the more elevated landforms of the study area. This soil landscape has a moderate to very high erosional susceptibility depending on disturbance and vegetation.

Land use practices have extensively impacted the landscape within the study area. Road corridors have modified the landscape through earthworks in addition to modifying the

course of several waterways. Underground utilities have also been constructed within the study area and where trenching has taken place this has modified the landscape and disturbed subsurface deposits. The properties within the study area are predominantly cleared of native vegetation and have been landscaped, which is likely to have modified the landscape and disturbed subsurface deposits.

Regional character

The proposal area is situated in a landscape with moderate to high levels of natural and human disturbance including the construction of roads, the installation of underground utilities, landscaping and erosion. Within these contexts Aboriginal objects are unlikely to survive in situ and the archaeological potential of such sites is generally low. Conversely, ground surface visibility is often increased by these processes, leading to increased identification of surface artefacts in these areas.

Search of heritage registers and databases

An extensive Aboriginal Heritage Information Management System (AHIMS) search was carried out on 24 October 2017 and 27 November 2019 to identify registered (known) Aboriginal sites or declared Aboriginal places within or adjacent to the study area. The search revealed 23 Aboriginal sites within about one kilometre of the proposal area. Of these, one site was located within the study area (AHIMS 45-5-0492). However, the review of previous archaeological investigations identified that a Section 90 Consent to Destroy (#485) under the NPW Act was issued for the site on 19 May 1993. The site was subsequently destroyed for the installation of a water pipeline.

Searches of other sources of information including heritage registers and lists were also searched for known Aboriginal heritage in the vicinity of the study area. These included:

- The Hills LEP 2012
- Roads and Maritime Heritage Register
- State Heritage Register and State Heritage Inventory
- Commonwealth Heritage List
- National Heritage List
- Australian Heritage Places Inventory
- Register of the National Estate (RNE).

These searches did not identify any known Aboriginal heritage.

Survey results

No Aboriginal archaeological objects, sites or potential archaeological deposits were identified within the study area during the survey carried out by KNC and the DLALC in 2017. The study area exhibited substantial ground disturbance with no potential for natural ground surface or intact buried surfaces containing Aboriginal objects. The study area had been highly disturbed by previous landscaping, agricultural use, road and footpath construction, earthworks and the installation of underground utilities.

No Aboriginal cultural heritage was identified in the additional areas surveyed on 19 November 2019. These areas were found to have nil to low Aboriginal archaeological potential. The potential ancillary facility sites and the roundabout at Lexington Drive and Irvine Place have been significantly disturbed by farming, domestic use, road construction and landscaping.

6.7.3 Potential impacts

6.7.3.1 Construction

No Aboriginal archaeological objects or potential archaeological deposits were identified within the study area and the area was found to be extensively disturbed by modern land use practices. The construction of the proposal is unlikely to impact on any Aboriginal archaeological objects, sites or potential archaeological deposits.

6.7.3.2 Operation

The operation of the proposal would not impact any Aboriginal archaeological objects, sites or potential archaeological deposits.

6.7.4 Safeguards and management measures

The wider study area contains evidence of past Aboriginal occupation and behaviour in the form of low-density artefact scatters. As there is low potential for Aboriginal cultural heritage being located within the proposal area, potential impacts to non-Aboriginal heritage will be managed through the implementation of the Roads and Maritime Services Unexpected Finds Procedure (Roads and Maritime, 2013b) (see **Table 6-40**).

Any further impacts proposed beyond those assessed in this report or beyond the boundary of the assessed areas must be subject to further assessment and consultation with the DLALC and in accordance with the PACHCI Guidelines.

Table 6-40 Safeguards and management measures – Aboriginal cultural heritage

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	*The Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where 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 will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Construction	Section 4.9 of QA *G36 Environment Protection*

6.8 Soils, topography and contaminated land

The potential impacts of the proposal on soils and contamination within the proposal area are assessed in the Stage 1 Preliminary Site Investigation (Jacobs, 2019) and limited Stage 2 Contaminated Site Investigation (CSI) (Jacobs, 2020) which is provided in **Appendix K**. A summary of the assessment is presented in this section.

6.8.1 Methodology

A limited Stage 2 CSI was prepared to investigate and document potential contamination that could impact upon the proposal, based on the findings and recommendations of the preliminary CSI. The following scope of works were undertaken as part of the soils and contamination assessment (PCSI and limited Stage 2 CSI):

- A desktop review from the following sources:
  - Historical aerial photographs (from 1956 to 2019)
  - Published geological, topographic, soil and acid sulphate soil maps
  - Review of previous reports relevant to the proposal area
  - Available hydrogeological information
  - Search of the NSW EPA contaminated land database for notices and records pertaining to licensed activities or investigation and/or remediation orders
  - Other information pertaining to potential contamination as detailed in the Environmental Risk and Planning Report (Lotsearch, 8 November 2019).
- Observations from a site inspection to assess potential contaminating activities undertaken
- Limited sampling as part of geotechnical investigation in 2019 and 2020, including:
  - Excavation of six test pits and one borehole to inform contamination assessment in 2019
  - Excavation of three test pits for contamination assessment in 2020
  - Descriptive logging of subsurface materials encountered within excavations/ boreholes, including material classification and visual/olfactory indications of contamination
  - Collection of environmental samples for laboratory testing by a National Association of Testing Authority (NATA) accredited laboratory.

The Stage 2 Contaminated Site Investigation was undertaken in accordance with the following guidelines:

- National Environment Protection (Assessment of Site Contamination) Measure 1999, as revised 2013 (NEPM, 2013)
- NSW EPA (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (NSW Environment Protection Authority, 2011)
- Roads and Maritime (2013) Guideline for the Management of Contamination (Roads and Maritime, 2013a)
- NSW EPA (2014) Waste Classification Guidelines (NSW Environment Protection Authority, 2014).

Site Assessment Criteria

To address potential health impacts at the site, the analytical testing results were compared against a set of health-based and ecological soil investigation and screening levels to be referred to as Site Assessment Criteria (SAC) appropriate for the current land use (i.e. commercial/industrial guidelines, given the current land use/on-site activities). That is, the SAC has been set at levels that provide confidence that contaminant concentrations below

the SAC would not adversely affect human health (health risks to construction workers and future users of the site), or the ecology of potential receiving environments.

The SAC developed for the investigation was derived (where applicable) from the following guidelines.

- NEPM (2013) - Schedule B1 Guideline on Investigation levels for Soil and Groundwater.

Further details on the SAC is provided in **Appendix K**.

6.8.2 Existing environment

Geology and soils

The published Penrith Soil Landscapes of Penrith 1:100,000 series map (Bannerman and Hazelton, 1990) notes that the sites underlying bedrock units are part of the Wianamatta Group and include Ashfield Shale (Rwa), Minchinbury Sandstone (Rwm) and Bringelly Shale (Rwb).

The proposal area traverses two soil landscapes; the Luddenham Soil unit and the Blacktown soil unit. Soils at north end of the proposal area (Lexington Drive) are likely to comprise of the Blacktown (REbt) soil unit, and the remainder of the proposal area is expected to comprise of the Luddenham (ERlu) soil unit. The results of the geotechnical investigation confirmed the materials sighted were indicative of the expected site geology.

Based on a review of available mapping, the probability of encountering potential acid sulfate soil (ASS) within the study area is extremely low (one to five per cent chance of occurrence).

Topography and drainage

The topography of the proposal area is described as generally gentle undulating terrain. High points in the topography extend to areas to the south east of the proposal area. The areas surrounding the proposal area slope away to the north, south and west with steeper slopes to the south.

Multiple stormwater drains were observed across the proposal area as well as two unnamed semi-constructed creeks/waterway systems, refer to **Section 6.9.2** for further detail on drainage characteristics of the proposal.

Contaminated land

Historical land use of the proposal area was predominantly agricultural and pastoral land use. Over the past 20 years much of the land has undergone extensive development with commercial premises to the north of Norwest Boulevard and east of Elizabeth Macarthur Drive. Low to medium density housing has also increased with residential developments in the east, north east and south east as well as west of Old Windsor Road.

A search of the list of contaminated sites was conducted in January 2020 to identify any sites that notified to the NSW Environmental Protection Authority (EPA) under section 60 of the *Contaminated Land Management Act 1997* and the NSW EPA record of notices issued under section 58 of the CLM Act. No regulated sites or sites notified to the NSW EPA were identified within the proposal area.

The PCSI report confirmed no PFAS investigation sites were identified, and no waste sites were identified from the national waste management database, for the proposal area. Three historic businesses were identified within 150 metres of the proposal area as undertaking potentially contaminating activities including drainlayers, fencing contractors and concrete contractors.

The site inspection identified no current potentially contaminating activities. However, fill material containing wastes such as concrete and cement rubble, brick and plastic was

observed in two locations within the proposal area. These two locations are identified in **Figure 6-15**. A single fragment of asbestos containing material (ACM) was identified at the potential ancillary facility 1 on the south west corner of Norwest Boulevard and Elizabeth Macarthur Drive (ResMed site), which may indicate the presence of more ACM within the proposal area.

Results from limited soil sampling (total of nine test pits and one borehole during two rounds of site investigations) did not identify any gross contamination that may present a risk to construction workers or maintenance staff, surrounding commercial industrial estate, or ecological receptors. However, the presence of a fragment of asbestos containing material (ACM) recovered from the surface of the site could indicate the potential for further asbestos to be present within the substratum of areas not investigated, especially within fill materials containing other construction/demolition wastes. As such, five areas of environmental interest (AEI) have been identified within the proposal area, based on the potential contamination risk posed to construction and operation of the proposal without mitigation measures. The details of the five AEI and their associated risk ranking are provided in **Table 6-41**.

Table 6-41 Risk assessment of areas of environmental interest with regards to potential contamination

AEI	Risk	Assessment	Rating
AEI 1	Potential herbicide application in waterways and/or drainage lines	• Licensed application of herbicides on waterways ceased in 2000 • Herbicides likely to be bound to the sediments of waterways and therefore confined unless sediments are disturbed • Only one waterway (located on the ResMed site) is likely to be impacted by construction activities.	Low risk
AEI 2	Subway/Rail corridor	• North West Metro Line runs underneath the proposal area • Rail corridors are associated with a range of contaminants, including metals, lubricants/fuel and asbestos • Construction of the upgrade is not expected to encounter the subway or rail line and associated potential contamination	Low risk
AEI 3	Imported fill and discarded waste	• Fill materials likely to be used during the construction of the roads, intersections and developments within the study area • The presence of wastes that were observed during the site visit indicate the potential types of fill materials that may exist across areas of the site • It is possible that more ACM or other contaminants may be present in fill materials • These materials could be disturbed as part of construction activities.	High risk
AEI 4	Agricultural activities	• The Bella Vista Farm Park was used for agricultural purposes prior to the 2000s • Herbicides, pesticides and fertilisers are commonly used in agricultural practices • No evidence of localised sources of contamination (structures, waste disposal and dip sites) within proposal area • Risk of encountering soils impacted by the historical agricultural activities in this area is unlikely.	Low risk

AEI	Risk	Assessment	Rating
AEI 5	Contaminated groundwater	• Excavation works associated with intersection upgrade are likely to be limited to 1.0 – 5.0 m below ground level • Information on groundwater depths was unavailable • Geological profile suggests potential for a perched groundwater layer to be present • No identification of potentially groundwater contaminating activities located within a 500 metre radius of the proposal area • Likelihood of excavation activities contributing to the mobilisation of contaminated groundwater is considered low.	Low risk

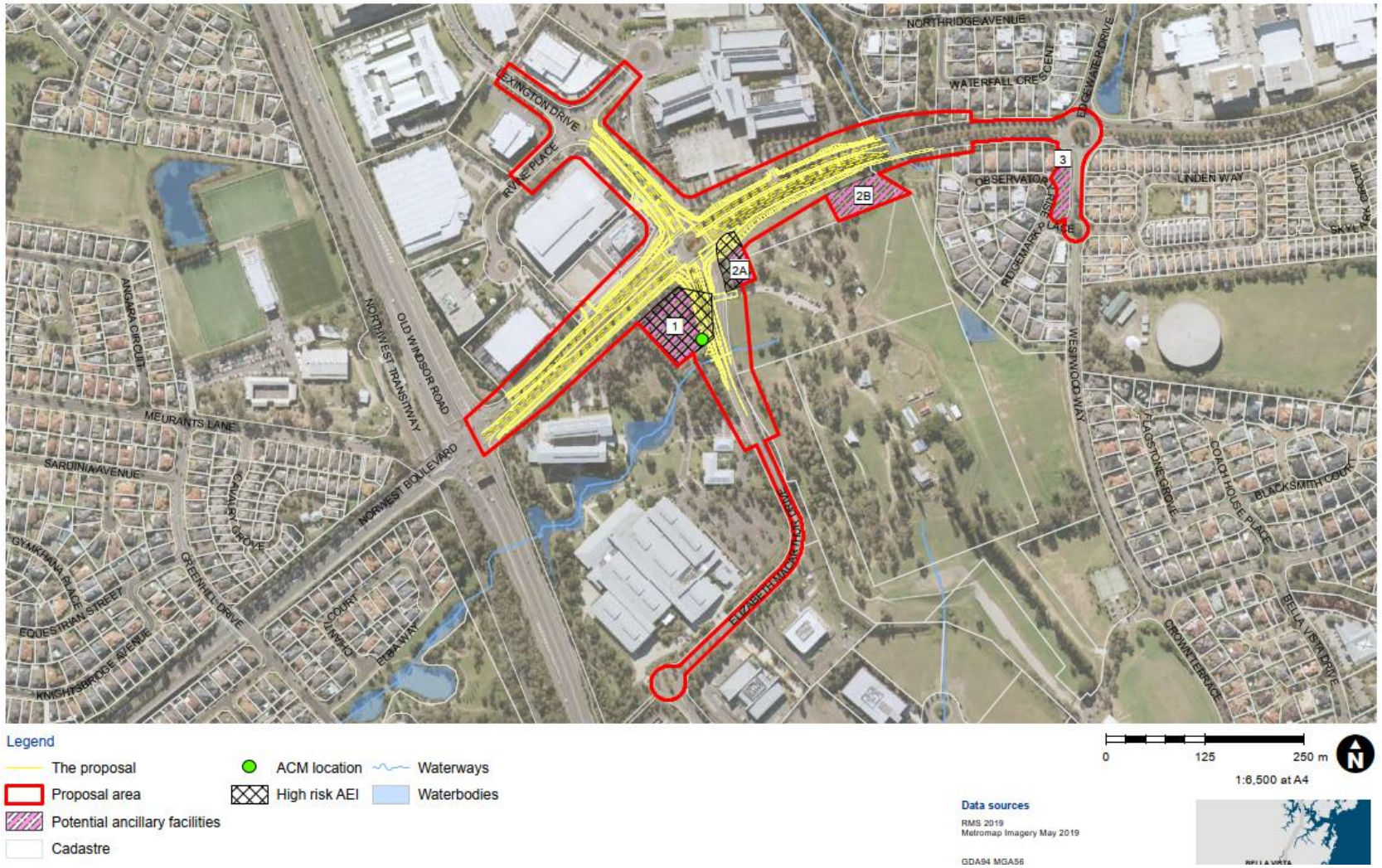


Figure 6-15 High risk areas of environmental interest

6.8.3 Potential impacts

6.8.3.1 Construction

Soils and geology

Most of the proposal would be constructed within the existing road corridor, although there would be minor earthworks required for the widening or partial realignment of the associated roads. The following construction works would be likely to disturb soils:

- Earthworks for the road widening
- Road sub-grade preparation and road pavement works
- Stripping, stockpiling and managing topsoil for pavement works
- Transport and handling of soil and materials to and from the proposal area.

Some soils of the Luddenham soil unit, which underlays the majority of the proposal area, can be highly erodible. These soils are likely to be located in the areas of steeper topography in and around the southern portion of the proposal area. There is a risk that if appropriate surface water flow management controls are not implemented during construction, these soils could be subject to erosion resulting in increased sediment loads in waterways.

Topography and drainage

The proposal would not result in any significant changes to the local topography. The potential impacts to drainage and proposed mitigation measures for the proposal have been assessed in **Section 6.9**.

Contaminated land

Fill material is present up to a maximum depth of about 80 cm within the proposal area. In addition, construction/demolition wastes (i.e. concrete, asphalt and glass) were observed in four of the 10 sites investigated. ACM was also identified at one location within the proposal area. As such, the proposal has the potential to disturb fill containing areas that may have ACM as a result of historic and more recent construction activities. The disturbance of contaminated and potentially contaminated fill material during construction could represent an exposure risk to human and environmental receptors if not adequately managed.

As described in **Section 1.1**, the proposal area boundary has been extended south along Elizabeth Macarthur Drive and east along Norwest Boulevard to allow for the excavation, transport and containment of fill materials within a single construction boundary. This extension allows for a variety of different remediation/management methods to be implemented to manage contaminated and potential contaminated fill material within the proposal area.

Management of contaminated and potentially contaminated fill material during construction within the two high risk AEI could include covering of potential ancillary facilities and laydown areas with separation layers (e.g. geofabric and sub-grade) to reduce exposure to underlying contaminated and potentially contaminated fill materials. This separation layer would be removed on completion of the construction and site surfaces returned to pre-construction conditions.

Controls required for the excavation (or isolation) of materials (including contaminated and potentially contaminated fill) would need to be developed by an appropriately experienced occupational hygienist and where required, excavation of materials would need to be managed by an appropriately licensed asbestos contractor with adequate controls and monitoring.

Materials which are surplus to the proposal needs (including contaminated and potentially contaminated fill) would be subject to waste classification and disposal off-site to a licensed facility. Materials which are surplus to the proposal needs (including contaminated and potentially contaminated fill) would be contained within and managed on TfNSW lands.

The preparation and implementation of an appropriate 'unexpected finds' protocol within construction documents (such as Construction Environmental Management Plan or similar) is recommended for construction activities across the proposal area.

Despite the site investigation not encountering groundwater, the proposal has the potential to disturb groundwater during construction if there is a perched groundwater layer present. If groundwater is encountered during excavations and dewatering is undertaken, water would be tested and disposed of at an appropriately licensed facility, if contamination is detected.

Spills

There is the potential for accidental spillages from the storage, transfer, use and disposal of hazardous and polluting materials. During construction, there would be a need to store small quantities of fuels, chemicals and other potentially hazardous materials on site. It is unlikely that large inventories of hazardous materials would be stored on site. Therefore, the potential for accidental spills is likely to be minor in nature and not result in a significant impact to the receiving environment.

6.8.3.2 Operation

All disturbed areas would be reinstated which would remove operational risks to soils, topography and contamination

6.8.4 Safeguards and management measures

Safeguards and management measures for potential soil and contamination impacts of the proposal are listed in **Table 6-42.**

Table 6-42 Safeguards and management measures – Soils, topography and contaminated land

Impact	Environmental safeguards	Responsibility	Timing	Reference
Contaminated land	A Contaminated Land Management Plan will be prepared in accordance with the *Guideline for the Management of Contamination* (Roads and Maritime, 2013a) and implemented as part of the CEMP. The plan will 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)	Contractor	Detailed design/ Pre-construction	Section 4.2 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Management of the remediation and subsequent validation of the contaminated land, including any certification required (where applicable) • Measures to ensure the safety of site personnel and local communities during construction.			
Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other work that may impact on the contaminated area will 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.	Contractor	Detailed design/ Pre-construction	Section 4.2 of QA *G36 Environment Protection*
Contaminated lands	An 'unexpected finds' protocol within the CEMP would be implemented to provide measures to manage other contamination (if present) which may be encountered as part of construction activities.	Contractor	Detailed design/ Pre-construction	
Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Contractor	Detailed design/ Pre-construction	Section 4.3 of QA *G36 Environment Protection*
Unexpected finds	An 'unexpected finds' protocol within the CEMP will be implemented to provide measures to manage other contamination (if present) which may be encountered as part of construction activities.	Contractor	Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
Groundwater contamination	If groundwater is encountered during excavations and dewatering is undertaken, water would be tested and disposed of at an appropriately licensed facility. These measures can be managed under a CEMP.	Contractor	Construction	

6.9 Hydrology and flooding

6.9.1 Methodology

The methodology for the hydrology and flooding assessment included:

- Collection and review of available data, relevant guidelines and previous studies
- A site inspection to understand the existing catchments and drainage paths
- Hydrologic and hydraulic modelling of the current conditions to establish existing drainage and flooding characteristics
- Assessment of potential construction phase impacts
- Hydrologic and hydraulic modelling of the proposal and assessment of operational impacts
- Identification of appropriate mitigation measures.

6.9.2 Existing environment

The proposal is located at the ridgeline that forms the boundary between the Hawkesbury-Nepean River and Parramatta River catchments. Lexington Drive and Norwest Boulevard (east of the intersection) generally fall in a northerly direction and are within the Hawkesbury-Nepean River catchment. While Norwest Boulevard (west of the intersection) and Elizabeth Macarthur Drive generally fall in a southerly direction and are within the Parramatta River catchment.

The land surrounding the intersection has largely been converted to commercial developments except for the Bella Vista Farm. The existing drainage infrastructure within the study area is predominantly pavement drainage systems. Rainfall runoff is collected by the existing kerbs, gutters and drainage pits, which then direct runoff through a network of underground drainage pipes to the downstream receiving watercourses.

There are three major catchment areas and drainage networks within the study area as shown in **Figure 6-16** and described in **Table 6-43**.

Table 6-43 Summary of three major catchments within the study area

Catchment	Description
Catchment 1	Catchment 1 includes the northern portion of the intersection between Norwest Boulevard and Lexington Drive. Runoff from catchment 1 is collected by an existing drainage system, which begins approximately 100 m north of the intersection between Norwest Boulevard and Lexington Drive. The drainage system for Catchment 1 forms part of a larger drainage network for the local Bella Vista industrial estate, which collects at a sag point east of Lexington Drive approximately 230 metres north of Irvine Place.

Catchment	Description
	The stormwater drainage network outlets on the western side of Old Windsor Road into a constructed open channel, which forms a tributary of Caddies Creek and eventually flows to the Hawkesbury River. The overall catchment area for catchment 1 is approximately 9.1 hectares and extends from Norwest Boulevard in the south to Meridian Place in the north, including the Lexington Drive road corridor, Irvine Place, and adjacent commercial developments.
Catchment 2	Catchment 2 includes Norwest Boulevard east of the crest at CH 400. The drainage system in Norwest Boulevard is part of a larger network that collects at a low point at Edgewater Crescent. Runoff from catchment 2 is collected by an existing drainage system that continues east toward Edgewater Crescent, bypassing Elizabeth Macarthur Creek and discharging to Strangers Creek. Both Strangers Creek and Elizabeth Macarthur Creek join with Caddies Creek (3.8-5.0 km downstream), which eventually flows to the Hawkesbury River via Cattai Creek. Runoff from a grassed recreational area (2.27 hectares in size) also enters the road pavement drainage system via a 450 mm diameter pipe at CH 540. The overall catchment area of catchment 2 is 19.2 hectares, extending from the Norwest Boulevard high point at CH 400 to a high point 100 metres east of Edgewater Crescent, and includes the Norwest Boulevard road corridor, and recreational and urban areas to the south.
Catchment 3	Catchment 3 includes Norwest Boulevard west of the high point at CH 400, and Elizabeth Macarthur Drive. Runoff from Norwest Boulevard is collected by an existing drainage system that begins immediately east of the intersection and flows west towards Old Windsor Road. This drainage system then continues along the Old Windsor Road southbound on ramp to a sag and pavement drainage crossing approximately 170 m south of Norwest Boulevard. Runoff from Elizabeth Macarthur Drive is collected by an existing drainage system at a sag located at the southern limit of works. The pavement drainage system connects to a 1200 mm diameter cross drainage pipe that also receives runoff from an area of Bella Vista Farm 2.5 hectares in size. The 1200 mm pipe culvert outlets to a watercourse running west through the adjacent ResMed property before it crosses under Old Windsor Road adjacent the pavement drainage crossing. This unnamed watercourse is a tributary of Blacktown Creek that eventually flows to the Parramatta River. The overall catchment area for catchment 3 is 18.8 hectares and includes areas of Norwest Boulevard, Elizabeth Macarthur Drive, Bella Vista Farm, the ResMed property and part of Old Windsor Road.

Hydrologic and hydraulic modelling of the existing conditions was conducted using DRAINS (a drainage system modelling program) and in accordance with Australian Rainfall and Runoff 2019 (ARR 2019) data and guidelines. The DRAINS models were run for 10 per cent and one per cent Annual Exceedance Probability (AEP) storm events and the results were reviewed to assess the existing flow patterns and drainage system capacities. Critical storm durations were found to range from five to 20 minutes.

The modelling revealed that for most of the proposal area, the existing drainage system has capacity for the 10 per cent AEP storm event, with sufficient height above the flood level (referred to as freeboard) to account for factors such as wind or potential blockages. However, in some areas the existing drainage infrastructure has insufficient capacity (eg undersized pipes) in a 10 per cent AEP storm event, potentially causing overflows.

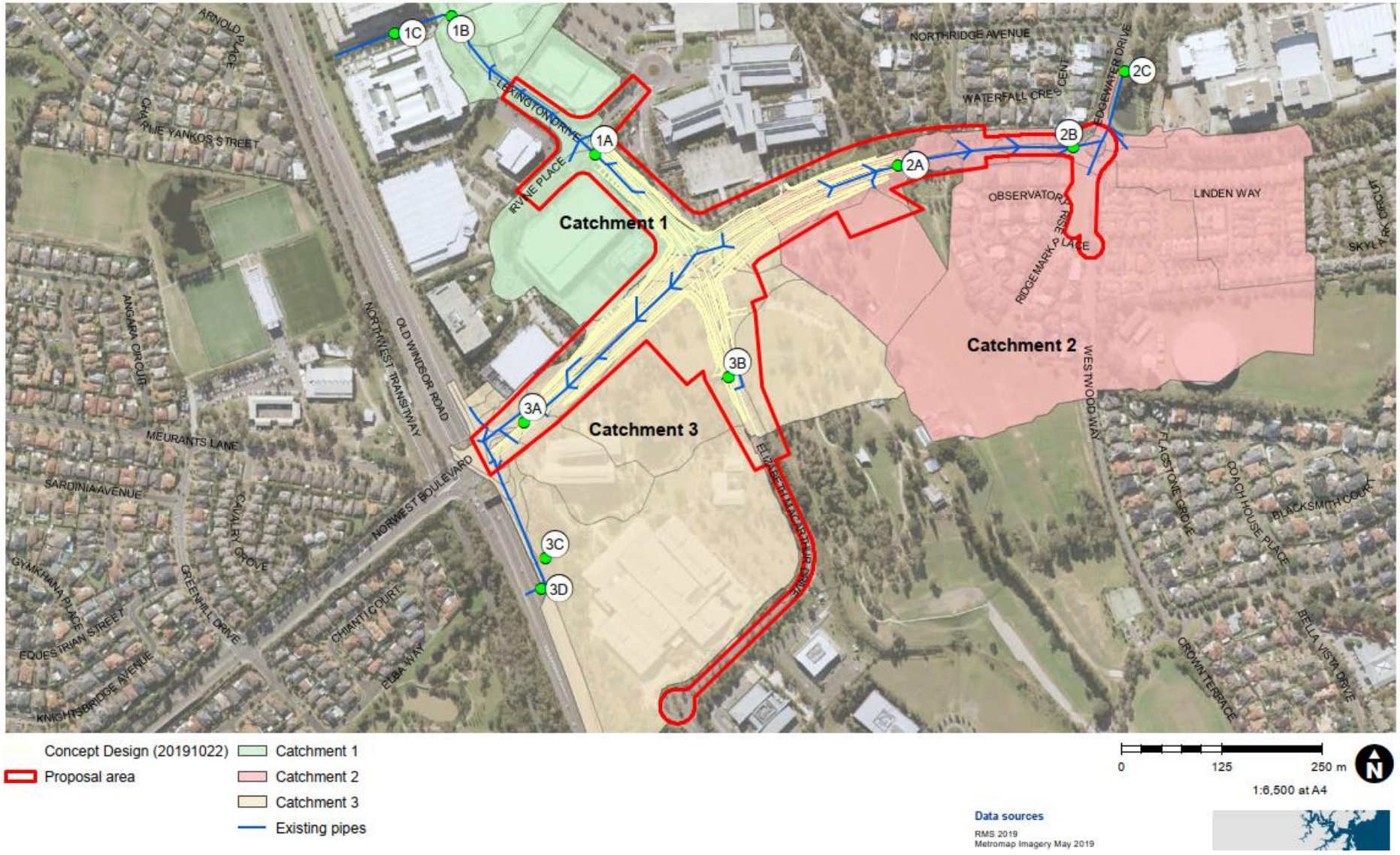


Figure 6-16 Catchment areas and drainage network

6.9.3 Potential impacts

6.9.3.1 Construction

The construction phase would involve the disturbance of land, stripping of soils and exposure of subsoils, and would include some cut and fill earthworks. This phase of the proposal presents a risk to degradation of downstream water quality if erosion and sediment controls are not adequately implemented.

Heavy rainfall during the construction period could result in local overland flows (surface runoff) entering disturbed areas, excavations or stockpiles of construction materials, and spoil being washed away into nearby drainage lines and waterways. Construction activities also have the potential to result in local changes to overland flow regimes and obstruction of drainage paths, resulting in temporary minor increases in surface flows along existing overland flow paths and localised flooding.

The potential ancillary facility locations 2B and 3 (see **Figure 1-2**) are located near existing overland flow paths and inlets to the existing drainage systems. These potential ancillary facilities would be managed to ensure the existing flow paths and inlets are maintained and kept clear of any obstructions.

6.9.3.2 Operation

The proposal would result in the installation of new drainage pits along the new kerb line and new pipes connected to the existing network due to the widening of the road. Operation of the proposal has the potential to change existing drainage patterns and flood behaviour, if changes in road gradients result in altered catchment flow distributions. Increased road pavement areas (impervious surface) would also increase peak runoff rates and volumes discharged to the downstream drainage systems and watercourses.

The potential changes to catchment areas and per cent imperviousness at the key locations have been assessed and are shown in **Table 6-44** (see green dots in **Figure 6-16**). The comparison shows there would be minor changes in contributing catchment areas at each location. It also shows increases in percent imperviousness would be more substantial at the limit of works and would be relatively minor at the catchment outlets.

Table 6-44 Comparison of existing and proposed catchment areas

Location ID	Description	Existing Catchment		Proposed Catchment	
		Area (ha)	Impervious (%)	Area (ha)	Impervious (%)
1A	Lexington Drive at northern limit of works	0.50	75.3	0.60	88.1
1B	Sag in Lexington Drive	8.65	76.2	8.70	77.0
1C	Flow path from Lexington Drive to Old Windsor Road	9.12	74.8	9.17	75.6
2A	Norwest Boulevard at eastern limit of works	2.92	18.6	3.09	24.5
2B	Norwest Boulevard immediately west of Edgewater Crescent	4.02	26.8	4.19	31.4
2C	Drainage outlet to tributary of Strangers Creek	19.23	56.6	19.41	57.3

Location ID	Description	Existing Catchment		Proposed Catchment	
		Area (ha)	Impervious (%)	Area (ha)	Impervious (%)
3A	Norwest Boulevard at western limit of works	2.01	45.4	1.65	81.8
3B	Sag in Elizabeth McArthur Drive at southern limit of works	3.28	19.6	3.63	27.4
3C	Inlet to cross drainage culvert under Old Windsor Road	14.95	46.6	15.13	48.2
3D	Pavement drainage sag in Old Windsor Road	3.86	58.6	3.49	77.1

DRAINS modelling of the proposal for the 10 per cent and one per cent AEP events was carried out using the (20 per cent) concept design to assess the performance of the drainage system and to assess changes in flow distributions. The results show that the majority of the existing pipe networks within the proposal area would have adequate capacity and freeboard in the 10 per cent AEP event to accommodate the increase in runoff from the proposed widening. However, upgrading the existing pipe to a larger diameter or adding additional pits along the westbound kerb at the eastern end of the proposal area within catchment 2 is recommended to provide 10 per cent AEP capacity.

The DRAINS modelling results of the proposal were also reviewed and compared against the existing results to assess changes in flow distributions. It was found that there would be no significant change in flood flow distribution that would cause flooding risk to the surrounding development. However, there would be an increase in peak flow from the cross drainage pipe under Elizabeth Macarthur Drive estimated to cause a maximum increase in peak water level of 0.02 metres to 0.03 metres in the channel immediately downstream within the ResMed property. This increase would cause a minor impact to an existing internal access road but would not impact the existing buildings. The increase in flow and level would diminish through the ResMed property as additional catchment flows enter the watercourse.

6.9.4 Safeguards and management measures

Safeguards and management measures for potential hydrology and flooding impacts of the proposal are listed in
Table 6-45.

Table 6-45 Safeguards and management measures – Hydrology and flooding

Impact	Environmental safeguards	Responsibility	Timing
Hydrology and flooding	Consultation with The Hills Shire Council in relation to drainage and flooding impacts of the proposal.	Contractor	Detailed design/ Pre-construction
Hydrology and flooding	Further detailed hydrologic and hydraulic modelling of the proposal would be undertaken during detailed design to confirm	Contractor	Detailed design/ Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	the outcomes of this assessment.		
Localised flooding and erosion	The CEMP will include measures aimed at intercepting any concentrated flow and diverting it toward the existing drainage system. Additionally, any ancillary facilities, construction equipment, material stockpiles or laydown areas would be located away from drainage infrastructure and overland flow paths.	Contractor	Pre-construction/ Construction

6.10 Surface water and groundwater

6.10.1 Methodology

An assessment of surface water and groundwater within the proposal area was undertaken to assess potential impacts to surface water and groundwater as a result of the construction and operation of the proposal.

Surface water

The methodology for this assessment included:

- A review of existing literature relating to the proposal, available water quality data and existing conditions, using available literature to obtain background information on catchment history and land use. Literature sources included:
  - Hills Shire Council routine monitoring from 2006 to 2013 (Hills Shire Council, 2013)
  - Sydney Water routine monitoring from 2006 to 2019
  - The Strategic Analysis of Water Quality Monitoring in the Parramatta River Catchment (Jacobs, 2016)
- A visual inspection of the existing waterway condition on 17 November 2016 and 19 November 2019. Habitat condition assessed against the Department of Primary Industries Policy and Guidelines for Fish Habitat Conservation and Management (2013) and Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003)
- Identification of potential water quality and hydrology impacts associated with the construction and operation of the proposal and provision of mitigation measures to address the potential impacts.

The study area and site locations for the surface water field assessment is shown in **Figure 6-17**. Monitoring locations where water quality data was collected Sydney Water are shown in **Figure 6-18**.

Groundwater

A desktop groundwater assessment was carried out to establish groundwater conditions, levels, quality and potential impacts associated with the proposal. Inputs to the groundwater assessment included:

- Geotechnical Interpretative Report (Jacobs, 2020)
- WaterNSW Continuous Water Monitoring Network – Groundwater Bores (WaterNSW, 2019)
- Norwest Boulevard Upgrade Concept Design Stage – Geotechnical Factual Report and AGS data file, Report No. G5168/1 (Roads and Maritime, 2019)
- Norwest Boulevard Upgrade Concept Design Stage – Geotechnical Factual Report 2 and AGS data file, Report No. G5168/2 (Roads and Maritime, 2020).

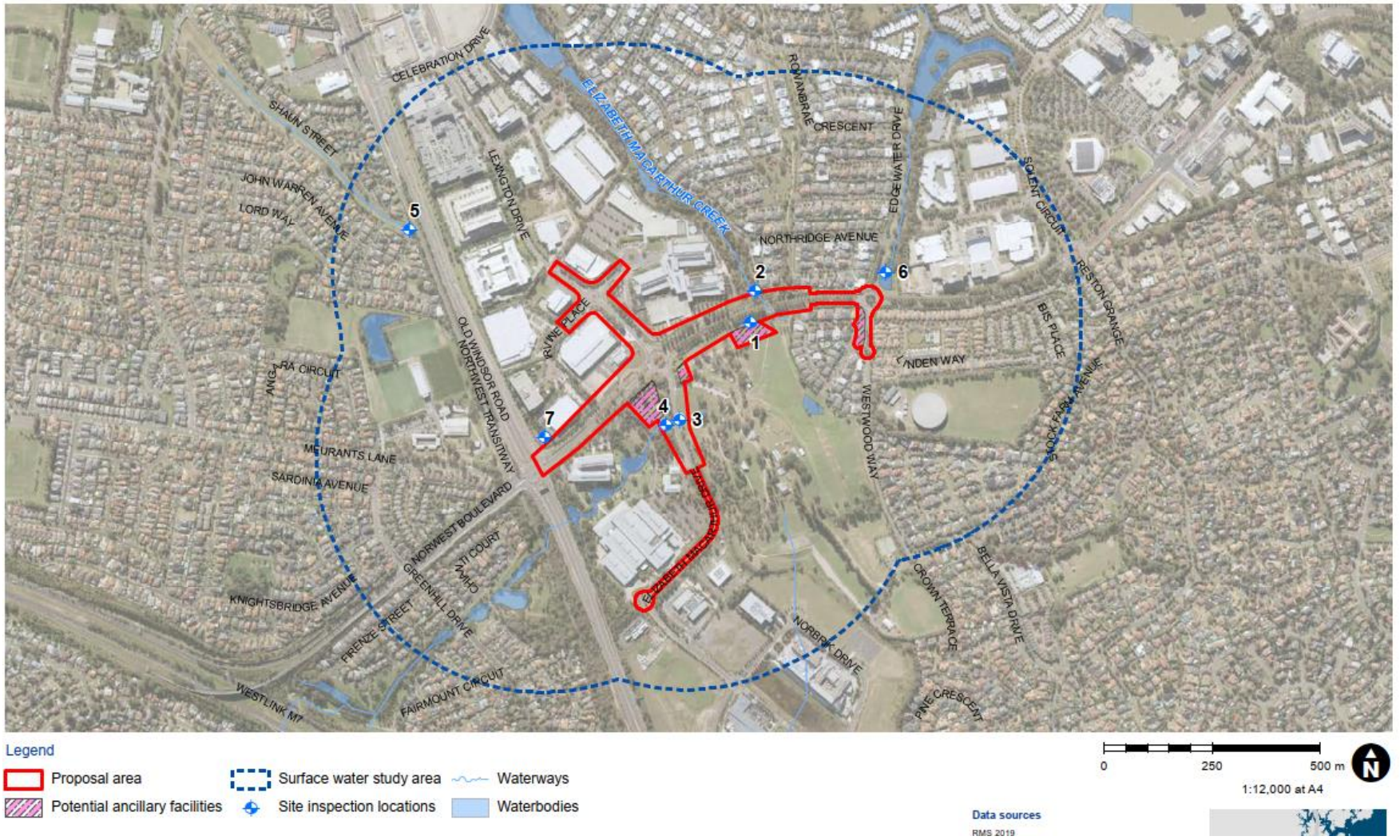


Figure 6-17 Surface water study area

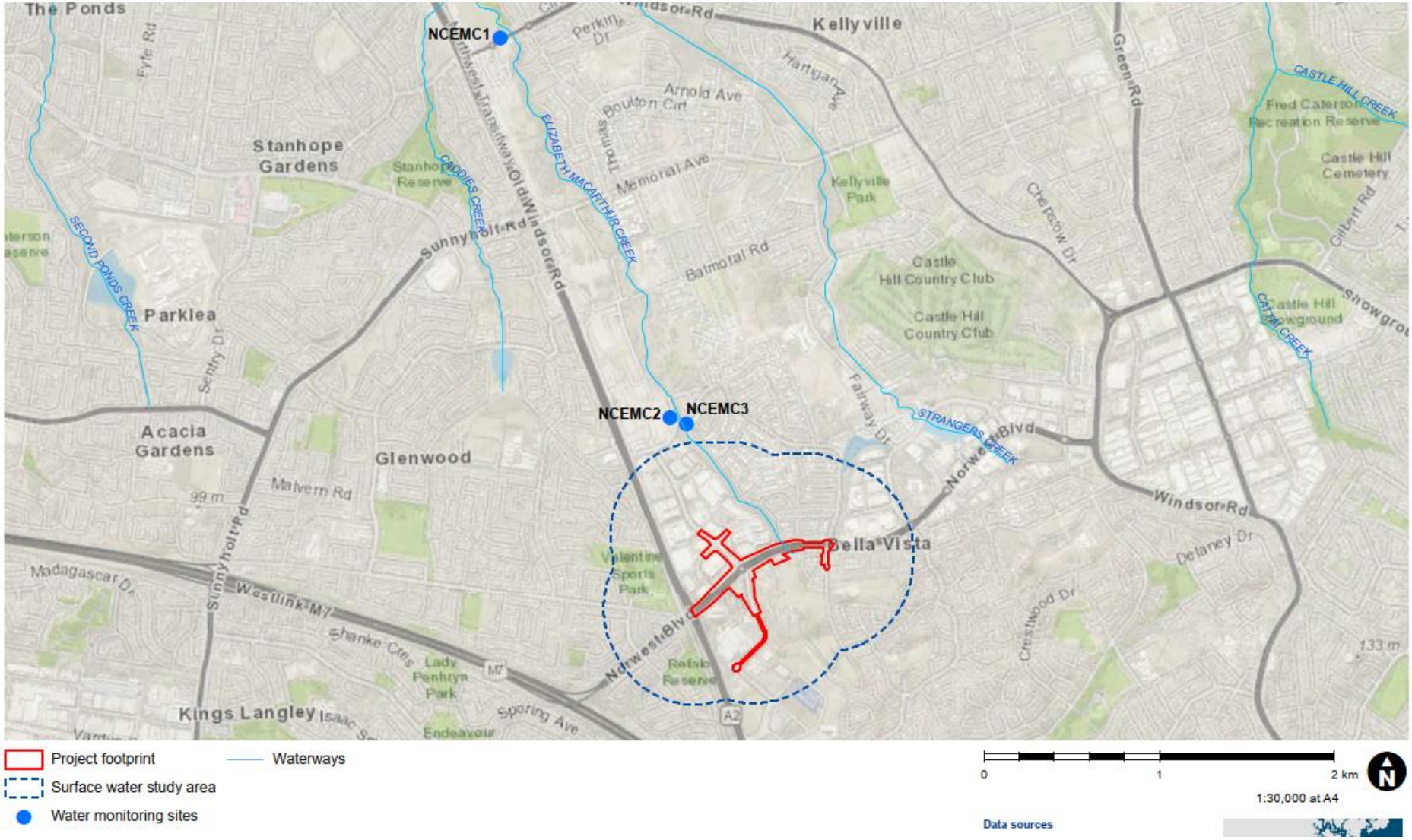


Figure 6-18 Water quality monitoring sites

6.10.2 Existing environment

6.10.2.1 Surface water

Existing conditions

The proposal is located within north-west Sydney along the ridge line which delineates catchment boundaries of the Hawkesbury Nepean River and the Parramatta River. The proposal area is bounded to the north-west, north-east and south-west by urban development comprising B7 zoned business park allotments. To the south-east, the proposal is bounded by Bella Vista Farm and associated grassed public open space areas.

As described in **Table 6-43** and shown in **Figure 6-16**, three stormwater catchments and a number of associated drainage features have been identified through hydrological assessment of the proposal area (Jacobs, 2019a).

Sensitive receiving environments

Sensitive receiving environments (SRE) are identified using aquatic habitat as an indicator and assessed against the Department of Primary Industries Policy and Guidelines for Fish Habitat Conservation and Management (2013) and Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge, 2003).

To determine presence of any SREs within the study area, site inspections of the waterways were undertaken on 17 November 2016 and again on 19 November 2019. Site descriptions are provided in **Table 6-46** and locations are shown in **Figure 6-17**. Out of all the seven sites, only the downstream portion of the tributary at Site 6 was considered an SRE.

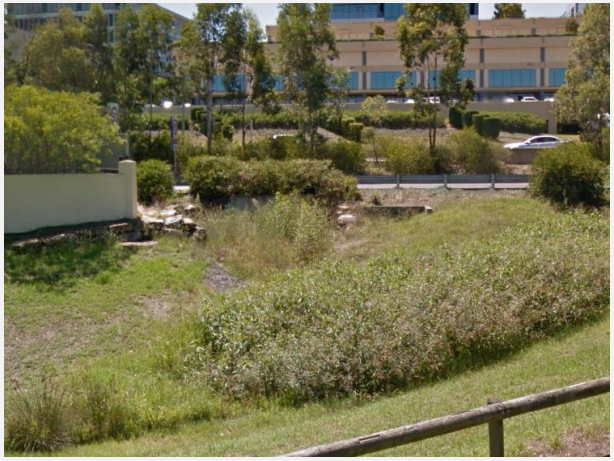
Table 6-46 Site description – determination of sensitive receiving environments.

Site Name	Catchment	Photos	Site Description
Site 1 – Open channel drain to Elizabeth Macarthur Creek (southern side of Norwest Boulevard)	Catchment 3	 Elizabeth Macarthur Creek at Site 1 (facing upstream)  Elizabeth Macarthur Creek at Site 1 (facing downstream)	On the southern side of the Norwest Boulevard (within proximity of the construction footprint), there is an open stormwater drainage depression in the north east corner of Bella Vista. During rainfall event, this flows into Elizabeth Macarthur Creek via a culvert under Norwest Boulevard. Elizabeth Macarthur Creek is an intermittent, 1st order Strahler stream and not mapped as Key Fish Habitat (Department of Primary Industries, 2007). Elizabeth Macarthur Creek is not mapped as potential habitat for any threatened fish under the *Fisheries Management Act 1994* (Department of Primary Industries, 2016). Elizabeth Macarthur Creek at Site 1 was classified as 'Type 4 – Not fish habitat' (Department of Primary Industries, 2013), and 'Class 4 – Unlikely key fish habitat' (Fairfull and Witheridge, 2003) as there was minimal channel definition and no aquatic habitat. The channel was dry at the time of inspection; however, flow is expected to migrate intermittently in a north-westerly direction toward Caddies Creek following rain events. **Due to its intermittent nature and lack of aquatic habitat features, the site was not considered a SRE.**

Site Name	Catchment	Photos	Site Description
Site 2 – Elizabeth Macarthur Creek (northern side of Norwest Boulevard)	Catchment 2	 Elizabeth Macarthur Creek (facing upstream)  Elizabeth Macarthur Creek foot-crossing.	On the northern side of the Norwest Boulevard, Elizabeth Macarthur Creek is an intermittent, 1st order Strahler stream and not mapped as Key Fish Habitat (Department of Primary Industries, 2007). Elizabeth Macarthur Creek is not mapped as potential habitat for any threatened fish under the *Fisheries Management Act 1994* (Department of Primary Industries, 2016). Elizabeth Macarthur Creek at Site 2 was classified as 'Type 4 – Not fish habitat' (Department of Primary Industries, 2013), and 'Class 4 – Unlikely key fish habitat' (Fairfull and Witheridge, 2003) as there was minimal channel definition and limited instream aquatic habitat. The channel was dry at the time of inspection; however flow is expected to migrate intermittently in a north-westerly direction toward Caddies Creek following rain events. **Due to its intermittent nature and lack of aquatic habitat features, the site was not considered a SRE**.

Site Name	Catchment	Photos	Site Description
Site 3 – Tributary of Blacktown Creek (eastern side of Elizabeth Macarthur Drive)	Catchment 3	 Tributary of Blacktown Creek (facing upstream)  Tributary of Blacktown Creek (facing downstream)	On the eastern side of Elizabeth Macarthur Drive, the tributary to Blacktown Creek is an intermittent, 1st order Strahler stream and not mapped as Key Fish Habitat (Department of Primary Industries, 2007). The tributary is not mapped as potential habitat for any threatened fish under the Fisheries Management Act 1994 (Department of Primary Industries, 2016). The tributary of Blacktown Creek at Site 3 was classified 'Type 4 – Not fish habitat' (Department of Primary Industries, 2013), and 'Class 4 – Unlikely key fish habitat' (Fairfull and Witheridge, 2003) as there was minimal channel definition and no instream aquatic habitat. The channel was dry at the time of inspection; however, flow is expected to migrate intermittently in a south-westerly direction toward Blacktown Creek following rain events. Flow would migrate downstream via a culvert under Elizabeth Macarthur Drive. **Due to its intermittent nature and lack of aquatic habitat features, the site was not considered a SRE.**

Site Name	Catchment	Photos	Site Description
Site 4 – Tributary of Blacktown Creek (western side of Elizabeth Macarthur Drive)	Catchment 3	 Tributary of Blacktown Creek (facing upstream)  Tributary of Blacktown Creek (facing downstream)	On the western side of Elizabeth Macarthur Drive, the tributary to Blacktown Creek is an intermittent, 1st order Strahler stream and not mapped as Key Fish Habitat (Department of Primary Industries, 2007). The tributary is not mapped as potential habitat for any threatened fish under the *Fisheries Management Act 1994* (Department of Primary Industries, 2016). The tributary of Blacktown Creek at Site 4 is a modified channel that flows to a stormwater retention pond in the ResMed facility. It is expected that flow would be able to migrate further downstream toward Blacktown Creek during discharge events of the stormwater retention pond. There is a culvert outlet and weir structure at the upstream extent of the site. At the time of inspection, the channel had about 0.2 metres water depth and there was moderate flow. Water quality appeared clear. There were no significant instream habitat features. Due to the isolation of the tributary from Blacktown Creek, and lack of aquatic habitat features, the tributary of Blacktown Creek at Site 4 was classified 'Type 4 – Not fish habitat' (Department of Primary Industries, 2013), and 'Class 4 – Unlikely key fish habitat' (Fairfull and Witheridge, 2003. **Due to isolation from Blacktown Creek and the lack of aquatic habitat features, the site was not considered a SRE.**

Site Name	Catchment	Photos	Site Description
Site 5 – Tributary of Caddies Creek (west of Old Windsor Road)	Catchment 2	 Tributary of Caddies Creek (facing upstream)  Tributary of Caddies Creek (facing downstream)	In the north-western extent of the study area, the Tributary to Caddies Creek is an intermittent, 1st order Strahler stream and not mapped as Key Fish Habitat (Department of Primary Industries, 2007). The tributary is not mapped as potential habitat for any threatened fish under the *Fisheries Management Act 1994* (Department of Primary Industries, 2016). The tributary of Caddies Creek at Site 5 was classified as 'Type 4 – Not fish habitat' (Department of Primary Industries, 2013), and 'Class 4 – Unlikely key fish habitat' (Fairfull and Witheridge, 2003) as there was minimal channel definition and limited aquatic habitat. There appeared to be some instream vegetation however this was a large weed infestation within the channel bed. The channel was dry at the time of inspection; however, during rain events, flow is expected to migrate intermittently in a north-westerly direction into Glenwood Lake, before flowing further downstream toward Caddies Creek. **Due to its intermittent nature and lack of aquatic habitat features, the site was not considered a SRE**.

Site Name	Catchment	Photos	Site Description
Site 6 – Tributary of Strangers Creek (north of Norwest Boulevard)	Catchment 2	 Stormwater retention pond upstream of the tributary of Strangers Creek (facing downstream)  Tributary of Strangers Creek (facing downstream)	In the north-eastern extent of the study area, the tributary to Strangers Creek is an intermittent, 1st order Strahler stream and not mapped as Key Fish Habitat (Department of Primary Industries, 2007). The tributary is not mapped as potential habitat for any threatened fish under the Fisheries Management Act 1994 (Department of Primary Industries, 2016). At the upstream extent of the tributary, there was a stormwater retention pond which appeared to have degraded water quality. The pond appeared to have some algal growth and oily films across the surface of the water. Water depth was unknown. No instream vegetation was present within the pond. Due to access constraints, the downstream portion of the tributary could not be properly assessed, and a visual inspection had to be made from a distance of approximately 30 metres from the creek. From the site inspection location, there appeared to be moderate channel definition and some aquatic habitat was present in the downstream portion of the tributary, which connected to Strangers Creek. Water level within the channel appeared to be moderate. The tributary of Strangers Creek at Site 6 was therefore classified as 'Type 3 – minimally sensitive fish habitat' (Department of Primary Industries, 2013), and 'Class 3 – Minimal key fish habitat' (Fairfull and Witheridge, 2003). Due to its intermittent nature, lack of aquatic habitat features and isolation from the rest of the tributary, the stormwater retention pond at the upstream extent of the site was not considered to be a SRE. **The downstream portion of the tributary at Site 6 is considered a SRE.**

Site Name	Catchment	Photos	Site Description
Site 7 – Open channel drain to tributary of Blacktown Creek (north of junction between Norwest Boulevard and Old Windsor Road) (facing downstream)	Catchment 3	 Open channel drain to tributary of Blacktown Creek (facing downstream)	In the western extent of the study area, there is an open drainage depression north of junction between Norwest Boulevard and Old Windsor Road. During rainfall event, this flows into Blacktown Creek. Blacktown Creek is an intermittent, 1st order Strahler stream and not mapped as Key Fish Habitat (Department of Primary Industries, 2007). Blacktown Creek is not mapped as potential habitat for any threatened fish under the *Fisheries Management Act 1994* (Department of Primary Industries, 2016). Tributary of Blacktown Creek at Site 7 was classified as 'Type 4 – Not fish habitat' (Department of Primary Industries, 2013), and 'Class 4 – Unlikely key fish habitat' (Fairfull and Witheridge, 2003) as there was minimal channel definition and no aquatic habitat. The channel was dry at the time of inspection; however, flow is expected to migrate intermittently in a southerly direction toward Blacktown Creek following rain events. **Due to its intermittent nature and lack of aquatic habitat features, the site was not considered a SRE.**

Existing water quality

No existing water quality data is available at the proposal crossings for Elizabeth Macarthur Creek or the unnamed tributary of Blacktown Creek or Strangers Creek. No water monitoring was undertaken during the site inspection (19 November 2019) as no water was present for sampling.

Ongoing sampling within Elizabeth Macarthur Creek, which flows perennially, has been undertaken historically by Sydney Water at locations variably downstream of the proposal area (locations shown on **Figure 6-18**.

Table 6-47 below presents a summary of the water quality monitoring results from the Sydney Water monitoring sites within Elizabeth Macarthur Creek – screened against the ANZG (2018) guideline values for 95 per cent species protection for toxicants and ANZECC (2000) guidelines for nutrients and stressors to elucidate a preliminary understanding of the existing conditions. Values outside of the guideline range are identified in red text.

There are currently no NSW Water Quality Objectives (WQO) for the Hawkesbury River. As such, parameters usually assessed within the WQO framework are not presented.

The results from sampling of Elizabeth Macarthur Creek show that parameters comprising total nitrogen, total phosphorous and Chlorophyll-a may often exceed water quality guideline values for ecological protection during both dry weather and wet weather events. Average concentrations of total nitrogen and total phosphorous are greater during and after wet weather events, whereas Chlorophyll-a concentrations are generally greater during dry weather events (indicating effect of stagnant flow conditions on water quality). Concentrations of faecal coliforms and enterococci are also higher during dry weather events.

Turbidity generally increases during wet weather events as a result of additional sediments entering waterways of Elizabeth Macarthur Creek, however remains below the guideline value range.

Limited water quality data is available within Blacktown Creek. A review of existing water quality within Blacktown Creek is provided in Jacobs (2016) Strategic Analysis of Water Quality Monitoring in the Parramatta River Catchment. The water quality of Blacktown Creek is poor, and the creek is considered eutrophic given the elevated nutrient concentrations (Jacobs, 2016). Blacktown Creek receives overflows and stormwater which are the most likely cause for the poor water quality. Additionally, Blacktown Creek is known to suffer from bank erosion, weed proliferation and accumulation of rubbish and sediment during stormwater events.

Overall, the poor water quality within the downstream waterways is largely attributable to the surrounding urban land use and associated stormwater discharges to the receiving channels. These impacts are also likely to occur upstream within the unnamed tributary of Blacktown Creek and Elizabeth Macarthur Creek where stormwater discharges contribute to channel flow.

Table 6-47 Existing water quality monitoring results for Elizabeth Macarthur Creek

Site ID Location (lat and long)	Parameter	Guideline Value	Dry Weather Conc^{n} Range	Dry Weather Conc^{n} Average	Wet Weather Conc^{n} Range	Wet Weather Conc^{n} Average
NCEMC1 -33.7110 150.936	Dissolved oxygen (%Sat)	85 - 110	52 – 112	80	67 – 121	90
	pH	6.5 – 8.5	7.1 – 8.07	7.62	7.26 – 8.06	7.62
	Conductivity (uS/cm)	125 – 2,200	453 – 1,971	1,136	367 – 1,341	743
	Turbidity (NTU)	6 - 50	2.3 – 47	14.5	12 – 300	70
	Faecal Coliform (CFU/100mL)	-	3 – 59,000	2,293	74 – 22,000	4,160
	Enterococci (CFU/100mL)	-	13 – 31,000	1,649	91 – 20,000	2,898
	Chlorophyll – a (mg/m3)	5	0.6 – 24.6	6.57	0.5 – 12.3	5.0
	Ammonia NH3-N (mg/L)	0.9	0.01 – 0.62	0.047	0.01 – 0.14	0.042
	Total Nitrogen (mg/L)	0.5	0.36 – 1.39	0.65	0.57 – 1.54	1.00
	Total Phosphorus (mg/L)	0.05	0.01 – 3.2	0.11	0.02 – 0.22	0.073
NCEMC2 -33.7307, 150.946	Dissolved oxygen (%Sat)	85 - 110	71 – 128	94	78 – 101	92
	pH	6.5 – 8.5	7.36 – 8.83	7.85	7.52 – 8.44	7.87
	Conductivity (uS/cm)	125 – 2,200	252 – 1,766	680	295 – 1,780	657
	Turbidity (NTU)	6 - 50	3.2 – 20	7.87	12 – 35	20.37
	Faecal Coliform (CFU/100mL)	-	2 – 11,000	647	12 – 960	312
	Enterococci (CFU/100mL)	-	29 – 780	255	12 – 1,100	273
	Chlorophyll – a (mg/m3)	5	0.5 – 31.6	7.55	1.5 – 14.4	5.1
	Ammonia NH3-N (mg/L)	0.9	0.01 – 0.07	0.02	0.01 – 0.08	0.03

Site ID Location (lat and long)	Parameter	Guideline Value	Dry Weather Concⁿ Range	Dry Weather Concⁿ Average	Wet Weather Concⁿ Range	Wet Weather Concⁿ Average
	Total Nitrogen (mg/L)	0.5	0.31 – 1.6	0.57	0.39 – 1.14	0.72
	Total Phosphorus (mg/L)	0.05	0.011 – 0.059	0.026	0.02 – 0.068	0.036
NCMC3 -33.731, 150.947	Dissolved oxygen (%Sat)	85 - 110	74 – 131	99	68 – 116	89
	pH	6.5 – 8.5	7.45 – 9.02	8.08	7.5 – 8.2	7.77
	Conductivity (uS/cm)	125 – 2,200	251 – 1,653	601	284 – 1,153	435
	Turbidity (NTU)	6 - 50	5.4 – 39	15.2	14 – 44	31
	Faecal Coliform (CFU/100mL)	-	8 – 5,000	420	100 – 3,500	712
	Enterococci (CFU/100mL)	-	10 – 4,500	370	45 – 880	332
	Chlorophyll – a (mg/m3)	5	1.3 – 22	6.53	1.6 – 20.3	6.85
	Ammonia NH3-N (mg/L)	0.9	0.01 – 0.13	0.03	0.01 – 0.08	0.35
	Total Nitrogen (mg/L)	0.5	0.35 – 1.35	0.54	0.48 – 1.21	0.71
	Total Phosphorus (mg/L)	0.05	0.011 – 0.052	0.025	0.025 – 0.075	0.045

Red text indicates values outside the guidance range

6.10.2.2 Groundwater

A geotechnical interpretive report prepared for the proposal (Jacobs, 2020) identified five groundwater monitoring bores located within one kilometre of the study area, through a search of the WaterNSW Continuous Water Monitoring Network database. Standing groundwater levels were not observed in the groundwater bores. However, the majority of the bores were shallow bores (eight to 27.5 metres below ground level) within the residual soil and shale bedrock units.

The regional groundwater table would be expected to be encountered at greater depths (greater than five metres) within the Bringelly Shale or Minchinbury Sandstone, with only localised perched groundwater levels anticipated at shallow depths (less than five metres).

Groundwater was not encountered during geotechnical or contamination investigations. It is not anticipated that the proposed works would encounter any groundwater.

6.10.3 Potential impacts

6.10.3.1 Construction

Construction of the proposal presents a risk to degradation of downstream water quality if management measures are not implemented, monitored and maintained throughout the construction phase.

If unmitigated, the highest risk to water quality would occur through the following construction activities:

- Removal of vegetation and general earthworks, including stripping of topsoil, excavation or filling
- Stockpiling of excavated materials, topsoil and vegetation
- Transportation of cut and/or fill materials and the movement of heavy vehicles across exposed earth
- Uncontrolled discharges to receiving waterways, including site wash-off during / following storm events and on-site leaks and spills.

Additional details on these risks are provided below.

Removal of vegetation and general earth works

Removal of vegetation and general earthworks would occur within 500 metres of both waterways. General earthworks including vegetation removal, stripping of topsoil and filling has a risk of disturbance or mobilisation of sediment into the surrounding waterways. The impact of these works on water quality could include increased turbidity, suspended solids, nutrients and contaminants from mobilisation of soils. Removal of vegetation is proposed at several locations, with about 3,417 square metres of vegetation estimated to be cleared (refer to **Section 6.1**).

Fill requirements throughout the proposal are expected to be generally minor. However, loose fill has the potential to be eroded during rainfall events by runoff, thereby increasing the potential for mass movements of soils and sedimentation of the abovementioned waterways where filling is proposed.

Stockpiling of topsoil and vegetation

Stockpile sites would be used to temporarily store excess spoil and wastes such as concrete from demolition before their reuse on-site or disposal off-site. Stockpile sites would also include environmental protection measures such as sediment basins and hoardings to minimise impacts on sensitive receivers from dust and receiving waters from erosion and

sedimentation. Stockpile sites would be established and managed in accordance with the Roads and Maritime environmental procedure Management of Wastes on Roads and Maritime Services Land (Roads and Maritime, 2014b).

Earthworks and construction vehicles

Earthworks and construction vehicles within the proposal area could increase erosion and sediment deposition in the waterways. Construction activities adjacent to waterways could introduce contaminants such as oil or grease and disturb contaminated sediments, potentially having an adverse impact on water quality. Accidental leaks or spills of chemicals, fuels and oils could occur from construction plant or construction materials and be mobilised to waterways or stormwater drains during a rainfall event.

6.10.3.2 Operation

During the operational phase of the proposal, the roads would be sealed, embankments landscaped and appropriate water quality controls in place. Typically, no exposed topsoil would remain once the proposal is operating. Hence, risks are no longer associated with sediment loading but are instead associated with pollutants from atmospheric deposition, motorists and changes to surface runoff and impervious surfaces.

Changes to impervious surfaces, surface runoff and hydrology

The changes in the road pavement catchment area between the existing conditions and the upgraded conditions is relatively small. It is expected that the main risk to water quality during operation is surface runoff from increased impervious surfaces and the concentration of runoff via drains and kerbs. The proposed works include the increase of the total pavement runoff catchment area from 9.8 hectares to 10 hectares, and therefore a small increase in imperviousness. This has the potential to increase peak surface runoff and cause an impact of flooding. The increase in imperviousness is expected to increase pollutant loads slightly but not significantly.

The build-up of contaminants on road surfaces and roadside corridors in dry weather can be transported during rainfall events to surrounding watercourses. The generation of additional pollutants would be directly attributable to the increased road surface area and associated increased vehicle traffic in the future.

The most important pollutants of concern relating to road runoff are:

- Sediments from the paved surface from pavement wear and atmospheric deposition
- Heavy metals attached to particles washed off the paved surface
- Oil and grease and other hydrocarbon products
- Litter from the road corridor
- Nutrients such as nitrogen and phosphorus (organic compounds) from natural atmospheric deposition of fine soil particles.

Stormwater quality management for road surface runoff includes managing the export of suspended solids and associated contaminants – namely heavy metals, nutrients and organic compounds (Austroads, 2001). Pollutants such as nutrients, heavy metals and hydrocarbons are usually attached to fine sediments (RTA, 2003). Therefore, trapping suspended solids is the primary focus of the water quality management strategy for the operational phase of the proposal.

6.10.4 Safeguards and management measures

The proposal would not cause any significant impact on surface water quality, provided adequate mitigation measures are implemented as described below. Given the ephemeral nature of these waterways, the existing poor water quality and small volumes they contribute downstream, these creeks are unlikely to impact on the downstream larger creeks and rivers to which they discharge.

For the widening works of Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive, the surface runoff from the road pavement footprint discharges into the drainage system before it reaches existing creeks. The runoff would discharge in four separate directions (shown on **Figure 6-16**):

1. On Norwest Boulevard, the runoff from the existing roundabout flowing in the westerly direction would be intercepted in the drainage system
2. On Norwest Boulevard, the runoff from the existing roundabout flowing in the easterly direction would be intercepted in the drainage
3. On Elizabeth Macarthur Drive, the runoff from the existing roundabout flowing in the southerly direction would be intercepted in the drainage system before it discharges into Minor Creek.
4. On Elizabeth Macarthur Drive, the runoff from the existing roundabout flowing in the northerly direction would be intercepted in the drainage system.

Measures to manage runoff during construction and operation of the proposal are described below.

6.10.4.1 Construction

Water quality controls and spill containment

A review of the four downstream locations indicates that there is no space for a sediment basin at the downstream ends and that the best alternative is to provide local erosion and sediment controls, and in particular sediment fences around the drainage pits. Adequate erosion and sediment controls and protection at the drainage pits would be required to capture runoff before it enters the drainage system. An ESCP would need to be prepared as part of the detailed design once the construction staging has been identified, including the location of drainage pits that would remain, those that would be moved and any proposed new pits.

The footprint of the potential ancillary facilities may not be sufficiently large to require a sediment basin. Surface runoff from any potential ancillary facility areas would need to be intercepted in sediment sumps (mini sediment basins) before discharging into downstream creeks, so sediment sumps would be installed at the downslope end of the potential ancillary facilities. The volume of the sediment sumps would be in the order of 10 to 20 cubic metres each.

Water quality monitoring

A visual water quality monitoring program would be undertaken upstream and downstream of proposed waterways that have the potential to be impacted during the construction of the proposal. Pre-construction monitoring would provide a baseline of the existing water quality to ensure there is no further degradation in water quality or impact on the nominated environmental values during construction.

In-situ physical parameters (e.g. electrical conductivity, dissolved oxygen, pH, turbidity) would also be recorded during construction phase on any controlled discharges to assess compliance against NSW guidelines on managing urban stormwater (Blue Book). Physical

parameters would be monitored within construction sediment basins prior to controlled discharge and downstream of sediment basins to measure and validate compliance.

6.10.4.2 Operation

The proposal would include the installation of gross pollutant traps (GPTs), subject to a review of the location of discharge or connection into an existing drainage system. The four connection points are:

- For catchment 1, the connection point occurs inside the existing roundabout at Woolworths Way and Lexington Drive
- For catchment 2, the connection point occurs on Norwest Boulevard at the eastern end near the limit of works
- For catchment 3A, Norwest Boulevard at western limit of works
- For catchment 3B, on Elizabeth McArthur Drive at southern limit of works.

The location of GPTs would be confirmed during detailed design based on space constraints for maintenance vehicles and location of utilities.

Currently, there are no existing water quality controls and no spill containment measures. GPTs would primarily be installed to capture litter and debris. Oil-water separators may be integrated into GPTs to capture small volumes of accidental spills (less than four cubic metres). GPT oil-water separators would not be intended to capture large accidental spills (spills greater than four cubic metres, such as from a tanker). However, the risk of this occurring is small and has been further reduced by the proposed upgrade works.

Water quality basins could also provide adequate controls, however there are several space constraints for permanent water quality basins on this proposal and therefore water quality basins have not been proposed.

Drainage pits

The proposal would require the installation of new drainage pits along the new kerb line and new pipes connected to the existing drainage network.

Consideration of the following would be required as part of the detailed design, once construction stage layout has been identified:

- Downstream locations where the surface runoff from construction would discharge or connect to an existing drainage system
- A layout of existing and new drainage pits.

Adequate erosion and sediment controls and protection at the drainage pits would be required to capture runoff before it enters the drainage system. An erosion and sediment control plan would include details of the location of drainage pits that would remain, those that would be moved and new proposed pits.

Table 6-48 Safeguards and management measures – Surface water and groundwater

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water	Contractor	Detailed design/ Pre-construction/ Construction	Section 2.1 of QA G38 Soil and Water Management

Impact	Environmental safeguards	Responsibility	Timing	Reference
	pollution and describe how these risks will be addressed during construction. The Soil and Water Management Plan (SWMP) will be reviewed by a soil conservationist on the Transport for NSW list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address the outcomes of the review. The SWMP will include but not be limited to: • Pre-construction monitoring would provide a baseline of the existing water quality to ensure there is no further degradation in water quality or impact on the nominated environmental values during construction. • A visual water quality monitoring program would be carried out upstream and downstream of proposed waterways during the construction of the proposal, recording in-situ physical parameters (e.g. electrical conductivity, dissolved oxygen, pH, turbidity) • An erosion and sedimentation control plan and maintenance schedule for ongoing maintenance of temporary erosion and sediment controls • An incident emergency spill plan which will include measures to avoid spillages of fuels, chemicals and fluids onto any surfaces or into any nearby waterways.			
Soil and water	A site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up	Contractor	Detailed design/ Pre-construction	Section 2.2 of QA G38 Soil and Water Management

Impact	Environmental safeguards	Responsibility	Timing	Reference
	measures to be applied in the event of wet weather. Other controls to be detailed in the ESCP include: • Diversion drains, sediment and barrier fences, stabilised access entrance points, drainage inlet pit protections and sediment sumps • Clearing of vegetation and site stabilisation of disturbed areas would be undertaken progressively to limit the time disturbed areas are exposed to erosion processes • High risk soil and erosion activities such as earthworks will not be undertaken immediately before or during high rainfall or wind events • Stockpiling of topsoil separately for potential reuse in landscaping and rehabilitation works			
Spills and leaks	All fuels, chemicals, and liquids will be stored at least 50 metres away from the existing stormwater drainage system and would be stored in an impervious bunded area within the potential ancillary facilities. The refuelling of plant and maintenance machinery will be undertaken in impervious bunded areas in the designated ancillary facilities. Vehicle wash downs and/or concrete truck washouts will be undertaken within a designated bunded area of an impervious surface or undertaken off-site	Contractor	Pre-construction/ Construction	
	Adequate water quality controls such as modified gross pollutant traps with oil-water separators that can trap sediments and accidental spills.	Contractor	Detailed design	

6.11 Air quality

This section of the assessment presents a review of potential air quality impacts associated with the construction and operation of the proposal. The method and outcomes of the assessment, and recommended safeguards to effectively manage the proposal's air quality-related risks are outlined below.

6.11.1 Methodology

Potential air quality impacts associated with the proposal were evaluated by:

- Identifying key risks during construction and operations
- Identifying relevant criteria by which to evaluate the risks
- Characterising key features of the surrounding environment including the location of surrounding receivers and sensitive land use areas; prevailing climate and meteorological conditions; and background air quality
- Determining the potential for impacts to occur during construction and operations. Impacts during construction were evaluated using metrics developed based on guidance from 'AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines', whereas the potential for operational impacts was quantitatively assessed using NSW Roads and Maritime Services' Tool for Roadside Air Quality (TRAQ) prediction model. Changes in operational contributions to local air quality were evaluated by comparing predictions for 'proposal' and 'no proposal' options for 'year of opening' and '10 years after opening'
- Recommending safeguards to effectively manage any risks to air quality during the proposal, based on the outcomes of the assessment.

Construction impact assessment

During construction the primary air quality-related risk is expected to be the generation of dust (including total deposited dust, total suspended particulates and fine particulate matter) during clearing and road construction activities. Exhaust emissions associated with plant and equipment would also be another key air quality risk during construction.

To evaluate the potential for air quality impacts during construction a risk-based qualitative assessment method was applied. The likelihood (probability) and consequence (severity) of activities with the potential to result in air quality impacts were evaluated to develop initial risk ratings. This was completed using metrics developed based on guidance from 'AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines' shown in **Table 6-49, Table 6-52** and **Table 6-51**.

Table 6-49 Method for determining likelihood (probability), (based on guidance from AS/NZS ISO 31000:2009)

Likelihood	Definition	Probability
Almost certain	The event is almost certain to occur in the course of normal or abnormal construction/operational circumstances.	Greater than 90%
Likely	The event is more likely than not to occur in the course of normal construction/operational circumstances.	51 to 90%

Likelihood	Definition	Probability
Possible	The event may occur in the course of normal construction/operational circumstances.	26 to 50%
Unlikely	The event is unlikely to occur in the course of normal construction/operational circumstances.	5 to 25%
Very unlikely	The event may occur in exceptional construction/ operational circumstances only.	Less than 5%

Table 6-50 Method for determining consequence (severity) (based on guidance from AS/NZS ISO 31000:2009)

Likelihood	Definition
Catastrophic	Long term (greater than three months) and irreversible impacts. Resulting in a major prosecution under relevant environmental legislation. Would cause exceedances at a larger number of receivers.
Major	Medium term (between one and three months) and potentially irreversible impacts. Resulting fine or equivalent penalty notice under relevant environmental legislation. Would likely cause exceedances at a small number of sensitive receivers under most circumstances.
Moderate	Moderate and reversible impacts, or medium term (between one and three months). Has the potential to result in exceedances of air quality criteria under some circumstances.
Minor	Minor and reversible, or short-term impacts (less than one month). Of a magnitude that would not be expected to result in exceedances of air quality criteria under almost all circumstances.
Insignificant	Minor, negligible impacts. Not of a magnitude that would be expected to result in exceedances of air quality criteria under any circumstances.

Table 6-51 Environmental risk evaluation matrix (based on guidance from AS/NZS ISO 31000:2009)

Consequence	Likelihood				
	Very unlikely	Unlikely	Possible	Likely	Almost certain
Catastrophic	15	19	22	24	25
Major	10	14	18	21	23
Moderate	6	9	13	17	20
Minor	3	5	8	12	16
Insignificant	1	2	4	7	11

Table 6-52 Method for evaluating the significance of calculated risks, (based on guidance from AS/NZS ISO 31000: 2009)

Risk rating	Risk category	Comments
1 to 7	Low	Negligible effect or implication on the environment. No injury, insignificant financial loss (ie less than $5000), minimal environmental damage, no complaints. Environmental impact that would not be of concern to a reasonable person.
8 to 12	Medium	Minor effect or implication on the environment. First-aid required, on site damage immediately contained with no long-term impacts, minor financial loss (greater than $5000 but less than $50,000), occasional complaints, possible media interest. Localised and reversible damage to the environment.
13 to 18	High	Moderate, medium-term effect or implication on the environment. Medical treatment required, containable localised damage on-site, moderate financial loss (greater than $50,000 but less than $5,000,000), low likelihood of prosecution, minimal fines, occasional complains and possible media interest. Extensive and reversible or localised and irreversible environmental damage.
19 to 22	Very High	Long-term effect or implication on the environment. Extensive injuries, project suspensions for a period of days, major financial loss (greater than $5 million but less than $100 million), significant on-site environmental damage, very bad media coverage, community discontent, possible prosecution. Extensive and reversible or localised and irreversible environmental damage.
23 to 25	Extreme	Irreversible, extensive implications on the environment. Death, project suspensions for a period of weeks, massive financial loss (greater than $100 million), significant off-site environmental damage, sustained bad media coverage, sustained complaints and community discontent, probable prosecution.

Operational impact assessment

Regarding operations, changes to roadside combustion-related pollutant concentrations, from anticipated changes in traffic conditions, is the primary risk. The 'Australia State of the Environment 2016: Atmosphere' (SoE 2016) report lists carbon monoxide (CO), oxides of nitrogen (NO_x) including nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) as the primary pollutants associated with motor vehicle emissions. Volatile organic compounds (VOCs) are also noted to be a key class of pollutant associated with motor vehicle exhaust emissions.

Projected traffic information was provided by Transport for NSW for the following assessment scenarios:

- Scenario 1A – No proposal, 2026
- Scenario 1B – Proposal, year of opening, 2026
- Scenario 2A – No proposal, 2036
- Scenario 2B – Proposal, 10 years after year of opening (2036)

Vehicle emissions were evaluated along each of the four road segments below for each of these scenarios:

- Segment A – Norwest Boulevard west of Lexington Drive/Elizabeth Macarthur Drive intersection
- Segment B – Norwest Boulevard east of Lexington Drive/Elizabeth Macarthur Drive intersection
- Segment C – Lexington Drive north of Norwest Boulevard intersection
- Segment D – Elizabeth Macarthur Drive south of Norwest Boulevard intersection

Potential impacts were quantitatively evaluated using Roads and Maritime's TRAQ model. Pollutant concentrations were evaluated at the nearest sensitive receiver areas identified above. The NSW EPA 2026 and 2036 emission factors were applied in the model with cold starts enabled.

6.11.2 Existing environment

Surrounding receivers

The proposal is set within a mixed-use commercial/business area, adjoined to the east by low density residential development. The nearest sensitive receivers include nearby residents (as close to Norwest Boulevard as 20 metres) along Cloverhill Grove, Waterfall Crescent and Observatory Rise.

Climate and meteorology

Meteorological conditions are important for determining the direction and rate at which emissions from a source would disperse. The nearest weather station with long-term historical records operated by the Bureau of Meteorology (BoM) is the Parramatta North (Masons Drive) automatic weather station (AWS) (Station number 066124). This station is located approximately 7.5 kilometres to the south east of the proposal area. **Table 6-53** lists long-term temperature and rainfall averages recorded at this station from its date of commission in 1965 until 27 November 2019.

Table 6-53 Long-term temperature and rainfall data from BoM Parramatta North (Masons Drive) AWS, (BoM, 2019)

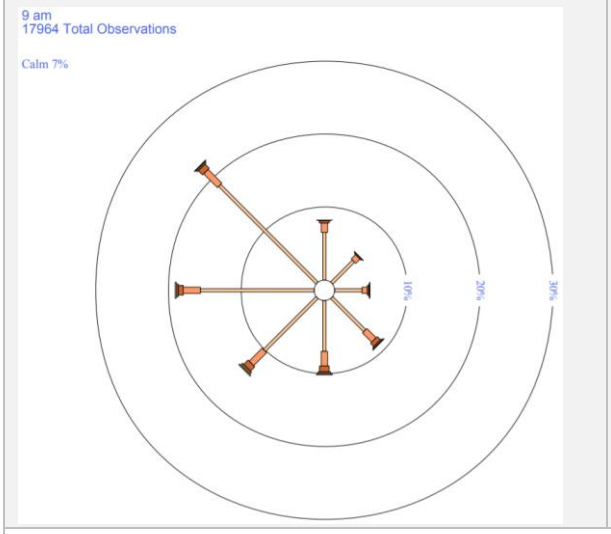
Month	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Mean rainfall (mm)	Mean number of rain days (> 1 mm)
January	28.6	17.7	102.2	8.8
February	27.9	17.6	120.7	9.1
March	26.3	15.9	112.6	9.8
April	23.9	12.9	89.6	7.1

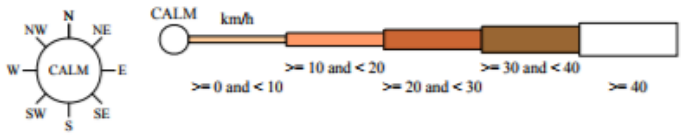
Month	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Mean rainfall (mm)	Mean number of rain days (> 1 mm)
May	20.7	9.9	66.2	6.9
June	17.8	7.5	92.7	7.6
July	17.5	6.2	44.2	5.4
August	19.1	7.1	55.3	5.2
September	21.7	9.3	50.2	5.8
October	24.1	12	68.1	7.5
November	25.5	14.1	84.6	8.8
December	27.6	16.3	73.4	7.7
Annual	**23.4**	**12.2**	**967.1**	**89.7**

The data indicates that the proposal area experiences warm and wet summers with mean daily maximum temperatures of around 28 degrees Celsius. The driest period of the year is between July and September with average monthly rainfall of around 50 millimetres per month. It is during periods of dry, higher temperature conditions that the potential for dust generation is greatest.

Long term wind roses for all records collected at the nearest BoM weather station at North Parramatta, for 9 am and 3 pm, are displayed below in **Table 6-54**. These data indicate that prevailing morning winds are more commonly from the north west and west, while afternoon winds are mainly from the east and southeast. Calm conditions are rare, being measured to occur seven per cent of the time during mornings and three per cent in the afternoon.

Table 6-54 Long-term 9 am and 3 pm wind roses from the BoM Parramatta North (Masons Drive) AWS, (BoM, 2019)

Long-term 9am wind rose	Long-term 3pm wind rose
	



Background air quality

The DPIE operates a state-wide air quality monitoring network which provides information on current and historical air quality. The nearest station in relation to the proposal that monitors air pollutants is located at Prospect (around seven kilometres to the south west). Data from this station have been used to characterise ambient air quality conditions around the proposal area. Measurements collected from 2014 to 2018 available for the identified pollutants of potential concern have been reproduced in **Table 6-55** and **Table** 6-56**.**

For context, these data are displayed in relation to 'impact assessment criteria' presented in the NSW EPA's Approved Methods for the Modelling and Assessment of Air pollutants in New South Wales (Approved Methods). It is noted that these criteria are applicable for assessing emissions to air from stationary sources in NSW, rather than from road projects.

The following terminology is used in the table below:

- PM_{10}: refers to particulate matter (less than 10 micrometres in diameter)
- $PM_{2.5}$: refers to fine particulate matter (less than 2.5 micrometres in diameter)
- $\mu g/m^3$: micrograms (one-millionth of a gram) per cubic metre air (concentration of an air pollutant).

Table 6-55 Monitored background PM_{10} and $PM_{2.5}$ concentrations at Prospect, 2014 to 2018

Year	Maximum 24-hour averaged *PM_{10} in *$\mu g/m^3$ (EPA criteria – 50 $\mu g/m^3$)	Annually averaged PM_{10} in $\mu g/m^3$ (EPA criteria – 25 $\mu g/m^3$)	Number of times 24-hour PM_{10} criterion exceeded	Maximum 24-hour averaged *$PM_{2.5}$ in $\mu g/m^3$ (EPA criteria – 25 $\mu g/m^3$)	Annually averaged $PM_{2.5}$ in $\mu g/m^3$ (EPA criteria – 8 $\mu g/m^3$)	Number of times 24-hour $PM_{2.5}$ criterion exceeded
2014	44	18	0	-	-	0
2015	69	18	1	30	8.2	1
2016	110	19	4	85	8.7	5
2017	61	19	1	30	7.7	3
2018	113	22	8	48	8.5	4

Table 6-56 Monitored background NO_2 and CO concentrations at Prospect, 2014 to 2018

Year	Maximum 1-hour averaged NO_2 in $\mu g/m^3$ (EPA criteria – 246 $\mu g/m^3$)	Annually averaged NO_2 in $\mu g/m^3$ (EPA criteria – 62 $\mu g/m^3$)	Maximum 1-hour averaged CO in mg/m^3 (EPA criteria – 30 mg/m^3)	Maximum 8-hour averaged CO in mg/m^3 (EPA criteria – 10 mg/m^3)
2014	88	19	2.4	0.8
2015	100	20	2.2	0.8
2016	100	19	1.8	0.9
2017	113	19	1.8	0.7

Year	Maximum 1-hour averaged NO_2 in $\mu g/m^3$ (EPA criteria – 246 $\mu g/m^3$)	Annually averaged NO_2 in $\mu g/m^3$ (EPA criteria – 62 $\mu g/m^3$)	Maximum 1-hour averaged CO in mg/m^3 (EPA criteria – 30 mg/m^3)	Maximum 8-hour averaged CO in mg/m^3 (EPA criteria – 10 mg/m^3)
2018	96	17	1.5	0.6

These data indicate that 24-hour PM_{10} and $PM_{2.5}$ concentrations occasionally exceeded the respective 50 $\mu g/m^3$ and 25 $\mu g/m^3$ impact assessment criteria. Natural events including dust storms and bush fires have historically contributed to short-term particulate matter exceedances in Sydney.

Annually averaged PM_{10} concentrations remained below the 25 $\mu g/m^3$ impact assessment criterion, but the $PM_{2.5}$ criterion of 8 $\mu g/m^3$ was exceeded in 2015, 2016 and 2018. These observations are consistent with other observations from the DPIE air quality monitoring network throughout Sydney and underline the importance of managing the generation of dust including fine particulate matter during the proposal. NO_2 and CO concentrations were measured well below the respective impact assessment criteria.

6.11.3 Potential impacts

Construction

The assessment identified the initial unmitigated risk category ratings for the following construction activities with the highest potential to result in air quality impacts:

- Dust generated during vegetation clearing and tree removal – 'medium risk', based on a consequence rating of 'moderate' and likelihood of impact of 'unlikely' given the limited extent of vegetation clearing and tree removal required
- Dust generated during bulk earthworks at widened and reconstructed pavement areas – 'medium risk' based on a consequence rating of 'moderate' and likelihood of impact of 'unlikely' given the scale of the proposal and expected worst-case potential being localised reversible effects
- Dust during placement and compaction of gravel base/sub-base layers for new pavement areas – 'medium risk' based on a consequence rating of 'moderate' and likelihood of impact of 'unlikely' given the scale of the proposal and expected worst-case potential being localised reversible effects
- Dust generated during excavation and backfilling for affected services relocations and adjustments, including new stormwater drainage infrastructure – 'low risk' based on a consequence rating of 'minor' given the small footprint and likelihood rating of 'very unlikely' given the short-term nature of these activities
- Dust arising from materials storage and handling activities at the potential ancillary facilities and stockpiling areas – 'medium risk' based on a consequence rating of 'moderate' and likelihood of impact of 'unlikely'
- Exhaust emissions from construction plant and equipment – 'low risk' based on a consequence rating of 'moderate' and likelihood of impact of very unlikely' given the low existing background concentrations compared to NSW EPA impact assessment criteria.

Measures manage these risks during construction are outlined in **Section 6.11.4** below.

Operation

The predicted results from each scenario at the most-affected nearby sensitive receiver location are summarised in **Table 6-57**. The difference between 'no proposal' and 'proposal' scenarios at both design horizons (i.e. 2026 and 2036) is listed. The results indicate that the proposal would result in increases in the concentration of road-related emissions at surrounding sensitive receivers compared with the 'no proposal' assessment scenarios.

Although the EPA's 'impact assessment criteria' from the Approved Methods do not apply to emissions from road projects, they have been considered for the purpose of evaluating the 'significance' of these changes.

The highest 95th percentile PM_{10} and $PM_{2.5}$ 24-hour concentrations measured at DPIE's Prospect station from 2014 to 2018 were 37 µg/m^3 and 18 µg/m^3 respectively. Considering these values as an appropriate approximation of maximum background values with extreme events excluded (as per the Approved Methods), the resulting estimated cumulative 24 hour PM_{10} and $PM_{2.5}$ concentrations at the most-affected sensitive receiver would be 39 and 20 µg/m^3 respectively. These values are below the respective 50 µg/m^3 and 25 µg/m^3 criteria. This indicates that changes in 24 hour averaged PM_{10} and $PM_{2.5}$ emissions from the proposal would not result in unacceptable changes to local air quality.

Regarding annually averaged PM_{10}, the highest background concentration was 22 µg/m^3. The additional 0.7 µg/m^3 predicted as a result of the proposal would result in an estimated annual concentration below the 25 µg/m^3 impact assessment criterion, and as such the change is not considered unacceptable.

Annual $PM_{2.5}$ concentrations exceeded the EPA's 8 µg/m^3 criterion at Prospect in 2015, 2016 and 2018. The predicted 0.7 µg/m^3 increase constitutes an eight per cent increase. There are no specific EPA assessment criteria which relate to incremental increases in annual average $PM_{2.5}$. For the purposes of this assessment, an incremental criterion of 1.6 µg/m^3 (annual average period) has been applied as a proxy of potential impacts, consistent with the approach adopted for the WestConnex New M5 Motorway air quality impact assessment. Considering this, a change of 0.7 µg/m^3 is not expected to result in adverse health impacts. Considering the background concentrations listed in **Table 6-57**, changes in NO_2 and CO concentrations would not result in concentrations above the relevant impact assessment criteria. Predicted VOCs such as benzene were also predicted to be at concentrations well below the EPA's 29 µg/m^3 source contribution impact assessment criterion.

Considering the outcomes above, it was concluded that changes as a result of the proposal would not result in unacceptable air quality conditions at surrounding sensitive receivers.

Table 6-57 Predicted changes in concentrations at most-affected sensitive receiver (road operations only)

Pollutant and averaging period	Predicted concentration at most-affected sensitive receiver (µg/m^3 unless stated), road contributions only					
	Without proposal, 2026	With proposal, 2026	% Change	Without Proposal, 2036	With proposal, 2036	% Change
PM_{10}, 24 hour averaged	4.3	5.7	33%	4.2	6.1	45%
PM_{10}, annually averaged	1.7	2.3	35%	1.7	2.4	41%

Pollutant and averaging period	Predicted concentration at most-affected sensitive receiver (µg/m^3 unless stated), road contributions only					
	Without proposal, 2026	With proposal, 2026	% Change	Without Proposal, 2036	With proposal, 2036	% Change
$PM_{2.5}$, 24 hour averaged	4.3	5.7	33%	4.2	6.1	45%
$PM_{2.5}$, annually averaged	1.7	2.3	35%	1.7	2.4	41%
NO_2, 1 hour averaged	7.1	9.4	32%	4.9	7.2	47%
NO_2, annually averaged	1.4	1.9	36%	1	1.4	40%
CO, 1 hour averaged (mg/m^3)	0.1	0.2	100%	0.1	0.1	0%
CO, 8 hour averaged (mg/m^3)	0.1	0.1	0%	0.1	0.1	0%
VOCs as benzene, 1 hour averaged	0.4	0.6	50%	0.4	0.6	50%

6.11.4 Safeguards and management measures

Safeguards and management measures for potential air quality impacts of the proposal are listed in **Table 6-58**.

Table 6-58 Safeguards and management measures – Air quality

Impact	Environmental safeguards	Responsibility	Timing
Dust emissions during construction	Incorporate the air quality measures below into the Construction Environmental Management Plan (CEMP) prepared for the proposal.	Contractor	Pre-construction
Dust, gas and particulate emissions during construction	Site planning and work practices: • Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. • Ensure all vehicles, plant, and equipment operate in a proper and efficient manner. • Switch off all vehicles, plant and equipment when not in-use for extended periods of time. • Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable. • Minimise drop heights from loading and handling equipment.	Contractor	Pre-construction/ Construction

Impact	Environmental safeguards	Responsibility	Timing
	• Implement the use of water-carts for dust suppression where necessary to prevent off-site dust emissions. • Review and modify activities as appropriate to mitigate the level of dust generated during inclement weather conditions. • Installation of perimeter screening around long-term ancillary facilities and storage areas. • Regularly water stockpiles and wherever possible and practical, limit the quantity of dispersive materials stored on-site. • Reduce or halt stockpiling activities during inclement weather conditions • Limit the amount of cleared and exposed areas to the extent practical.		
Dust emissions during construction	Haulage of materials: • In the event that material tracking onto roads is identified a street sweeper would be provided on-site and deployed on an as needed basis. Rumble grids would also be considered if tracking be a persistent problem. • Haulage vehicles would be regularly cleaned and would not be arriving at site with loose material. Where issues arise additional off-site cleaning would be implemented associated with the wider study area • Ensure that all loads are covered • Impose and signpost suitable maximum on-site speed limits to limit the generation of dust.	Contractor	Pre-construction/ Construction

6.12 Climate change and greenhouse gas

This section of the assessment presents a review of climate change and potential greenhouse gas (GHG) impacts associated with the proposal's construction, operation and maintenance. The method, outcomes and recommended safeguards as related to greenhouse gases are outlined below.

6.12.1 Methodology

Climate change

The frequency and intensity of floods and storms are likely to be affected by climate change. Current research predicts a likely outcome of future climatic change would be an increase in flood producing rainfall intensities and that the magnitude of the increase would be relative to temperature increase.

Climate change projections from AdaptNSW (Office of Environment and Heritage, 2014) indicate Metropolitan Sydney would continue to warm during the near future (2020–2039)

and far future (2060–2079), compared to recent years (1990–2009). The warming is projected to be on average about 0.7°C in the near future, increasing to about 1.9°C in the far future.

ARR (2019) adopts a 5 per cent increase in rainfall intensity (or depth) for every one degree of projected local warming. Based on the far future (2060-2079) projected warming from OEH (2014) and ARR (2019) advice, a rainfall intensity increase of 10 per cent has been adopted for assessing climate change impacts.

DRAINS modelling of the proposal with the 10 per cent increase in rainfall intensity was carried out to assess the impact of climate change on the proposed intersection upgrade.

Greenhouse gases

Greenhouse gases is a collective term for a range of gases that are known to trap radiation in the upper atmosphere, where they have the potential to contribute to the greenhouse effect (global warming). Creating an inventory of the likely GHG emissions associated with a proposal has the benefit of determining the scale of the emissions and providing a baseline from which to develop and deliver GHG reduction options. GHGs include:

- Carbon dioxide (CO_2) – by far the most abundant, primarily released during fuel combustion
- Methane (CH_4) – from the anaerobic decomposition of carbon based material (including enteric fermentation and waste disposal in landfills)
- Nitrogen dioxide (NO_2) – from industrial activity, fertiliser use and production
- Hydrofluorocarbons (HFCs) – commonly used as refrigerant gases in cooling systems
- Perfluorocarbons (PFCs) – used in a range of applications including solvents, medical treatments and insulators
- Sulphur hexafluoride (SF_6) – used as a cover gas in magnesium smelting and as an insulator in heavy duty switch gear.

In relation to the proposal which would involve the use of plant and equipment powered through the combustion of fossil fuels, and upon completion would result in changes to local traffic conditions; CO_2 would be the primary GHG and climate change substance of concern.

It is common practice to aggregate the emissions of these gases to the equivalent emission of CO_2. This provides a simple figure for comparison of emissions against targets. Aggregation is based on the potential of each gas to contribute to global warming relative to carbon dioxide and is known as the global warming potential (GWP). The resulting number is expressed as carbon dioxide equivalents (or CO_2e).

The GHG inventory in this document is calculated in accordance with the principles of the GHG Protocol. The GHG emissions that form the inventory can be split into three categories known as ‘Scopes’. Scopes 1, 2 and 3 are defined by the GHG Protocol and can be summarised as follows:

- **Scope 1** – Direct emissions from sources that are owned or operated by a reporting organisation (examples – combustion of diesel in company owned vehicles or used in on-site generators).
- **Scope 2** – Indirect emissions associated with the import of energy from another source (examples – importation of electricity or heat).
- **Scope 3** – Other indirect emissions (other than Scope 2 energy imports) which are a direct result of the operations of the organisation but from sources not owned or

operated by them (examples include business travel (by air or rail) and product usage).

The GHG Protocol (and similar reporting schemes) dictates that reporting Scope 1 and 2 sources is mandatory, while reporting Scope 3 sources is optional. Reporting significant Scope 3 sources is recommended. Within this inventory, an assessment has been made of all (Scopes 1, 2 and 3) sources of GHG deemed significant to the implementation of the proposal.

GHG emissions during construction were evaluated using the 'Carbon Gauge' prediction tool which automates many of the calculations, assumptions and default GHG emissions factors presented in the Greenhouse Gas Assessment 'Workbook for Road Projects', developed by the Transport Authorities Greenhouse Group (Transport Authorities Greenhouse Group Australia and New Zealand, 2013). This tool provides a framework for assessing the GHG emissions associated with road construction projects through the completion of a materiality assessment, and then provision of standard carbon emissions factors for activities typically undertaken. This allows the user to build a GHG profile through input of standard data on the length and area of pavement, road features included and cost of construction, among other accessible data. The tool was used to estimate GHG emissions associated with construction, as well as emissions arising from some post-construction operational and maintenance activities; namely electricity used to power the upgraded intersections, and materials used to maintain the asset into the future.

The Roads and Maritime Tool for Roadside Air Quality (TRAQ) prediction model was used to determine emissions associated with operational road use of the proposed upgrade. This model is described in further detail in **Section 6.11**.

Based on the outcomes of these calculations, safeguards and management measures were developed.

6.12.2 Potential impacts

The proposal involves the upgrade of existing roads around the Norwest Boulevard and Lexington Drive/Elizabeth Macarthur Drive intersection to allow a greater number of vehicles to travel with greater efficiency. The potential impacts associated with this activity include GHG emissions associated with the construction of the upgrade, and the change in GHG emissions associated with its operation including maintenance activities, both in absolute and relative terms.

Construction

GHG emissions from the following activities were modelled as part of the construction of the proposal:

- Fuel usage (site vehicles, plant and equipment and earthworks)
- Vegetation removal (lost carbon sink capacity)
- Embedded emissions in materials used in construction of new pavement, concrete footpaths, median and traffic islands
- Embedded emissions in materials used in construction of new structures and drainage features.

For each of the four areas outlined above, Carbon Gauge was used to determine the potential impacts, using standard emissions factors for road construction activities, referencing a relevant unit of activity. The input data applied in the model to estimate these emissions is summarised in **Table 6-59** below.

Table 6-59 Carbon Gauge construction GHG emissions input data

Parameter	Input value*
Estimated project value	$114M
Construction duration	18 months (weather permitting)
Fuel used in plant and equipment	100% Diesel
Area of full depth asphalt pavement	19,550 m^2
Area of concrete footpath	2895 m^2
Area of median and traffic island infill	3529 m^2
Dimensions of concrete retaining walls	471 m long and 1 m high
Length of upright kerb and gutter	3.52 km
Volume of cut to spoil	21,492 m^3
Volume of cut to fill	1005 m^3
Road through carriageways requiring lighting	2.16 km
Number of LED traffic signals	1
Vegetation biomass class	Class 3: 100 to 150 t dry matter per Ha
Area of Class C (Open forest to be removed)	1.74 Ha
Area of Class I (Grassland to be removed)	1.31 Ha

*These values are indicative and subject to change during detailed design.

Calculated emissions are summarised below by source in **Table 6-60**. As shown, 3057 tonnes of CO_2e was estimated to be generated during the construction phase of the proposal, with the greatest contribution arising from cement (used in batching concrete on site) and loss of vegetation.

Table 6-60 Estimated GHG emissions during construction

Source	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
Fuel combustion activities				
Ancillary facility electricity generation	150	-	11	161
Site vehicles	164	-	13	177
Plant and equipment	121	-	9	130
Demolition and earthworks	233	-	18	251
Vegetation removal	13	-	1	14
Vegetation removal				
Lost carbon sink	678	-	-	678

Source	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
Material usage				
Aggregate	-	-	266	266
Concrete (ready mixed)	-	-	211	211
Cement	-	-	615	615
Steel	-	-	158	158
Bitumen	-	-	376	376
Overall total	**1359**	**0**	**1678**	**3037**

Operation

Climate change

The results show the existing pavement drainage pipe system within the limit of works has adequate capacity for the 10 per cent annual exceedance probability (AEP) event with the projected increase in rainfall intensity, except the existing pipe under the westbound carriageway of Norwest Boulevard at the eastern limit of works that is already undersized for the 10 per cent AEP event without climate change. The existing 1200 mm diameter cross drainage pipe under Elizabeth Macarthur Drive also has adequate capacity for the projected increase in one per cent AEP rainfall intensity and peak flow.

Greenhouse gas

GHG emissions arising from the following operational and maintenance activities have been estimated over the proposal's 50 year design life, from the year of opening.

- Electricity consumption for powering intersection signalling and lighting
- Fuel and material consumption for maintenance activities
- Fuel consumption from road traffic using the proposal.

Carbon Gauge was used to predict future emissions from energy consumption for operation of intersection signals and lighting, and fuel and materials usage during pavement maintenance activities. The input values applied in Carbon Gauge to estimate emissions associated with these sources and activities for the proposal are summarised in **Table 6-61**.

Table 6-61 Carbon Gauge lighting, signalling and maintenance GHG emissions input data

Parameter	Input value
Length of carriageway requiring lighting	2.16 km
Number of LED traffic signals at major, divided road urban intersections	1
Pavement maintenance area	19,550 m^2

For the existing Base Case (i.e. without the proposal), the same length of carriageway lighting is necessary, although the Norwest Boulevard/Lexington Drive and Elizabeth Macarthur Drive intersection is a roundabout, and the estimated pavement maintenance area is approximately 14,600 square metres.

Calculated emissions from these sources and activities associated with the operation of the proposal and Base Case over the 50-year design life are listed in **Table 6-62**.

Table 6-62 Estimated GHG emissions from lighting, traffic signals and maintenance activities

Source	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
Base case, No Project, 2026 to 2075 (50-year design life)				
Lighting	-	1882	385	2267
Maintenance activities	313	-	402	716
Overall total	313	1882	787	2983
Project, 2026 to 2075 (50-year design life)				
Lost carbon sink	678	-	-	678
Material usage				
Lighting	-	1882	385	2267
Traffic signalling	-	267	55	322
Maintenance activities	420	-	539	958
Overall total	420	2149	979	3547
Difference between proposal and 'no proposal' Base Case				
Overall difference	107	267	192	564

As shown, GHG emissions from these sources were estimated to increase by 18 per cent for the proposal compared with the Base Case. This was a result of additional fuel consumed in vehicles to maintain a greater area of pavement as a result of the additional lanes, as well as from the signalised intersection replacing the existing roundabout structure.

GHG emissions resulting from the combustion of fuel in vehicles using the roads were estimated using Roads and Maritime's TRAQ model. Emissions were predicted for two design horizons; 2026 (year of opening) and 2036 (10 years after opening) with and without the proposal (Base case). Linear interpolation was applied to estimate annual GHG emissions between 2026 and 2036, with the remaining years of operation assumed to be constant at the 2036 level. Estimated emissions are summarised below in **Table 6-63**.

Table 6-63 Estimated GHG emissions from road traffic along the proposed upgrade

Assessment scenario	Total estimated traffic GHG emissions
Base case: no proposal, 2026 to 2075 (50-year design life)	94,628 tCO_2e
Proposal, 2026 to 2075 (50-year design life)	133,906 tCO_2e

As listed, total estimated road traffic GHG emissions over the 50-year design life from the proposal were predicted to be 41 per cent higher than for the Base Case. This is a result of the substantial additional traffic (additional 32,119 and 46,751 vehicle movements per day from the proposal in 2026 and 2036 respectively) as a result of the proposal. This is illustrated by the comparable GHG emissions per vehicle kilometre travelled values below in

Table 6-64**.**

Table 6-64 Estimated GHG emissions per vehicle kilometre travelled along the proposed upgrade

Assessment scenario	Emissions per car kilometre, 2026	Emissions per car kilometre, 2036
Base Case: no proposal	0.183 kg CO_2e per vehicle kilometre travelled	0.173 kg CO_2e per vehicle kilometre travelled
Proposal	0.182 kg CO_2e per vehicle kilometre travelled	0.174 kg CO_2e per vehicle kilometre travelled

Considering these road traffic emissions calculated over the proposal's design life in conjunction with the other operational emissions from lighting, signals and road maintenance activities above in

Table 6-64, it is clear that emissions arising from road traffic is the predominant GHG emissions source for operations and maintenance, contributing 97 per cent of the overall 104,885 tCO_2e estimated over the 50-year assessment period.

Summary

In summary, the proposal would largely be able to accommodate a rainfall intensity increase of 10 per cent, with the exception of the existing pipe under the westbound carriageways of Norwest Boulevard at the eastern limit of works.

Table 6-65 demonstrates the estimated GHG emissions for the proposal during construction and operation. The assessment identified that construction was estimated to contribute 2.2 per cent of the calculated overall GHG emissions from the proposal. Total overall GHG emissions estimated for the Base Case were 97,611 tonnes of CO_2e. As such, the proposal is estimated to contribute an additional 42,879 tonnes of CO_2e over its 50-year design life (includes construction and operation). This is expected given the intent of the proposal to increase traffic carrying capacity around the intersection to facilitate future growth.

Table 6-65 Summary of estimated emissions for proposal

Source	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)	% contrib.
Construction activities					
Fuel combustion activities	681	0	52	733	0.52
Vegetation removal	678	0	0	678	0.48
Material usage	0	0	1626	1626	1.16
Construction subtotal	**1359**	**0**	**1678**	**3037**	**2.16**
Operation and maintenance activities over the 50 year design life					
Lighting	-	1882	385	2267	1.61
Traffic signalling	-	267	55	322	0.23
Maintenance activities	420	-	539	958	0.68

Road traffic	133,906	-	-	133,906	95.30
Operation and maintenance subtotal	**134,326**	**2149**	**979**	**137,453**	**97.84**
Overall total	**99,957**	**2149**	**2778**	**140,490**	

6.12.3 Safeguards and management measures

Measures to reduce GHG emissions associated with the proposal have already been incorporated into the design such as the use of LED lighting and low energy equipment for signals and signage. Based on the outcomes of this assessment, the following additional measures are also recommended to improve energy efficiency and minimise resource wastage to reduce the GHG footprint associated with the proposal.

Management measure in relation to hydrology and flooding are discussed in **Section 6.9.4**.

Table 6-66 Safeguards and management measures – Climate change and greenhouse gas

Impact	Environmental safeguards	Responsibility	Timing	Reference
GHG emissions during construction	Identify recycled materials (such as recycled aggregates in road pavement and surfacing; steel with recycled content) for use in construction or operation of the proposal where they are cost, quality and performance competitive. Use of modern diesel engine equipment, to ensure highest fuel efficiency ratings Specification of the use of biofuels, or biofuel blends in construction plant and equipment. Provision of clear guidance to construction staff on equipment start up and shut down procedures to ensure that they are not left idling when not in use. Review of cut and fill balances for earthworks to ensure material is transported the least possible distances. Review of local options for import and export of fill materials as needed to reduce excess fuel used during transport. Specification and certification of steel from recycled sources where suitable for offsetting virgin steel. Specification of materials with low embodied energy/embodied GHG content, such as replacement of Portland cement in concrete mixes	Construction contractor	Pre-construction/ Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	with low carbon alternatives such as fly ash; and use of warm mix rather than hot mix asphalt. Resource and Waste Management Plan (RWMP) would be prepared to maximise re-use and recycling of construction and demolition waste.			
GHG emissions during operations and maintenance	Optimise planning and scheduling of maintenance activities to realise efficiencies to limit fuel use. As appropriate, consider the use of materials with low embodied energy/embodied GHG content for any maintenance repair works	Transport for NSW	Post-construction	Standard safeguard

6.13 Waste and resource use

The potential impacts of the proposal on waste and resource management are presented in this section, together with safeguards and management measures to manage any negative impacts.

6.13.1 Policy setting

The *Protection of the Environment Operations Act 1997* (POEO Act), the POEO (Waste) Regulation 2005 and the hierarchy prescribed in the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) are the key pieces of legislation that regulate waste in New South Wales. They contain the requirements for managing, storing, transporting, processing, recovering and disposing of waste.

The NSW Government released the NSW WARR Strategy 2014-21 to minimise waste generated across all government sectors and improve the efficient use of resources. This reflects the community's view that waste would be treated as a resource. The WARR Strategy identifies the following waste avoidance and resource recovery goals and targets:

- Avoid and reduce waste reduction
- Increase recycling
- Divert more waste from landfill
- Manage problem wastes better
- Reduce litter
- Reduce illegal dumping.

Transport for NSW manages waste according to the NSW Waste Avoidance and Resource Recovery Strategy 2014-21 and the NSW Waste Classification Guidelines (Department of Energy, Climate Change and Water, 2009).

6.13.2 Existing environment

The road network in the proposal area currently generates minimal waste. Waste sources are limited to roadside litter, some waste material from clearing roadside drainage, and green waste associated with the maintenance of roadside vegetation.

As discussed in **Section 6.8**, fill material, construction / demolition wastes (i.e. concrete, asphalt and glass) were observed in some of the investigation locations within the proposal area, including a single fragment of asbestos containing material.

6.13.3 Potential impacts

6.13.3.1 Construction

Waste

Construction of the proposal involving earthworks, structures, pavements, drainage, utilities placement and protection, establishment of ancillary sites, installation of lighting and fencing, would generate waste streams typical of road construction, including:

- Green waste from cleared vegetation
- Road infrastructure materials to be removed and/or replaced
- Oil, grease and other liquid wastes from the maintenance of construction plant and equipment
- General wastes and sewage from potential ancillary facility offices
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics and wrapping materials
- Potential contaminated material unearthed during construction (refer to **Section 6.8**).

At this stage of concept design, it is anticipated that cut and fill earthworks would result in a surplus of fill material, in the order of about 22,000 cubic metres of excess cut material that would not have suitable engineering properties to be used as 'select' fill (refer **Section 3.3.4**). This material would therefore need to be disposed of at a suitable landfill or other facility. During detailed design, the quantity of waste streams would be estimated, taking into account the suitability (or otherwise) of cut material for reuse.

Volumes of waste generated by the proposal would be managed through the application of standard mitigation measures shown in **Table 6-67.**

The adoption of an 'unexpected finds' protocol within construction documents such as the CEMP would be used to manage potential asbestos finds as detailed in **Table 6-42**.

Resource use

Construction of the proposal would require the use of various construction materials, including:

- Earthworks materials, such as topsoil and general fill material
- Aggregates for drainage construction, concrete and asphalt production and spray seals
- Sand for drainage construction, and concrete and asphalt production
- Concrete for drainage and pavement construction and miscellaneous works
- Bitumen for spray seals and asphalt production
- Cement and fly ash for concrete production
- Road base for the construction of flexible pavements
- Precast concrete elements for drainage construction and miscellaneous works
- Steel for barrier railings and reinforcement in concrete

The proposal would not generate any significant demand on these resources such that they would become in short supply.

6.13.3.2 Operation

Operation of the proposal would not increase the amount or change the type of waste generated within the proposal area.

6.13.4 Safeguards and management measures

Safeguards and management measures for potential impacts of the proposal on waste and resource management are listed in **Table 6-67.**

Table 6-67 Safeguards and management measures for waste and resource management

Impact	Environmental safeguards	Responsibility	Timing	Reference
Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will 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 will be prepared taking into account the *Environmental Procedure – Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014b) and relevant Roads and Maritime Waste Fact Sheets.	Contractor	Detailed design/ Pre-construction	Section 4.2 of QA *G36 Environment Protection*
Waste	All excavated materials would be stockpiled and tested at an appropriate laboratory to identify the appropriate waste classification stream for offsite disposal or on-site beneficial reuse. Surface soils and subsoils would be stockpiled separately to mitigate potential cross-contamination and promote beneficial re-use of	Contractor	Construction	

Impact	Environmental safeguards	Responsibility	Timing	Reference
	topsoil materials where practicable.			

6.14 Cumulative impacts

Cumulative impacts occur when two or more projects are carried out concurrently and in close proximity to one another. The impacts may be caused by both construction and operational activities, and can result in a greater impact to the surrounding area than would be expected if each project was carried out in isolation.

6.14.1 Study area

A search of the Department of Planning, Industry and Environment's (DPIE) NSW Planning Portal Major Projects website, Sydney Central City Planning Panel Development and Planning Register, Sydney and Region, The Hills Council Development Application Register and Blacktown City Council Development Applications on Public Display in May 2020 was carried out for Bella Vista and the adjacent suburbs of Norwest and Glenwood.

Relevant projects are described in **Table 6-68**, noting that the expected construction time frame for the proposal is August 2023 to February 2025. Other developments likely to occur within the locality would be small scale projects such as residential dwellings in adjacent residential areas.

6.14.2 Other projects and developments

As discussed in **Section 2.1**, the Norwest and Bella Vista areas are undergoing substantial redevelopment as part of precinct planning along the Sydney Metro Northwest Urban Renewal Corridor. Over the next two to 30 years, these areas would be redeveloped to accommodate much higher densities of residents and jobs. **Table 6-68** includes some current development projects in the immediate area of the proposal.

Table 6-68 Past, present and future projects

Project	Construction impacts	Operational impacts
Application number: 1714/2017/HA, 2-8 Lexington Drive, Bella Vista Masterplan and Development Application (DA) for the construction of a service station with canopy and retail building, construction of a fast food restaurant, and construction of two generic food and beverage premises was approved in February 2018. Construction of the fast food restaurant (McDonalds) is now complete. Works include reconfiguration of existing car parking within the site, new access from Norwest Boulevard, and provision of associated landscaping, additional infrastructure and signage. Once built, the facilities would be operational 24 hours a day.	The proposed development is located immediately adjacent to the proposal however construction is expected to be complete well before the proposal. No cumulative construction impacts are expected.	The development once operational would contribute additional road users 24 hours a day in the vicinity of the proposal.
New Kellyville South Public School, 83 Free Settler's Drive, Kellyville Development for about 1000 students, including classrooms, open spaces, sport fields and associated facilities. Development was approved by DPE on 24 November 2017, with modifications approved in 2018 and 2019.	Now referred to as Bella Vista Public School. The school development is complete and the school opened in January 2020. The development is located about 1.4 km north east of the proposal.	The new school, once operational, would contribute additional road journeys across the region, including increased traffic using the new intersection.
The Orchards Apartments, 104 Fairway Drive, Norwest The Orchards will be one of the largest masterplanned estates in NSW, containing over 1,300 apartments. Stage 2 of the masterplan has commenced which involves the construction of 57 apartments.	The proposed location of the development is about 1 kilometre north east of the proposal. Even if some construction of future stages does occur at the same time, there is unlikely to be any noticeable cumulative construction impacts.	Cumulative operational impacts once the proposal is operational are likely to include increased capacity and travel times across the region to accommodate major developments such as the proposed Orchards Apartments development.
Memorial Avenue Upgrade, Kellyville The NSW Government is upgrading Memorial Avenue between Old Windsor Road and Windsor Road from a two lane road to a four lane road, a distance of about 2.2 kilometres. To prepare for this upgrade, Transport for NSW is currently relocating existing electrical cabling along Memorial Avenue. All new	Memorial Avenue is located about 2 kilometres north of the proposal. Given the timing of the proposed construction activities associated with the Memorial Avenue Upgrade,	Cumulative operational impacts once the proposal is operational are likely to be increased capacity and improved travel times across the region.

Project	Construction impacts	Operational impacts
cables will be placed underground. This relocation work is expected to take eight months to complete and started in October 2019. Once this relocation work is complete, work on the upgrade will commence. Construction of the original proposal was indicated to be around two years. Subsequent modifications have been approved but no program details announced. The project is largely proposed to be completed off line, in two stages.	it is unlikely to contribute to construction cumulative impacts for the proposal.	
Proposed Dancers Square Development, Norwest Boulevard, Norwest Concept proposal for a 300 room hotel, a convention and exhibition centre, commercial offices, 311 residential apartments, a public plaza, 1898 car parking spaces and retail and hospitality uses, on the site of the existing Rydges Norwest Hotel.. A Secretary's Environmental Assessment Requirements (SEARs) report is currently being prepared for this SSD project. Typical time frames for a major project assessment and approval can range from 1-3 years. Construction would likely be staged over a number of years	The proposed location of the development is about 2 kilometres north east of the proposal on the corner of Norwest Boulevard and Windsor Road. Even if some construction does occur at the same time, there is unlikely to be any noticeable cumulative construction impacts.	Cumulative operational impacts once the proposal is operational are likely to include increased capacity and travel times across the region to accommodate major developments such as the proposed Dancers Square Development.

6.14.3 Potential impacts

Environmental factor	Construction	Operation
Traffic and transport	The proposal is not expected to start construction for about another three years, consequently cumulative traffic and transport impacts are difficult to predict. The study area and wider north western Sydney region are undergoing substantial ongoing growth and development and it is likely that there would be some localised impacts associated with traffic and delays.	The number and scale of new developments identified in the study area demonstrate the increased volume of traffic that can be expected in the area in the coming years. The proposal would contribute to improved traffic flows and travel times across the region which is expected to be considerably higher than current volumes, as well as improving the network resilience on Norwest Boulevard.

6.14.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative construction impacts	A Consultation Plan will include consultation with the proponents of any surrounding proposed developments relevant at the time of construction to: • Gain an understanding of construction timeframes and impacts • Coordinate impact mitigation and management if necessary.	Transport for NSW	Pre-construction/ Construction	G1

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 (or system)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal, and are listed in **Table 7-1**. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) 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 CEMP would be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment Officer, Greater Sydney Project Office, 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 and would be developed in accordance with the specifications set out in the adjust as necessary: 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 CEMP will 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 will address the following: • Any requirements associated with statutory approvals • Details of how the proposal will implement the identified safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review.	Transport for NSW/ Contractor	Pre-construction / Detailed design	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		The endorsed CEMP will be implemented during the undertaking of the activity.			
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Transport for NSW/ Contractor	Pre-construction	
GEN3	General – environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the proposal. This will include up-front site induction and regular 'toolbox' style briefings. Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include: • Non-Aboriginal heritage • Threatened ecological communities • Adjoining residential areas requiring particular noise management measures (particularly in relation to the potential use of ancillary facility 3)	Transport for NSW/ Contractor	Pre-construction / Detailed design	
GEN4	General - Utilities	Prior to the commencement of work: • The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment will be undertaken.	Contractor	Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic, transport and access					
T01	Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will 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 will include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms.	Contractor	Detailed design/ Pre-construction	Section 4.8 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
T02	Impacts to local traffic and access	Requirements for any changes to local traffic and access arrangements will be confirmed during detailed design in consultation with Transport for NSW, Hills Shire Council and any affected landowners, including any temporary alternative access arrangements as required.	Contractor	Detailed design	
T03	Haulage vehicles	Where practicable, movements of haulage vehicles will be planned to minimise movements on the road network during the morning and evening peak periods where practicable.	Contractor	Pre-construction/ Construction	
T04	Impacts to pedestrian and cyclists	Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements would be provided following consultation with affected residents, Transport for NSW and Hills Shire Council.	Contractor	Pre-construction/ Construction	
T05	Impacts to bus services	Access for public transport services will be maintained. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community. If required, alternative temporary bus stops will be provided with appropriate signage to direct commuters. Safe access will be provided in accordance with relevant safety and accessibility standards.	Contractor	Pre-construction	
T06	Impacts to business	A signage strategy will be prepared as part of the TMP to provide appropriate signage for businesses where existing signage is obscured or no longer visible or where customers are required to use alternative access to reach the businesses during construction.	Contractor	Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration					
NV1	Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim *Construction Noise Guideline* (ICNG) (Department of Energy and Climate Change, 2009) and identify: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account standard treatments as outlined in Appendix B of the CNVG, and *Beyond the Pavement: urban design policy, process and principles* (Roads and Maritime, 2014a). • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Detailed design/ Pre-construction	Section 4.6 of QA G36 Environment Protection
NV2	Noise and vibration	All sensitive receivers (eg schools, local residents) likely to be affected will be notified at least five days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The planned construction activities • The construction period and construction hours	Contractor	Detailed design/ Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Contact information for project management staff • Complaint and incident reporting • How to obtain further information.			
NV3	Sleep disturbance	Attended noise measurements will be undertaken at the nearest affected receivers once equipment is introduced on site at the beginning of night works to establish and quantify actual L_{Amax} noise levels on site. Where measured L_{Amax} noise levels exceed the sleep disturbance limit, then a reasonable and feasible approach towards noise management, in accordance with the CNVG should be considered to reduce noise levels as much as possible to manage the impact from construction noise during night time periods.	Contractor	Construction	
NV4	Construction vibration	Site-specific minimum working distances should be determined whenever significant vibration generating plant will be working close to or within the CNVG recommended minimum working distances. The structural damage site-specific minimum working distances should be determined based on the DIN4150-3 limits.	Contractor	Construction	
NV5		Where construction activity occurs in close proximity to sensitive receivers, vibration testing of actual equipment on site will be carried out prior to commencement of site operations, to determine acceptable buffer distances to the nearest affected receiver locations.	Contractor	Construction	
NV6	Vibration monitoring	Further attended vibration monitoring will be conducted whenever significant vibration generating plant items are operating close to or within the determined minimum working distances. Locations for	Contractor	Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		vibration monitoring during particular works will be determined by the construction contractor. Where vibration is found to be excessive, management measures will be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones, and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.			
NV7	Structural damage	Dilapidation surveys will be conducted at residential receivers determined, by the contractor, to be sensitive to vibration impacts.	Contractor	Construction	
Landscape character and visual impact					
LV01	Landscape character and visual impact	An Urban Design Plan will be prepared to support the final detailed proposal design and implemented as part of the CEMP. The Urban Design Plan will 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 will 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	Contractor	Detailed design/ Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Fixtures such as seating, lighting, fencing and signs • Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas. The Urban Design Plan will 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).			
LV02	General Design Integration - standard proposal safeguards	Ongoing integrated proposal development will follow Transport for NSW's integrated proposal development processes, including with urban designers as part of the proposal team.	Contractor	Detailed design	
LV03		The need for a masterplan for the entire corridor to achieve a consistent and strong identity is recommended, prior to detailed design.	Transport for NSW/ Contractor	Prior to detailed design	
LV04		Roads and Maritime Urban Design Policy (*Beyond the Pavement*) and Roads and Maritime Urban Design Guidelines will be used to guide future design development of the proposal.	Contractor	Detailed design	
LV05		The urban design objectives, principles and concept design strategy presented in the urban design report	Contractor	Detailed design	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		(**Appendix F**) will form the basis for future design development and consultation with stakeholders.			
LV06	Structures – limit visibility of built elements	Retaining wall design - simple, refined, integrated structure which sits comfortably within the landscape, consideration of textures and finishes will be a key element in terms of achieving an integrated response	Contractor	Detailed design	
LV07		Minimise footprint and impacts to adjoining properties/services	Contractor	Detailed design/ Construction	
LV08	Earthworks	Integrate with adjoining landform through adoption of appropriate grades, avoiding sharp transition in profile	Contractor	Detailed design	
LV09		Stabilise/revegetate as works progress to limit erosion and visual impacts through early integration with surrounding vegetation	Contractor	Construction	
LV10	Retention of existing vegetation	Design the proposal to avoid impact to adjoining trees Investigate opportunities for transplant of existing deciduous trees dependant on construction timing and service constraints. Clearance extent will be minimised where possible	Contractor	Detailed design	
LV11		Clearly define clearance limits and exclusion zones to protect vegetation cover	Contractor	Pre-construction	
LV12	Revegetation	Plant species to respond to existing species used within the corridor and landscape character Maximise canopy planting within verge to provide strong definition to the corridor, reinforce the character of the adjoining road corridor and to limit visibility of the proposal from adjoining residential properties	Contractor	Detailed design	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
LV13		Progressively implement revegetation works to limit erosion and to establish vegetation. Utilise cleared material as part of revegetation works	Contractor	Construction	
LV14	Minimise road furniture and signage	Provide minimum signage requirements and limit structural elements to provide and open and permeable setting in which landscape is dominant	Contractor	Detailed design	
LV15		Look for opportunities to minimise designed signage and fencing	Contractor	Construction	
LV16	Lighting	Maintain character of the overall lighting and potential for light spill	Contractor	Detailed design	
LV17		Limit night works and provide lighting which minimises spill	Contractor	Construction	
LV18	Landscape character	Design would be responsive to the principles and objectives established for the Norwest Business Park, its landscape palette and management objectives Engagement with the Norwest Association would continue throughout detailed design.	Transport for NSW/ Contractor	Detailed design	
LV19	View management	Provide visual screening within the road corridor to limit the visual impact of the proposal in areas identified as moderate or high impact Provide sense of space and openness associated with the heritage parkland landscape of Bella Vista	Contractor	Detailed design	
LV20		Retain vegetation beyond the footprint to retain any existing screening	Contractor	Construction	
LV21	Ancillary facilities	Setout ancillary facilities to limit impacts, consider screening and location of key structures which provide the greatest impact	Contractor	Detailed design	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
LV22		Maintain ancillary facilities in a tidy and well-presented manner. Provide and maintain screening	Contractor	Construction	
LV23		Progressively throughout the work, where feasible and reasonable, the ancillary facility sites will be returned to at least their pre-construction state	Contractor	Construction	
Biodiversity					
B01	Biodiversity	A Construction Flora and Fauna Management Plan will be prepared in accordance with Roads and Maritime's *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011) and implemented as part of the CEMP. It will 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 in accordance with Roads and Maritime *Unexpected Threatened Species Find Procedure in the Biodiversity Guidelines, Guide 1* (pre-clearing process) (Roads and Maritime, 2011) • 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.	Contractor	Detailed design/ Pre-construction	Section 4.8 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B02	Removal of native vegetation	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible. Where feasible, the ancillary facilities would be located to minimise or avoid removal of Shale Sandstone Transition Forest.	Contractor	Detailed design/ Pre-construction	
Socio-economic, land use and property					
SLP01	Community engagement	A Communication and Stakeholder Engagement Plan (CSEP) will be prepared and implemented as part of the Construction environmental management plan (CEMP to help provide timely and accurate information to the community during construction. The CSEP will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, business owners and commuters including changed traffic and access conditions and amenity impacts • Mechanisms to provide details to managers of social infrastructure near to the proposed works (e.g. Bella Vista Farm) about potential construction activities, timing, impacts and management measures • Provide regular updates to emergency services on construction staging and potential delay issues • Mechanisms to provide details about proposed changes to emergency services and managers of surrounding community facilities • Contact name and number for complaints.	Contractor	Detailed design/ Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		The CEP will be prepared in accordance with the *Community Involvement and Communications Resource Manual* (RTA, 2008).			
SLP02	Property acquisition	Transport for NSW will continue to consult with directly affected property owners throughout the detailed design phase.	Transport for NSW	Detailed design	
SLP03		All property acquisition will be carried out in accordance with *the Land Acquisition Information Guide* (Roads and Maritime, 2014b), the *Land Acquisition (Just Terms Compensation) Act 1991* and the NSW Government Land Acquisition Reform 2016.	Transport for NSW	Detailed design, pre-construction	
SLP04	Impact of potential ancillary facilities	The ancillary facility will be restored to pre-existing conditions or to a condition agreed with the land owner.	Contractor	Post-construction	
SLP05	Construction staff parking	The construction contractor will provide suitable off-street parking to accommodate workers that does not impact on local businesses. The Construction Traffic Management Plan (TMP) will include appropriate measures to prevent construction staff from utilising these public parking areas.	Contractor	Construction	
SLP06	Impacts to McDonalds and Shell Service Station operations	The construction contractor would consult with the operator of the McDonalds restaurant during the preparation of the TMP.	Contractor	Pre-construction	
SLP07	Impacts to business from strip acquisition	Opportunities to provide additional directional and promotional signage to businesses in the vicinity of the proposal during construction will be explored in consultation with the property owners and operators.	Transport for NSW	Detailed design	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SLP08	Impacts to social infrastructure – Norwest Private Hospital	Access will be maintained to Norwest Private Hospital for ambulance and hospital users on Norbik Drive.	Transport for NSW	Detailed design	
SLP09	Impacts of potential ancillary facility on ResMed site	The potential ancillary facility will be screened and secured from other operations on the ResMed site during construction and will be left clean and tidy at the end of each day.	Contractor	Construction	
SLP10	Impacts from street tree, fencing and signage removal	During detailed design a landscaping design plan would be prepared that identifies opportunities for the replacement of the street trees, fencing and signage removed by the proposal.	Transport for NSW	Detailed design	
Non-Aboriginal heritage					
NAH01	Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage. The NAHMP will be prepared in consultation with the NSW Environment, Energy and Science.	Contractor	Detailed design/ Pre-construction	Section 4.10 of QA G36 Environment Protection
NAH02	Non-Aboriginal heritage	*The Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Detailed design/ Pre-construction	Section 4.10 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NAH03	Non-Aboriginal heritage	Non-Aboriginal heritage awareness training must be provided for contractors prior to commencement of construction works to ensure understanding of potential heritage items and correct procedures to be undertaken in respect to unexpected finds and significant trees that may be impacted during the proposal.	Contractor	Pre-construction/ Construction	
NAH04	Bella Vista Farm - Impact to remnant native woodland (significant trees)	The NAHMP must identify significant trees to be preserved. If it is not possible to avoid young remnant native woodland trees then this loss is to be offset by revegetating these species elsewhere on the property if possible.	Transport for NSW	Detailed design/ Pre-construction	
NAH05	Bella Vista Farm - Impact to driveways (built)	Measures must be taken to ensure the unsealed driveway from Elizabeth Macarthur Drive is maintained. If damage to its surface from heavy vehicular traffic is unavoidable then it shall be reinstated to its current state at the completion of the proposal. Suggest using either track mats or a gravel layer prior to use and then reinstatement to original condition post use.	Contractor	Pre-construction/ Construction	
NAH06	Bella Vista Farm - Impact to pasture (landscape)	Pasture is to be reinstated after the demobilisation of potential ancillary facilities (2A and/or 2B).	Contractor	Construction	
NAH07	Bella Vista Farm - Impact to replica post and rail fencing (built)	Prior to removal of the replica post and rail fencing, a photographic recording of the current fencing must be prepared. The current post and rail fencing along Norwest Boulevard and Elizabeth Macarthur Drive must be reinstated to maintain the cultural landscape values of the site. It is not necessary to reinstate by using the	Contractor	Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		existing fence materials however a fence of the same design and material must be reinstated.			
NAH08	Bella Vista Farm - Impact to views and curtilage (site aesthetics)	Due consideration must be given to the maintenance of vistas to and from the Bella Vista Farm with respect to the placement of traffic signalling, plantings and signposting in the proposed intersection upgrade and material used in the ancillary facility.	Transport for NSW	Detailed design/ Pre-construction	
NAH09	Bella Vista Farm – Impacts to archaeologically sensitive soils (scientific)	Archaeological monitoring of the site shall be undertaken wherever soil disturbance occurs within the curtilage of Bella Vista Farm.	Contractor	Construction	
NAH10	Old Windsor Road – Area of archaeological potential	If relics of the Old Windsor Road are identified during monitoring works then the Roads and Maritime *Standard Management Procedure: Unexpected Heritage Items* (Roads and Maritime Services 2015) would be followed.	Contractor	Construction	
Aboriginal cultural heritage					
A01	Aboriginal heritage	*The Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where 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 will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Construction	Section 4.9 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Soils, topography and contaminated land					
SC01	Contaminated land	A Contaminated Land Management Plan will be prepared in accordance with the *Guideline for the Management of Contamination* (Roads and Maritime, 2013a) and implemented as part of the CEMP. The plan will 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 (where applicable) Measures to ensure the safety of site personnel and local communities during construction.	Contractor	Detailed design/ Pre-construction	Section 4.2 of QA *G36 Environment Protection*
SC02	Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other work that may impact on the contaminated area will 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.	Contractor	Detailed design/ Pre-construction	Section 4.2 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SC03	Contaminated lands	An 'unexpected finds' protocol within the CEMP would be implemented to provide measures to manage other contamination (if present) which may be encountered as part of construction activities.	Contractor	Detailed design/ Pre-construction	
SC04	Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Transport for NSW and EPA officers).	Contractor	Detailed design/ Pre-construction	Section 4.3 of QA *G36 Environment Protection*
SC05	Unexpected finds	An 'unexpected finds' protocol within the CEMP will be implemented to provide measures to manage other contamination (if present) which may be encountered as part of construction activities.	Contractor	Construction	
SC06	Groundwater contamination	If groundwater is encountered during excavations and dewatering is undertaken, water would be tested and disposed of at an appropriately licensed facility. These measures can be managed under a CEMP.	Contractor	Construction	
Hydrology and flooding					
H01	Hydrology and flooding	Consultation with The Hills Shire Council in relation to drainage and flooding impacts of the proposal.	Contractor	Detailed design/ Pre-construction	
H02	Hydrology and flooding	Further detailed hydrologic and hydraulic modelling of the proposal would be undertaken during detailed design to confirm the outcomes of this assessment.	Contractor	Detailed design/ Pre-construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
H03	Localised flooding and erosion	The CEMP will include measures aimed at intercepting any concentrated flow and diverting it toward the existing drainage system. Additionally, any ancillary facilities, construction equipment, material stockpiles or laydown areas would be located away from drainage infrastructure and overland flow paths.	Contractor	Pre-construction/ Construction	
Surface water and groundwater					
SW01	Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The Soil and Water Management Plan (SWMP) will be reviewed by a soil conservationist on the Roads and Maritime list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address the outcomes of the review. The SWMP will include but not be limited to: • Pre-construction monitoring would provide a baseline of the existing water quality to ensure there is no further degradation in water quality or impact on the nominated environmental values during construction. • A visual water quality monitoring program would be carried out upstream and downstream of proposed waterways during the construction of the proposal, recording in-situ physical parameters (e.g. electrical conductivity, dissolved oxygen, pH, turbidity)	Contractor	Detailed design/ Pre-construction/ Construction	Section 2.1 of QA G38 Soil and Water Management

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• An erosion and sedimentation control plan and maintenance schedule for ongoing maintenance of temporary erosion and sediment controls • An incident emergency spill plan which will include measures to avoid spillages of fuels, chemicals and fluids onto any surfaces or into any nearby waterways.			
SW02	Soil and water	A site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather. Other controls to be detailed in the ESCP include: • Diversion drains, sediment and barrier fences, stabilised access entrance points, drainage inlet pit protections and sediment sumps • Clearing of vegetation and site stabilisation of disturbed areas would be undertaken progressively to limit the time disturbed areas are exposed to erosion processes • High risk soil and erosion activities such as earthworks will not be undertaken immediately before or during high rainfall or wind events • Stockpiling of topsoil separately for potential reuse in landscaping and rehabilitation works	Contractor	Detailed design/ Pre-construction	Section 2.2 of QA G38 Soil and Water Management

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
SW03	Spills and leaks	All fuels, chemicals, and liquids will be stored at least 50 metres away from the existing stormwater drainage system and would be stored in an impervious bunded area within the potential ancillary facilities. The refuelling of plant and maintenance machinery will be undertaken in impervious bunded areas in the designated ancillary facilities. Vehicle wash downs and/or concrete truck washouts will be undertaken within a designated bunded area of an impervious surface or undertaken off-site	Contractor	Pre-construction/ Construction	
SW04		Adequate water quality controls such as modified gross pollutant traps with oil-water separators that can trap sediments and accidental spills.	Contractor	Detailed design	
Air quality					
AQ01	Dust emissions during construction	Incorporate the air quality measures below into the Construction Environmental Management Plan (CEMP) prepared for the project.	Contractor	Pre-construction	
AQ02	Dust, gas and particulate emissions during construction	Site planning and work practices: • Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. • Ensure all vehicles, plant, and equipment operate in a proper and efficient manner. • Switch off all vehicles, plant and equipment when not in-use for extended periods of time. • Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.	Contractor	Pre-construction/ Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Minimise drop heights from loading and handling equipment. • Implement the use of water-carts for dust suppression where necessary to prevent off-site dust emissions. • Review and modify activities as appropriate to mitigate the level of dust generated during inclement weather conditions. • Installation of perimeter screening around long-term ancillary facilities and storage areas. • Regularly water stockpiles and wherever possible and practical, limit the quantity of dispersive materials stored on-site. • Reduce or halt stockpiling activities during inclement weather conditions • Limit the amount of cleared and exposed areas to the extent practical.			
AQ03	Dust emissions during construction	Haulage of materials: • In the event that material tracking onto roads is identified a street sweeper would be provided on-site and deployed on an as needed basis. Rumble grids would also be considered if tracking be a persistent problem. • Haulage vehicles would be regularly cleaned and would not be arriving at site with loose material. Where issues arise additional off-site cleaning would be implemented associated with the wider study area • Ensure that all loads are covered • Impose and signpost suitable maximum on-site speed limits to limit the generation of dust.	Contractor	Pre-construction/ Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Climate change and greenhouse gas					
CC01	GHG emissions during construction	Identify recycled materials (such as recycled aggregates in road pavement and surfacing; steel with recycled content) for use in construction or operation of the proposal where they are cost, quality and performance competitive. Use of modern diesel engine equipment, to ensure highest fuel efficiency ratings Specification of the use of biofuels, or biofuel blends in construction plant and equipment. Provision of clear guidance to construction staff on equipment start up and shut down procedures to ensure that they are not left idling when not in use. Review of cut and fill balances for earthworks to ensure material is transported the least possible distances. Review of local options for import and export of fill materials as needed to reduce excess fuel used during transport. Specification and certification of steel from recycled sources where suitable for offsetting virgin steel. Specification of materials with low embodied energy / embodied GHG content, such as replacement of Portland cement in concrete mixes with low carbon alternatives such as fly ash; and use of warm mix rather than hot mix asphalt. Resource and Waste Management Plan (RWMP) would be prepared to maximise re-use and recycling of construction and demolition waste.	Contractor	Pre-construction/ Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
CC02	GHG emissions during operations and maintenance	Optimise planning and scheduling of maintenance activities to realise efficiencies to limit fuel use. As appropriate, consider the use of materials with low embodied energy / embodied GHG content for any maintenance repair works	Transport for NSW	Post-construction	
Waste and resource use					
W01	Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will 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 will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Roads and Maritime Waste Fact Sheets.	Contractor	Detailed design/ Pre-construction	Section 4.2 of QA G36 Environment Protection
W02	Waste	All excavated materials would be stockpiled and tested at an appropriate laboratory to identify the appropriate waste classification stream for offsite disposal or on-site beneficial reuse. Surface soils and subsoils would be stockpiled separately to mitigate potential cross-contamination and promote beneficial re-use of topsoil materials where practicable.	Contractor	Construction	

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative impacts					
CM01	Cumulative construction impacts	A Consultation Plan will include consultation with the proponents of any surrounding proposed developments relevant at the time of construction to: • Gain an understanding of construction timeframes and impacts • Coordinate impact mitigation and management if necessary.	Transport for NSW	Pre-construction/ Construction	G1

7.3 Licensing and approvals

The proposal involves the acquisition of a strip of the curtilage of the Bella Vista Farm, between one and 20 metres in width, along Norwest Boulevard for approximately 230 metres from its junction with Elizabeth Macarthur Drive. In addition, the proposal also includes the potential ancillary facilities (2A and 2B) within the SHR curtilage. Any works that would impact the SHR curtilage of the Bella Vista Farm would need to be the subject of an application under section 60 of the Heritage Act (see **Table 7-2**).

Table 7-2 Summary of licensing and approvals required

Instrument	Requirement	Timing
Heritage Act 1977 (s60)	Permit to carry out activities to an item listed on the State Heritage Register or to which an interim heritage order applies from the Heritage Council of NSW.	Prior to start of the activity.

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 2000.*

8.1 Justification

8.1.1 The need for the proposal

Norwest Boulevard in Bella Vista is a pivotal travel route between the M7 Motorway and Castle Hill, and provides access to the Norwest Business Park. The existing roundabout intersection at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive is currently experiencing large volumes of traffic and congestion. In 2017, traffic signals were installed at the roundabout to assist in alleviating congestion. While this work has improved journey reliability and travel times, the upgrade to traffic signals was only a short term solution.

Transport for NSW was tasked with investigating the upgrade of the existing roundabout intersection in response to:

- Extensive congestion and delays during the weekday morning and afternoon peaks at the intersection causing queues to extend on the M7 Motorway off ramp, the Old Windsor Road interchange, Greenhill Drive and Woolworths Way
- The intersection operates poorly for extended periods
- Pedestrians confront a safety issue when crossing the road particularly when accessing the bus stops on:
  - Norwest Boulevard eastbound and westbound carriageways around 30 metres east of Lexington Drive and Elizabeth Macarthur Drive
  - Lexington Drive southbound carriageway 55 metres south of Woolworths Way
  - Elizabeth Macarthur Drive northbound carriageway 150 metres south of Norwest Boulevard.

In addition to the above factors, development of the Sydney Metro Northwest is stimulating investment and growth along the rail corridor, with areas surrounding the new metro stations becoming the focus for increased housing, economic activity and social infrastructure. While it is recognised that the Sydney Metro encourages a modal shift towards the use of public transport, the level of development will nevertheless place increased pressure on the surrounding road network, and on the capacity of the intersection.

The proposal is within Bella Vista Station Precinct, which was nominated as a Priority Precinct in the Sydney Metro Northwest Priority Urban Renewal Corridor. The Priority Precincts program aims to provide new housing, jobs and deliver infrastructure to support the growth. The Bella Vista Station Precinct Finalisation Report (Department of Planning and Environment, 2017) estimates that development in the area will provide:

- About 9400 new jobs over the next 20 years
- Renewal and expansion of existing business areas in and around the Norwest Business Park, which already supports over 25,000 employees

- About 4200 additional dwellings over the next 20 years.

The proposal would improve the efficiency of Norwest Boulevard at the Lexington Drive/ Elizabeth Macarthur Drive intersection to cater for current and future travel demand on the corridor. It would improve access, crossing opportunities and road safety for all road users, and would improve road network resilience on Norwest Boulevard, thereby reducing impacts on other arterial roads such as the M7 Motorway and Old Windsor Road.

In addition, the proposal would help to fulfil the goals and objectives of numerous strategic planning instruments, including:

- NSW State Infrastructure Strategy (Infrastructure NSW, 2018)
- Greater Sydney Region Plan – A Metropolis of Three Cities (Greater Sydney Commission, 2018a)
- Central City District Plan (Greater Sydney Commission, 2018b)
- NSW Long Term Transport Master Plan (Transport for NSW, 2012a)
- Future Transport Strategy 2056 (Transport for NSW, 2018)
- North West Rail Link Corridor Strategy (Transport for NSW and Department of Planning and Environment, 2013)
- Bella Vista Station Precinct (Department of Planning and Environment, 2017)
- NSW Road Safety Strategy 2012-2021 (Transport for NSW, 2012b)
- Norwest Boulevard Upgrade – Long term Strategic Design 'Scoping Study' (URAP, 2015).

8.1.2 Social factors

As documented in **Section 6.5.3**, the proposal would have some minor short-term negative social impacts as a result of the disturbance and change that would occur during construction. The combined effect of construction noise, dust, and general disturbance caused by construction activity, construction traffic and machinery movements would result in a short term, temporary loss of amenity for residents, motorists, workers and others who live near the proposal (residents to the east) or access the proposal area during their commute to and from work.

The proposal may also include the temporary installation of a potential ancillary facility in areas zoned for public recreation and within the heritage curtilage of Bella Vista Farm.

Any works that would impact the SHR curtilage of the Bella Vista Farm, including acquisition and the installation of an ancillary facility, would need to be the subject of an application under section 60 of the Heritage Act. Safeguards in **Chapter 7** have been proposed to minimise these impacts.

The proposal would require property partial acquisition of some private property and property adjustments (such as reconfigured access) in consultation with landowners. The long-term effect would be an overall social benefit, through improvements to the transport network in and around the proposal area, and improved road safety for all road users. The proposal would also improve the overall road network resilience on Norwest Boulevard.

8.1.3 Biophysical factors

The proposal involves works largely within an existing main road corridor, but would result in disturbance through earthworks and the removal of existing vegetation.

The proposal would require the removal of 1.4 hectares of native tree landscape plantings (or about 185 planted trees) located next to the existing roadway. The proposal would also

require the removal of 0.34 hectares of Shale Sandstone Transition Forest, which is a critically endangered ecological community listed under the BC Act. Given the very small impact on the Shale Sandstone Transition Forest critically endangered ecological community and the poor quality of the vegetation to be removed there is unlikely to be a significant impact (**Appendix H**). Where feasible, the ancillary facilities would be located to minimise or avoid removal of Shale Sandstone Transition Forest.

The proposal would also remove about 1.4 hectares of native landscape plantings that represent marginal potential foraging habitat for threatened fauna. Tests of significance concluded that the small loss of foraging resources for potential threatened fauna is unlikely to result in a significant effect (**Appendix H**).

The proposal would may also require the removal of *Eucalyptus scoparia*, a planted threatened species. Given the trees are planted roadside trees, are not part of a key source populations and outside of their natural occurrence range, these trees were assessed as being of little conservation significance to the species. The extent of tree removal would be determined during detailed design and it is likely that many trees can be retained.

Based on limited water quality data, existing creeks and watercourses downstream of the proposal experience poor water quality, largely attributable to the surrounding urban land-use and associated stormwater discharges to the receiving channels. The proposal would result in no major change to water quality in downstream receiving environments, and would not impact on any sensitive aquatic ecosystems or key fish habitat. The proposal would not have any impacts on groundwater flows or quality.

8.1.4 Economic factors

The proposal would be constructed largely within the existing road corridor. However, some land acquisition and property adjustments would be required. The upgrade of an existing road corridor would minimise long-term disruption and economic impacts on residents, landowners and motorists.

The proposal has been designed so that construction can be staged to avoid the need for any road closures or diversions, thereby keeping a critical transport link open throughout the construction duration.

In the longer term, the proposal would deliver road transport improvements through:

- Improved road safety for all road users,
- Reduced congestion and better overall efficiency for traffic movements through the Norwest Boulevard at the Lexington Drive/Elizabeth Macarthur Drive intersection
- Improved network resilience on Norwest Boulevard to reduce impacts on other arterial roads such as the M7 Motorway and Old Windsor Road.

The reduced costs of congestion and delays for freight and other traffic would constitute an economic benefit to the proposal.

Traffic modelling demonstrates that the network is at capacity at 2026. Therefore without intervention, the majority of additional 2036 traffic would not be able to access the corridor. The proposal would deliver long-term economic benefits and support new development within the Bella Vista Station Precinct (as part of the Sydney Metro Northwest Priority Urban Renewal Corridor program) by improving the overall road network capacity beyond 2036.

8.1.5 Public interest

The public interest is best served through the equitable distribution of resources, and investment in public infrastructure that fulfils the needs of the majority. The proposal represents a cost-efficient investment in public infrastructure that would maximise the long-

term social and economic benefits, while minimising the long-term negative impacts on communities and the environment. By improving local and regional transport facilities, the proposal would better enable the movement of people, goods and services.

Although the proposal would result in some short-term impacts on amenity during the construction phase, these impacts would be outweighed by the long-term benefits once the proposal is operational.

Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	Where reasonable and feasible, the proposal has been designed to avoid impacts on the natural and built environment and to minimise the need for land acquisition. The proposal integrates a shared user path utilising the corridor to connect with existing pathways and facilitate future connections to new urban development, providing an important community benefit. The proposal would also provide improved traffic conditions, safety and efficiency on parts of the surface road network, and would result in improvements to local amenity.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in **Section 8.1.6** below
1.3(c) To promote the orderly and economic use and development of land.	The proposal is needed to address current and future traffic congestion issues and road safety issues. In meeting these needs, the proposal would help to support development and growth within Bella Vista Station Precinct. It would also make use of an existing transport corridor, and therefore minimise the need for any realignment that would impact directly on the economic development of surrounding land.
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 involve the removal of 1.4 hectares of native tree landscape plantings (or about 185 planted trees) located next to the existing roadway, and 0.34 hectares of Shale Sandstone Transition Forest, a critically endangered ecological community listed under the BC Act. Given the very small impact on the Shale Sandstone Transition Forest critically endangered ecological community and the poor quality of the vegetation to be removed there is unlikely to be a significant impact (**Appendix H**). Where feasible, the ancillary facilities would be located to minimise or avoid removal of Shale Sandstone Transition Forest. The proposal would may also require the removal of a small number of specimens of *Eucalyptus scoparia*, a planted threatened species. Given the trees are planted roadside trees, are not part of a key source populations and outside of their natural occurrence range, these trees were assessed as being of little conservation

Object	Comment
	significance to the species. The extent of tree removal would be determined during detailed design and it is likely that many trees can be retained The proposal would also remove 1.4 hectares of native tree landscape plantings that represent marginal potential foraging habitat for threatened fauna. Tests of significance concluded that the small loss of foraging resources for potential threatened fauna is unlikely to result in a significant effect. A number of mitigation measures to minimise direct and indirect ecological impacts would be implemented as part of the project in line with Roads and Maritime Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects. Any residual impacts that cannot be avoided, minimised or mitigated, would be offset in accordance with the Framework for Biodiversity Assessment (OEH, 2014a), the NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014b) and the Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013).
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal involves the acquisition of between one and 20 metres of the curtilage of the Bella Vista Farm along Norwest Boulevard for approximately 230 metres from its junction with Elizabeth Macarthur Drive. In addition, two potential ancillary facility site options (2A and 2B) are proposed within the northern portion of the curtilage adjacent to Norwest Boulevard. These compounds would comprise about 1100 m^2 for ancillary facility 2A and about 3300 m^2 for ancillary facility 2B. Where feasible, the proposal would avoid the placement of ancillary facilities on Bella Vista Farm. Any works that would impact the heritage curtilage of the Bella Vista Farm, including acquisition and the installation of an ancillary facility, would need to be the subject of an application under section 60 of the Heritage Act. Management measures to minimise heritage impacts are listed in **Section 6.6.4.** A site walkover with a representative of the Deerubbin Local Aboriginal Land Council confirmed the proposal would be unlikely to impact on any Aboriginal archaeological objects, sites or potential archaeological deposits due to the highly disturbed and urbanised nature of the proposal area.
1.3(g) To promote good design and amenity of the built environment.	A collaborative design process has identified several design objectives and features that were incorporated into the design to promote good design and amenity of the proposal and its place in the surrounding landscape. Urban design objectives for the proposal include: • Maintaining the fundamental characteristics of the existing road corridor which signify the Norwest Business Park and the experience of the road user • Enabling the sensitive integration of the proposal into the landscape context • Maximising safety of road and path users by ensuring adequate and safe pedestrian and cycle connectivity along and across the corridor

Object	Comment
	• Providing a robust and sustainable environment, which minimises maintenance and is safe to maintain. The objectives and how they related to the design principles are discussed further is **Section 3.2.5.**
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 project.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	A Communication and Stakeholder Engagement Plan (CSEP) was developed at the start of the options assessment and concept design stage, which described the communication and consultation approach and activities to be carried out. Consultation was carried out with the relevant local councils and government agencies throughout the development of the proposal and the preparation of this REF. Two value management workshops were held in June 2017 and December 2019, which was attended by technical experts, key stakeholders as well as Hills Shire Council. The workshop was to assess the design options against agreed criteria such as safety, constructability, traffic efficiency and environmental impacts Online surveys were sent to business owners and/or managers located around the proposal in January 2020 to better understand local business perspectives and concerns. Five businesses participated in the survey. Consultation carried out to date is described in **Chapter 5**.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Consultation with the community and relevant government agencies was undertaken during the development of the proposal. There would be further opportunities for the public to comment on the proposal during the exhibition of the REF. Details of this consultation can be found in **Chapter 5**.

8.1.6 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.

The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. This principle states: "*if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

This principle was considered during proposed upgrade options (see to **Chapter 2.3**) and assessing a worst-case scenario in relation to the operation of potential ancillary facilities. The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures.

These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed out of any lack of scientific certainty.

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

Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations. The principle states: "t*he present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations*".

The proposal would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations.

The proposal would assist in supporting future population and traffic growth in the region. The proposal would benefit future generations by addressing the future increases in traffic volumes and traffic congestion associated with movement of traffic at the intersection, and more broadly improving road network resilience on Norwest Boulevard to reduce impacts on other arterial roads such as the M7 Motorway and Old Windsor Road.

While the proposal would have some adverse impacts, they are not considered to be of a nature or extent that would result in disadvantage to any specific section of the community or to future generations.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would inherit a lower level of service associated with the performance of the existing intersection with the majority of additional 2036 traffic would not be able to access the corridor.

Conservation of biological diversity and ecological integrity

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

The environment in which the proposal would be undertaken is a modified urban environment that is largely cleared of native vegetation. Subsequent landscape planting includes exotic species, native species which are not indigenous to the locality, and some locally indigenous species.

The proposal would require the removal of 1.4 hectares of native tree landscape plantings (or about 185 planted trees) located next to the existing roadway, and 0.34 hectares of Shale Sandstone Transition Forest critically endangered ecological community listed under the BC Act. The proposal would may also require the removal of a small number of specimens of *Eucalyptus scoparia*, a planted threatened species.

The assessment concluded that the proposal is unlikely to be a significant impact of any threatened species, populations or ecological communities (**Appendix H**).

The 1.4 hectares of native tree landscape plantings (native (local and non-local) trees) to be removed represents marginal potential foraging habitat for threatened fauna. The

assessment concluded that the small loss of foraging resources for potential threatened fauna is unlikely to result in a significant effect (**Appendix H**).

Where possible, detailed design would investigate opportunities to minimise direct impacts on biodiversity (i.e. through the placement of potential ancillary facilities) and through revegetation. With implementation of the recommended management measures and safeguards, the proposal would not have a significant impact on biological diversity and ecological integrity. The biodiversity assessment and appropriate site-specific safeguards are provided in **Section 6.4**.

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 proposal, including air, water, land and living things.

This principle is defined as: "*improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as: polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*"

This REF has examined the environmental consequences of the proposal and identified mitigation measures to manage the potential for adverse impacts. The requirement to implement these mitigation measures would result in an economic cost to Transport for NSW, and would increase the capital and operating costs of the proposal. The costs of the generation and management of waste and pollution would be captured in any waste disposal charges. This signifies that environmental resources have been given appropriate valuation.

The concept design has been developed with an objective of minimising potential impacts on the surrounding environment. This indicates that the proposal is being developed with an environmental objective in mind.

8.2 Conclusion

The proposed intersection upgrade at Norwest Boulevard, Lexington Drive and Elizabeth Macarthur Drive 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 (as 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 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 proposal objectives but would still result in some impacts on biodiversity, visual amenity, socio-economic conditions, land use and potential impacts on non-Aboriginal heritage.

Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve the efficiency of Norwest Boulevard at its intersection with Lexington Drive and Elizabeth Macarthur Drive, to cater to current and future travel demand on the corridor. It would improve access, crossing opportunities and road safety for all road users and improve road network resilience on Norwest Boulevard to reduce impacts on other arterial roads such as the M7 Motorway and Old Windsor Road. On balance the proposal is considered justified and the following conclusions are made.

8.2.1.1 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 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.

8.2.1.2 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 the Environment and Energy 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.

Tim Colman

Principal Environmental Planner

Jacobs

Date: 21/10/2020

I have examined this review of environmental factors and accept it on behalf of Transport for NSW.

Sureena Singh

Project Development Manager

Greater Sydney Project Office

Date: 21/10/2020

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Terms and acronyms used in this REF

Term/ Acronym	Description
ACM	Asbestos containing material
AEI	Areas of environmental interest
AEP	Annual exceedance probability
AHIP	Aboriginal Heritage Impact Permit
Alignment	The vertical and horizontal location of the road
ARR	Australian Rainfall and Runoff 2019
ASS	Acid Sulfate Soil
AWS	Automatic weather station
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016* (NSW).
BoM	Bureau of Meteorology
BOS	Biodiversity Offsets Scheme
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
Clearway	A kerbside lane in which vehicles may only stop at certain times of the day.
CMP	Conservation Management Plan
CNVG	Construction Noise and Vibration Guideline
CPTED	Crime Prevention through Environmental Design
CSEP	Communication and stakeholder engagement plan
CSI	Contaminated Site Investigation
DA	Masterplan and Development Application
DDO	Double Diamond Overlap
DLALC	Deerubbin Local Aboriginal Land Council
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment (formerly Department of Planning (DPE))
EESG	Environment, Energy and Science Group of the Department of Planning, Industry and Environment (formerly NSW Office of Environment and Heritage)
EIA	Environmental impact assessment
EIS	Environmental impact statement
EPA	Environmental Protection Agency
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.

Term/ Acronym	Description
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
FM Act	*Fisheries Management Act 1994* (NSW)
GHG	Greenhouse gas
GPT	Gross pollutant traps
GSC	Greater Sydney Commission
GWP	Global warming potential
Heritage Act	*Heritage Act 1977* (NSW)
HV	High voltage
ICNG	Interim Construction Noise Guideline
IDM	Intersection Diagnostic Monitor
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
KNC	Kelleher Nightingale Consulting
kPA	Kilopascal
kV	Kilovolt, a measure of electric current equal to 1,000 volts
LALC	Local Aboriginal Land Council
LCVIA	Landscape Character and Visual Impact Assessment
LCZ	Landscape Character Zones
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local government area
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
LV	Low voltage
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
MP	Member of parliament
NAHMP	Non-Aboriginal Heritage Management Plan
NATA	National Association of Testing Authority
NEPM	*National Environment Protection Measure 1999*
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NSW	New South Wales
NVMP	Noise and Vibration Management Plan
OEH	Office of Environment and Heritage
ONVR	Operation noise and vibration review
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PCSI	Preliminary Contaminated Site Investigation
PCT	Plant community type
PMST	Department of the Environment and Energy Protected Matters Search Tool
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
REF	Review of environmental factors
Roads and Maritime (RMS)	NSW Roads and Maritime Services

Term/ Acronym	Description
RWP	Resource and waste management plan
SAC	Site Assessment Criteria
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
CM SEPP	State Environmental Planning Policy (Coastal Management) 2018
SoHI	Statement of Heritage Impact
QA Specifications	Specifications developed by Transport for NSW for use with road work and bridge work contracts let by Transport for NSW.
SRE	Sensitive receiving environments
SWMP	Soil and water management plan
RNE	Register of the National Estate
RoL	Road occupancy licence
SEARs	Secretary's environmental assessment requirements
SHR	NSW State Heritage Register
SISD	Safe Intersection Sight Distance
STM	Strategic Transport Model
TfNSW	Transport for New South Wales
TMC	Transport Management Centre
TMP	Traffic Management Plan
TRAQ	Roads and Maritime Services' Tool for Roadside Air Quality
UDLP	Urban Design and Landscape Plan
URAP	Urban Research and Planning
VHT	Vehicle Hours Travelled
VIS	DPIE Vegetation Information System
VKT	Vehicle Kilometres Travelled
VMS	variable message sign
VOC	Volatile organic compound
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
WQO	NSW Water Quality Objectives

Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance and Commonwealth land

Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline (DUAP 1995/1996) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
Any environmental impact on a community? The proposal involves some impact on a community during construction including noise and vibration impacts, generation of airborne dust, temporary changes to traffic and access, and visual amenity impacts. During construction, sites would be used for ancillary purposes such as ancillary facilities, material and plant storage, or material stockpiles. In the long term the proposal would result in improvements to traffic efficiency and road safety for all users. The proposal would also result in permanent changes to the visual environment and the overall landscape within the proposal area. The final detailed design for the proposal would incorporate an integrated urban design and landscape concept plan, to mitigate visual impacts and to improve the proposal's landscape setting. Chapter 6 of this REF describes the likely temporary and permanent impacts of the proposal, and lists recommended measures to mitigate impacts during construction and operation. The construction contractor's Construction Environmental Management Plan would incorporate all of the proposed safeguards for implementation throughout the proposal's construction phase.	Short term - negative Long term – positive
Any transformation of a locality? The proposal area would undergo temporary transformation during construction due to clearing of vegetation and earthworks required to widen the road corridor and the operation of ancillary facilities, as well as the operation of ancillary facilities. The proposal would introduce a number of changes in the locality including road widening, acquisition of land and the removal of vegetation. The urban design would introduce revegetated areas and screening to improve the visual amenity of the proposal area.	Short term – negative Long term – neutral
Any environmental impact on the ecosystems of the locality? The proposal would require the removal of 1.4 hectares of native tree landscape plantings (or about 185 planted trees) located next to the existing roadway, and 0.34 hectares of Shale Sandstone Transition Forest, which is a critically endangered ecological community listed under the BC Act. Given the very small impact on the Shale Sandstone Transition Forest critically endangered ecological community and the poor quality of the vegetation to be removed there is unlikely to be a significant impact (**Appendix H**). Where feasible, the ancillary facilities would be located to minimise or avoid removal of Shale Sandstone Transition Forest. The proposal would may also require the removal of *Eucalyptus scoparia*, a planted threatened species. Given the trees are planted roadside trees, are not part of a key source populations and outside of their natural occurrence range, these trees were assessed as being of little conservation significance	Short term – neutral

Factor	Impact
to the species. The removal of trees would be determined during detailed design and it is likely that many trees can be retained The proposal would have no longer term impacts on any other ecosystems, habitat or threatened species.	
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? The proposal would involve clearing of some planted trees and regrowth vegetation which would transform the landscape character and the aesthetics of the locality. The urban design would introduce revegetated areas and screening to maintain the visual amenity of the proposal area.	Short term – negative Long term – neutral
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 involves the acquisition of between one and 20 metres of the curtilage of the Bella Vista Farm along Norwest Boulevard for approximately 230 metres from its junction with Elizabeth Macarthur Drive In addition, two potential ancillary facility site options (2A and 2B) are proposed within the northern portion of the heritage curtilage of Bella Vista Farm adjacent to Norwest Boulevard. These compounds would comprise about 1100 m^2 for ancillary facility 2A and about 3300 m^2 for ancillary facility 2B. Where feasible, the proposal would avoid the placement of ancillary facilities on Bella Vista Farm. Any works that would impact the SHR curtilage of the Bella Vista Farm, including acquisition and the installation of an ancillary facility, will need to be the subject of an application under section 60 of the Heritage Act The proposal is not expected to have any other impacts on any locality, place or building having aesthetic, anthropological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations.	Short term – potential negative Long term – neutral
Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974)?* The proposal would not impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)	Nil
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The assessment of the proposal's impact on nationally listed threatened species, populations, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance.	Nil
Any long-term effects on the environment? Long-term negative effects on the environment are not expected. Benefits would be realised in terms of reduced congestion and improvements in road safety.	Nil

Factor	Impact
Any degradation of the quality of the environment? Construction would have the potential to result in temporary visual, noise and air quality impacts. These potential impacts would be managed by the implementation of safeguards listed in **Section 7** of this REF.	Nil
Any risk to the safety of the environment? Traffic management safeguards including the preparation of a traffic management plan, would address safety risks during construction. The proposal would improve safety for road users during operation by reducing congestion and increasing traffic capacity. The proposal would also improve intersection performance and pedestrian/cyclist facilities.	Short term – minor negative Long term – positive
Any reduction in the range of beneficial uses of the environment? The proposal would not reduce the range of beneficial uses of the environment.	Nil
Any pollution of the environment? There is potential for accidental spills of chemicals during construction which could affect the surrounding land, surface water and groundwater. Management of impacts on surface water and groundwater is addressed in **Section 6.10** of this REF.	Short term – potential minor negative Long term- neutral
Any environmental problems associated with the disposal of waste? Waste streams generated during construction are common and would pose no difficulty in their disposal. Waste would be recycled wherever possible.	Nil
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? All resources required for the proposal are readily available and are not in short supply.	Nil
Any cumulative environmental effect with other existing or likely future activities? The study area and wider north western Sydney region are undergoing substantial ongoing growth and development and it is likely that there would be some localised impacts associated with traffic and delays. The number and scale of new developments identified in the study area demonstrate the increased volume of traffic that can be expected in the area in the coming years. The proposal would contribute to improved traffic flows and travel times across the region which is expected to be considerably higher than current volumes, as well as improving the network resilience on Norwest Boulevard. A Consultation Plan would include consultation with the proponents of any surrounding proposed developments relevant at the time of construction to coordinate with nearby construction programs and methodologies.	Short term – potential negative Long term – positive
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposal would not result in any impact on coastal processes and coastal hazards.	Nil

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on the Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of the Environment and Energy.

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
Any impact on a World Heritage property?	Nil
Any impact on a National Heritage place?	Nil
Any impact on a wetland of international importance?	Nil
Any impact on a listed threatened species or communities? The proposal would impact on 0.34 hectares of Shale Sandstone Transition Forest in the Sydney Basin Bioregion is listed as critically endangered under the BC Act. Shale Sandstone Transition Forest in the Sydney Basin Bioregion is also listed as critically endangered under the EPBC Act however the community is required to meet certain diagnostics related to conditions class.	Nil
Any impacts on listed migratory species? While some migratory species of bird are likely use the proposal area and locality, the proposal area would not be classed as an 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of the Environment, 2013).	Nil
Any impact on a Commonwealth marine area?	Nil
Does the proposal involve a nuclear action (including uranium mining)?	Nil
Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	Nil

Appendix B

Concept Design Drawings

Appendix C

Statutory consultation checklists

Infrastructure SEPP

Certain development types

Development type	Description	Yes/No	If 'yes' consult with	ISEPP clause
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No		ISEPP cl. 95A
Bus Depots	Does the project propose a bus depot?	No		ISEPP cl. 95A
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No		ISEPP cl. 95A

Development within the Coastal Zone

Issue	Description	Yes/No/NA	If 'yes' consult with	ISEPP clause
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No		ISEPP cl. 15A

Council related infrastructure or services

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Stormwater	Is the work likely to have a *substantial* impact on the stormwater management services which are provided by council?	No		ISEPP cl.13(1)(a)
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		ISEPP cl.13(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		ISEPP cl.13(1)(c)

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
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		ISEPP cl.13(1)(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?	Yes	Hills Shire Council	ISEPP cl.13(1)(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 authority and responsible for maintenance?	Yes	Hills Shire Council	ISEPP cl.13(1)(f)

Local heritage items

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the 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		ISEPP

Flood liable land

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
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?	No		ISEPP cl.15
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	No		ISEPP cl.15AA

Public authorities other than councils

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
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	NSW Environment, Energy and Science	ISEPP cl.16(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	NSW Environment, Energy and Science	ISEPP cl. 16(2)(b)
Aquatic reserves	Is the work adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*?	No	Department of Industry	ISEPP cl.16(2)(c)
Sydney Harbour foreshore	Is the work in the Sydney Harbour Foreshore Area as defined by the *Place Management NSW Act 1998?*	No	Property NSW	ISEPP cl.16(2)(d)
Bush fire prone land	Is the work for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service	ISEPP cl.16(2)(f)
Artificial light	Would the work increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	Director of the Siding Spring Observatory	ISEPP cl.16(2)(g)
Defence communications buffer land	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	ISEPP cl. 16(2)(h)

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Mine subsidence land	Is the work on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	Mine Subsidence Board	ISEPP cl. 16(2)(i)

Growth Centres SEPP

Issue	Potential impact	Yes/No	If 'yes' consult with	ISEPP clause
Clearing native vegetation	Does the work involve clearing native vegetation (as defined in the *Local Land Services Act 2013)* on land that is not **subject land** (as defined in clause 17 of schedule 7 of the *Threatened Species Conservation Act 1995)?*	No	Department of Planning and Environment	SEPP 18A

Appendix D

Traffic Impact Assessment (Bitzios Consulting, 2020)

Appendix E

Construction and operational noise and vibration assessment (Renzo Tonin, 2020)

Appendix F

Urban Design, Landscape Character and Visual Impact Assessment (LCVIA) (Tract, 2020)

Appendix G

Socio-economic Impact Assessment (Jacobs, 2020)

Appendix H
Biodiversity Searches

Appendix I

Historic Heritage Assessment

Appendix J

Aboriginal Archaeological Assessment

Appendix K

Stage 2 Contaminated Site Investigation (Jacobs, 2020)