

# Wakehurst Parkway Improvements – Frenchs Forest to Narrabeen

Review of Environmental Factors

October 2023

## Acknowledgement of Country

Transport for NSW acknowledges the traditional custodians of the Northern Beaches on which the Wakehurst Parkway Improvements project is proposed.

We pay our respects to their Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

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

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



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# Executive summary

## The proposal

Transport for NSW (Transport) proposes to carry out road improvements, including intersection upgrades, along Wakehurst Parkway between Frenchs Forest Road, Frenchs Forest and Pittwater Road, North Narrabeen (the proposal). The proposal is being delivered by Transport's Easing Sydney's Congestion program, which aims to support Sydney's growing population by delivering improvements to reduce traffic congestion on Sydney's main roads. Sections of Wakehurst Parkway are subject to traffic congestion and have an extensive crash history. The proposal would help improve safety and travel time by improving the overall efficiency of the wider road network.

The proposal's key features include:

### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

- widening of Wakehurst Parkway southbound between Trefoil Creek and Dreadnought Road to provide an additional southbound lane (resulting in two continuous southbound lanes from Oxford Falls Road to Frenchs Forest Road)

### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

- widening of Wakehurst Parkway northbound ahead of Dreadnought Road intersection for 170 metres to accommodate a longer shared through and left turn lane, a new concrete median and new shoulders
- widening of Wakehurst Parkway to the west of the northbound lane from Dreadnought Road to Oxford Falls Road to accommodate an additional lane in each direction. The northbound kerbside lane would become a dedicated left turn on approach to Oxford Falls Road intersection
- widening of Oxford Falls Road intersection's southwest corner to accommodate a new dedicated left turn lane from Wakehurst Parkway northbound
- extension of the existing right turn bay on Wakehurst Parkway southbound onto Dreadnought Road to provide additional storage capacity
- construction of a new left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road with a pedestrian island and signalised pedestrian crossing at the north-eastern corner of the intersection
- installation of a dedicated right turn bay from Wakehurst Parkway southbound onto Oxford Falls Road
- construction of a rock cutting wall on Wakehurst Parkway southbound, opposite Oxford Falls Road intersection to facilitate road widening
- installation of a new northbound bus bay north of Dreadnought Road intersection, on Wakehurst Parkway
- installation of a new southbound bus bay north of Dreadnought Road intersection, at the end of the new left turn slip lane onto Dreadnought Road
- installation of signalised pedestrian crossings on the western, eastern and southern legs of Dreadnought Road intersection

### Wakehurst Parkway from Elanora Road to Mirrool Street

- localised widening of Wakehurst Parkway southbound at the Mirrool Street intersection to allow through traffic to pass vehicles waiting to turn right into Mirrool Street
- widening of Wakehurst Parkway northbound between Elanora Road and Mirrool Street to accommodate a new left turn bay
- conversion of the existing kerbside through lane on northbound approach to Elanora Road into a dedicated left turn lane
- banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left-in and left-out only and redirecting right turn movements to the Mirrool intersection

The location of the proposal is shown in Figure 1-1 and a depiction of the proposal areas are provided in Figure 1-2 to Figure 1-5. Chapter 3 describes the proposal in more detail.

Construction of the proposal is planned to commence in mid to late 2024, with a staged approach.

## Need for the proposal

Wakehurst Parkway is a State Road and a key link between Sydney's Central Business District and the upper part of the Northern Beaches. Traffic performance along Wakehurst Parkway is currently limited by a single lane of traffic in each direction, with a low level of service at Dreadnought Road intersection due to insufficient turning and through traffic capacity. Vehicle queuing occurs at the intersections of Oxford Falls Road, Elanora Road and Mirrool Street due to insufficient through traffic capacity at these locations. The proposal would reduce queueing by providing additional turning bays and through traffic lanes to improve the flow of vehicles, particularly during peak periods.

Wakehurst Parkway has an extensive crash history. Increasing the capacity for traffic flow through the addition of dedicated turning lanes, passing lanes and through lanes would improve road safety. Pedestrian safety would also improve with the provision of signalised pedestrian crossings on all legs of Dreadnought Road intersection.

Public transport would be improved through the provision of a bus stop on both the northbound and southbound lanes of Wakehurst Parkway north of the intersection of Dreadnought Road, with associated footpath connections. The proposal will provide overall improvements to public transport by reducing travel times for buses through the area.

## Proposal objectives

The objectives of the proposal are:

- improve network efficiency and increase utilisation of Wakehurst Parkway corridor
- improve road safety along the corridor with targeted reduction in crashes in key cluster areas
- provide capacity for future traffic growth
- improved active transport accessibility
- encourage mode shift to public and active transport.

The development criteria for the proposal include:

- constructability including impacts to utilities and services
- minimise land use and community impacts
- minimise property acquisition
- minimise environmental impacts.

The urban design objectives include:

- ensure the design and character of the proposal is integrated with the adjoining landscape and urban conditions
- provide connectivity between areas beyond the road corridor and improve definition of streets and landmarks
- ensure the design, construction and management of the project responds to the living environment
- unlock potential for urban regeneration, landscape improvements and active transport upgrades along the project corridor
- embed sustainability considerations into the design and delivery of the project in order to minimise environmental and social impacts.

The proposal is consistent with the objectives and development criteria as it provides improved safety outcomes and network efficiency, enables greater uptake of public and active transport, and reduces vehicle queueing, improving Wakehurst Parkway's capacity for future traffic growth. Urban design objectives have been considered throughout the design development to ensure the integration of the proposal with the surrounding landscape.

## Options considered

A range of options were developed for four key areas of the proposal and assessed against the proposal's objectives and development criteria. These options included:

### Area A (Wakehurst Parkway from Trefoil Creek to Dreadnought Road intersection):

- **Option A1 'Do nothing':** Involves doing no work to the existing road corridor
- **Option A2 'The proposal':** As described in Chapter 1
- **Option A3:** Widening of Wakehurst Parkway to the west between Trefoil Creek and Dreadnought Road for about 800 metres to provide an additional southbound lane, a shoulder and a safety barrier. This would result in two southbound through lanes between Dreadnought Road and Frenchs Forest Road.
- **Option A4:** Widening Wakehurst Parkway to the west between Frenchs Forest Road and Dreadnought Road for about 1480 metres to provide an additional northbound lane and a shoulder. This would provide two northbound lanes between Frenchs Forest Road and Dreadnought Road.

### Area B (Intersection of Wakehurst Parkway and Dreadnought Road):

- **Option B1 'Do nothing':** Involves doing no work to the existing intersection
- **Option B2 'The proposal':** As described in Chapter 1.
  - during development of the design of Wakehurst Parkway northbound duplication from Dreadnought Road to Oxford Falls Road, an option was considered whereby the kerbside lane of the northbound duplication terminated before the left turn slip lane to Oxford Falls Road, meaning that the two were separate elements. As the design progressed, the decision was taken to continue the kerbside lane of the northbound duplication all the way to Oxford Falls Road, with the section of this lane on the approach becoming a 'trapped' left turn lane. It was considered that this design would maximise use of the kerbside lane and improve traffic capacity through the area.
- **Option B3:** Involves the following work:
  - widening of Wakehurst Parkway southbound for about 210 metres to accommodate an extension of the existing southbound dual lane on approach to Dreadnought Road intersection
  - construction of new left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road with a pedestrian island and unsignalised pedestrian crossing
  - widening of Wakehurst Parkway northbound, north of Dreadnought Road intersection, for about 120 metres to accommodate two northbound lanes. The two lanes would then merge back to one northbound lane
  - widening of Dreadnought Road westbound for about 65 metres to accommodate one westbound through lane and one dedicated right turn lane on approach to Dreadnought Road intersection
  - conversion of the kerbside lane on the northbound approach to Dreadnought Road intersection from a left turn lane to a shared left and through lane
  - reconfiguration of the traffic signals at Dreadnought Road intersection to suit the road upgrade
  - installation of a new northbound bus bay north of Dreadnought Road intersection, on Wakehurst Parkway
  - installation of a new southbound bus bay north of Dreadnought Road intersection, at the end of the new left turn slip lane onto Dreadnought Road
  - installation of signalised pedestrian crossings on the western, eastern and southern legs of Dreadnought Road intersection
- **Option B4 'No bus stops, no left turn slip lane to Dreadnought Road':** Same as Option B3 without the southbound left turn slip lane onto Dreadnought Road. There is no allowance for bus stops in this option.

### Area C (Wakehurst Parkway from Dreadnought Road to Oxford Falls Road):

- **Option C1 'Do nothing':** Involves doing no work to the existing intersection
- **Option C2 'The proposal':** As described in Chapter 1

- **Option C3:** Conversion of Oxford Falls Road intersection into a signalised intersection.

Area D (Wakehurst Parkway from Elanora Road to Mirrool Street):

- **Option D1 ‘Do nothing’:** Involves doing no work to the existing intersection
- **Option D2 ‘The proposal’:** As described in Chapter 1
- **Option D3:** Provision of a roundabout at the intersection of Wakehurst Parkway and Elanora Road. Banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left-in and left-out only.
- **Option D4:** Provision of a roundabout at the intersection of Wakehurst Parkway and Mirrool Street. Banning of right turn movements from Elanora Road onto Wakehurst Parkway, redirecting traffic traveling southbound on Wakehurst Parkway to the Mirrool Street roundabout where motorists can perform a U-turn. Banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left-in and left-out only.
- **Option D5:** Involves the following upgrades to the intersection:
  - maintain the existing operation of the Elanora Road and Mirrool Street intersections, however adopting a seagull intersection layout compliant with Austroads design standards
  - widening on both sides of Wakehurst Parkway for about 800 metres from west of Elanora Road to east of Mirrool Street
  - provision of raised medians to separate the eastbound and westbound Wakehurst Parkway lanes from about 420 metres west of the Elanora Road intersection to the Mirrool Street intersection
  - provision of dedicated right turn bays from Wakehurst Parkway westbound onto Mirrool Street and Elanora Road
  - provision of a protected right turn and acceleration lane from Elanora Road to Wakehurst Parkway, allowing for about 405 metres of acceleration and merging distance for Elanora Road traffic joining the southbound lane on Wakehurst Parkway.

Options A2, B2, C2, and D2 were selected as they best met the proposal objectives and design requirements. The ‘do nothing’ options were not selected as they would not improve safety, traffic capacity, uptake of public or active transport, despite having the least environmental and property impacts.

The options assessment concluded that the traffic, safety, and efficiency improvements associated with the preferred options would outweigh the environmental and social impacts of the preferred options with implementation of safeguards and other mitigation measures.

## Statutory and planning framework

The proposal is for a road and is to be carried out by Transport. It is assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW). The proposal would be likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation Act 2016* (BC Act). A Biodiversity Development Assessment Report has been prepared to assess the anticipated significant impact on the endangered Angus’s Onion Orchid (*Microtis angusii*) due to the proximity of identified colonies to the intersection of Wakehurst Parkway and Oxford Falls Road.

The proposal is likely to have a significant impact on threatened species, ecological communities and/or migratory species within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth (EPBC Act)). This Review of Environmental Factors (REF) has considered the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advice and guidelines provided by the Australian Government. The REF finds that the activity would not threaten the long-term survival of nationally-listed biodiversity matters and that suitable offset measures can be secured as set out in the Biodiversity Offset Strategy for the proposal.

This REF has been prepared to meet the requirements of the EPBC Act strategic assessment approval for Transport Division 5.1 road activities. A referral to the Australian Department of Climate Change, Energy, the Environment and Water is not required.

There would be no significant impact on any other aspect of the environment. Therefore it is not necessary for an environmental impact statement to be prepared nor approval to be sought from the Minister for Planning under Division 5.1 of the EP&A Act. Consent from Council is not required.

## Stakeholder consultation

### Transport and Infrastructure State Environmental Planning Policy consultation

Northern Beaches Council has been consulted on the proposal in line with Part 2.2 of *State Environmental Planning Policy (Transport and Infrastructure) 2021* due to potential impacts on nearby Council-owned land and infrastructure. Details of this consultation are provided in Section 5.2. The NSW State Emergency Service was also consulted under *State Environmental Planning Policy (Transport and Infrastructure) 2021*. Details of this consultation are provided in Section 5.2.

Transport for NSW will continue to consult with Northern Beaches Council and the State Emergency Service as the project progresses.

## Environmental impacts

The REF assesses the potential direct and indirect impacts related to the construction and operation of the proposal. The assessment also includes an outline of mitigation and management measures, stated as environmental safeguards.

The main environmental impacts of the proposal are:

### Biodiversity

A Biodiversity Development and Assessment Report and Arboricultural Assessment Report has been prepared for the proposal in accordance with the Biodiversity Assessment Method (BAM) (2020), as required by the *Biodiversity Conservation Act 2016*. The land in which biodiversity values have been assessed by this Biodiversity Development Assessment Report is known as the proposal area. The proposed compound sites would not directly impact native vegetation or other biodiversity values during construction or operation and have subsequently not been included in the proposal area.

Database searches and the BAM species development identified:

- 58 threatened flora species. Of these, targeted surveys were carried out for 37 threatened flora species
- 125 threatened fauna species. Of these, targeted surveys were conducted for 15 threatened fauna species.

Targeted surveys for threatened flora and fauna species were carried out between October 2022 and June 2023. The study area covered a total area of 17.51 hectares.

Two threatened flora species were identified during surveys:

- Angus's Onion Orchid (*Microtis angusii*) (Endangered under the BC Act and EPBC Act)
- Magenta Lilly Pilly (*Syzygium paniculatum*) (Endangered under the BC Act and Vulnerable under the EPBC Act)

Nine threatened fauna species were identified during surveys:

- Red-crowned Toadlet (*Pseudophryne australis*) (Vulnerable under the BC Act)
- Southern Myotis (*Myotis macropus*) (Vulnerable under the BC Act)
- Glossy Black-cockatoo (*Calyptorhynchus lathami*) (Vulnerable under the EPBC Act and BC Act)
- Powerful Owl (*Ninox strenua*) (Vulnerable under the BC Act)
- Grey-headed Flying-fox (*Pteropus poliocephalus*) (Vulnerable under the EPBC Act and BC Act)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) (Vulnerable under the BC Act)
- Eastern Osprey (*Pandion cristatus*) (Vulnerable under the BC Act)
- Little Bent-winged Bat (*Miniopterus australis*) (Vulnerable under the BC Act).

Direct impacts of the proposal on biodiversity include:

- removal of 2.38 hectares of native vegetation from within the proposal area comprising the following Plant Community Types (PCT): PCT 3586, PCT 3592, PCT 3593, PCT 3595, PCT 3924, PCT 4019 and PCT 4028
- removal of 0.06 hectares of threatened ecological communities comprising of:



- 0.02 hectares of PCT 3924 which qualifies for listing as the endangered ecological community Coastal Upland Swamp under the BC Act and EPBC Act
- 0.02 hectares of PCT 4019 which qualifies for listing as the endangered ecological community Swamp Sclerophyll Forest under the BC Act, and critically endangered ecological community River-flat Eucalypt Forest under the EPBC Act, and
- 0.02 hectares of PCT 4028 which qualifies for listing as the endangered ecological community Swamp Oak Floodplain Forest under the BC Act, and endangered ecological community Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland under the EPBC Act.
- removal of 52 individuals of Angus’s Onion Orchid across 0.21 hectares of habitat
- removal of 0.83 hectares of breeding, foraging and sheltering habitat for Red-crowned Toadlet
- removal of 1.07 hectares of foraging habitat for Southern Myotis
- potential for injury or mortality of terrestrial fauna from proposed works.

As the proposal would require the removal of native vegetation and fauna habitat from the proposal area, Transport is required to offset these impacts on biodiversity. The offsets required for the proposal were calculated using the BAM Calculator. A total of 42 ecosystem credits (refer to Table 6-9) and 48 species credits (refer to Table 6-10) are required to offset the direct impacts of the proposal. No offsets are required for aquatic habitats as no impacts would occur to mapped areas of Key Fish Habitat.

Some patches of native vegetation fall below the offsetting threshold under the BAM. These trees would therefore be offset under the Tree and Hollow replacement guidelines (TfNSW, 2022). Transport (2022) identifies the non-statutory offset requirements for proposals that result in tree loss in areas not offset under the BOS. In accordance with the guidelines, the proposal would require:

- 448 new trees planted within the proposal footprint or nearby properties or, where this is not feasible,
- a payment to Transport’s Conservation Fund.

Mitigation measures for biodiversity related impacts, such as native vegetation, threatened species, aquatic impacts, fauna related impacts, light spill and shading, include the implementation of a Flora and Fauna Management Plan (with measures such as pre-clearing surveys, boundary marking for clearing areas, unexpected threatened species finds protocol and fauna handling measures, and protocols to manage weeds and pathogens), compliance with guidance for pre-clearing, vegetation removal, vegetation re-establishment, fauna handling, habitat replacement or re-instatement, and unexpected species finds. These measures would be implemented in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).

More targeted measures would be adopted to mitigate the impacts of the proposal on the endangered orchid species Angus’s Onion Orchid, including a plant salvage and translocation project. A salvage management plan would be prepared in consultation with the Royal Botanical Gardens and the NSW Threatened Species Officer for Angus’s Onion Orchid, with the ultimate objective of salvaging individuals within the proposal area prior to construction and replanting in suitable habitat beyond the limit of works.

Potential impacts of the proposal on biodiversity are expected to be mitigated by the safeguards detailed in this REF.

### **Traffic and transport**

Traffic is currently performing at an unsatisfactory Level of Service (LoS F) during both the AM (morning) and PM (afternoon) peaks. Traffic modelling suggests average delays would increase to 42 seconds in the morning peak (a 54 per cent increase) and 47 seconds in the afternoon peak (a 55 per cent increase) by 2046. This indicates that there are existing capacity constraints at Dreadnought Road intersection, highlighting the need to improve traffic capacity at this intersection.

In 2026, the average weekday traffic volumes on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road are predicted to increase about 101 per cent of existing traffic volumes. In 2046, traffic volumes on Wakehurst Parkway are predicted to increase to about 112 per cent of existing traffic volumes.

In response to higher traffic volumes, the broader network performance of Wakehurst Parkway is expected to deteriorate. Between 2023 and 2046, the total vehicle hours travelled would increase by 58 per cent in the morning peak and 30 per cent in the afternoon peak. In contrast, the total vehicle kilometres travelled would increase by 2 per cent and 10 per cent respectively. Such scenarios where travel time greatly exceeds growth in travel distance indicates a highly congested network without the proposal.

Between 2023 and 2046, the travel time northbound is expected to increase by 2.4 minutes and 2.1 minutes in the morning and afternoon peaks respectively. In the southbound direction, the travel time is expected to increase by 4.8 minutes and 1.3 minutes in the morning and afternoon peaks respectively.

The proposal would improve lane capacity, the operation of intersections, and overall traffic performance on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road. In 2026, the proposal is expected to reduce travel time on Wakehurst Parkway by up to 1.5 minutes in the AM peak (southbound) and up to 0.6 minutes in the PM peak (northbound), as well as reduce the number of stops by up to 44 per cent. In 2046, the travel time reduction is estimated to be up to 5.7 minutes in the AM peak (southbound) and up to 2 minutes in the PM peak (northbound). The model shows that the number of stops would reduce by up to 76 per cent during the peak periods in 2046.

The proposed upgrades would address capacity issues at key intersections along Wakehurst Parkway and contribute to improved accessibility for the local community. Notably, the proposal would improve access to the local communities of Oxford Falls and Elanora Heights.

Some impacts to traffic flow within the proposal area may occur during the construction phase of the proposal due to an increase in light and heavy vehicles. Roads within the proposal area would remain open during the construction period, however partial road closures would be required. Lane closures would be carried out primarily out of hours in accordance with Road Occupancy licences, to minimise disruption to traffic.

Operation of the proposal would have a beneficial impact on traffic capacity and traffic performance. The proposed improvements would reduce delays and improve safety for motorists travelling on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road.

Mitigation measures to manage construction traffic impacts would include the preparation of a Traffic Management Plan. This would include, but is not limited to, confirmation of haulage routes, measures to maintain access to local roads and properties, site-specific traffic control measures and requirements and methods to consult and inform the local community of impacts on the local road network. Mitigation measures would also include maintaining property access, and pedestrian and cyclist access throughout construction. Directional signage would be provided where relevant.

Potential traffic and transport impacts of the proposal are expected to be mitigated by the safeguards detailed in this REF.

### **Noise and vibration**

Noise and vibration assessments for the proposal have been carried out conservatively to identify the worst-case potential impacts assuming, for example, that all machinery and equipment are operating simultaneously in one location. The scenarios tested rarely occur in reality, however, enable the identification of the potential risks and the subsequent development of appropriate mitigation and management measures.

The proposal has been split into two noise assessment areas – the R1 area which includes the northern section of the proposal and R2 which includes the southern section of the proposal. Construction scenarios were defined for the proposed work, with the noisiest scenario being bulk earthworks.

Residential dwellings at the northern area of the proposal are the closest sensitive receivers to the proposed works. The C3 Pentecostal Church and associated Christian college (C3 SYD Church), St Pius X College playing fields and sporting facilities and Oxford Falls Grammar School are the closest non-residential receivers to the proposal, both located at Dreadnought Road intersection.

During construction, noise impacts to sensitive receivers may include:

- impacts in the southern section of the proposal, the highly noise affected level is predicted to be exceeded for receivers within 60 metres of bulk earthworks and 45 metres of corridor clearing activities (about two residences).
- impacts in the northern section of the proposal, the highly noise affected level is predicted to be exceeded for receivers within 50 metres of bulk earthworks and corridor clearing activities. There are 41 residences located along the northern side of Wakehurst Parkway expected to be within this distance to construction work.

Standard noise mitigation measures would be implemented to manage any potential noise impacts during construction. These include preparing a Noise and Vibration Management Plan to identify potential substantial noise and vibration generating activities, a monitoring program to assess performance against relevant noise and vibration criteria, and stakeholder engagement with affected households and sensitive receivers as well as contingency measures to be implemented in the event of non-compliance. Other mitigations include advanced notification of noisy works to sensitive receivers, vibration assessments and building condition surveys, cut off times for noisy work, and other measures detailed in Section 6.7.5.

There is potential for construction vibration to impact about five buildings within 25 metres of the construction footprint, which represents the safe working distance for cosmetic damage in the most conservative scenario. Construction vibration could also impact about 85 buildings within 100 metres of the construction footprint, which represents the safe working distance for human comfort in the most conservative scenario. The built heritage item Oxford Falls Public School is located in close proximity to Dreadnought Road intersection, with a heritage sandstone wall located at the front of the site facing the intersection. If safe working distances cannot be maintained, safeguards including vibration trials and monitoring would be implemented to mitigate any potential impacts.

During operation, the expected increase of road traffic noise is below the 2.0 dBA road noise criteria for operational road traffic noise levels, and therefore does not require mitigation. This change is generally imperceptible to the human ear. There are no operational vibration impacts generated from the proposal, and mitigation is not required.

Potential noise and vibration impacts of the proposal are expected to be mitigated by the safeguards detailed in this REF.

### **Hydrology and flooding**

The proposal area is located within a low-lying floodplain and is in close proximity to Narrabeen Lagoon. The proposal crosses a tributary to Middle Creek at Dreadnought Road intersection, and Trefoil Creek at the southern end. Closures of Wakehurst Parkway have occurred up to seven times a year when Middle Creek overflows into the floodplain, which within the proposal area impacts Oxford Falls Road intersection, and where an unnamed tributary of Middle Creek crosses Wakehurst Parkway 200 metres north of Dreadnought Road intersection. Flood immunity of Trefoil Creek is presently one in 50 Annual Exceedance Probability (AEP), which would reduce when the culvert is partially blocked. There is a high risk of partial blockage at this location. Construction of the proposal in this area would largely fall outside of flood prone land.

At the tributary to Middle Creek that crosses the road 200 metres north of the intersection of Wakehurst Parkway and Dreadnought Road, flooding and road closures are expected up to seven times per year.

At Elanora and Mirrool Street intersections in the northern section of the proposal area, the proposal footprint is close to Narrabeen Lagoon and is in a medium to high flood risk area.

Potential impacts during construction include erosion or sedimentation of exposed soil during flood events, pollution of floodwaters with chemicals and other construction materials, and plant equipment and construction materials being mobilised during flood events and forming part of flood debris. These impacts would be mitigated by appropriate siting of construction compounds, storage of stockpiles and materials out of flood impacted areas, and removing equipment, machinery and stockpiles from compounds and construction areas when flooding is anticipated.

Performance of culverts and other drainage infrastructure would be impacted temporarily during construction of new stormwater drainage lines and connections to existing stormwater network. Function of drainage infrastructure would be restored when flood events are forecast. There is also the potential for flooding to occur more broadly within the proposal footprint during storm events as the current drainage network is at capacity. Construction activities are not expected to result in any change to existing flooding conditions on adjacent properties. Construction staging would aim to maintain existing drainage flow paths by maintaining connectivity of piped drainage systems and overland flow paths through the proposal site throughout the construction period. A flood contingency plan would be developed prior to construction facilitate effective flood preparation.

Construction compound option 3 (CC3) and 4 (CC4) are partially impacted, and option 6 (CC6), 7 (CC7), 8 (CC8) and 9 (CC9) are wholly impacted by the 1 per cent Annual Exceedance Probability flood. Potential impacts during construction include erosion or sedimentation of exposed soil during earthworks in flood events, pollution of floodwaters with chemicals and other construction materials, and plant equipment and construction materials being mobilised during flood events and forming part of flood debris.

The flood risks would be managed through appropriate controls around stockpiles, equipment and potentially hazardous liquids and materials, as well as observing weather forecasts for heavy rainfall events and transportation of materials to another site if flooding is anticipated. For compounds CC7 and CC9 within high risk flood prone land, stockpiling of material and storage of hazardous materials would not take place.

The road is designed for flood immunity not less than the existing road flood immunity, without precluding future flood immunity upgrades including those planned by Northern Beaches Council. In the area between Elanora Road and Mirrool Street, Wakehurst Parkway is mapped as a high flood risk precinct (subject to 1 in 100 Annual Recurrence Interval) and is also subject to high hydraulic hazard (the potential damage that overland flows can do, such as dangerous water speeds or damage to buildings). Where Wakehurst Parkway crosses an unnamed tributary to Middle Creek, the proposal area is mapped as medium to high flood risk, and the road closes up to seven times per year on average. South of Dreadnought Road intersection, Wakehurst Parkway is not mapped as flood prone and is concluded to be flood immune (above Probable

Maximum Flood levels). Outside of the proposal area, most of Wakehurst Parkway between Oxford Falls Road and Pittwater Road is considered a high risk precinct. Therefore the road design would result in no change to existing flood immunity.

There would be no change to the current flood risk as a result of the proposal.

Potential hydrology and flooding impacts of the proposal on motorists, pedestrians, residents, and the environment are expected to be mitigated by the safeguards detailed in this REF.

#### **Surface water**

The proposal is within the Northern Beaches sub catchment, which forms part of the Sydney Metro catchment. Wakehurst Parkway intersects Trefoil Creek and several unnamed and unmapped watercourses including two tributaries of Middle Creek, one south of Dreadnought Road and the other south of Oxford Falls Road, and ephemeral drainage lines formed along the power line within the road reserve in the southern extent of the proposal. The tributaries of Narrabeen Lagoon include Middle Creek, Deep Creek, South Creek, and Mullet Creek. In accordance with the 2019-20 summer results of the NSW Department of Planning and Environment (DPE) water quality monitoring program, the overall health of Narrabeen Lagoon is graded to be good (NSW DPE, 2021).

Construction activities have the potential to affect the quality of local surface water as a result of:

- the upgrade of culverts and headwalls within waterways
- excavation to relocate utilities and stormwater services.
- bulk earthwork activities, including:
  - excavation for new batters, rock cuttings and retaining walls
  - excavation of new road verges road pavements, medians and road verges
- sediment runoff from the installation of stormwater drainage upgrades entering stormwater drainage system
- sediment runoff from site and the proposed site compound and stockpile during rainfall events due to increased soil exposure
- pollutants from site and site compound reaching nearby stormwater drains and waterways. Potential pollutants include spills and leaks of linemarking paint, fuel, chemicals, concrete washout water or sediment laden water from excavations and stockpiles.

All disturbed areas would be reinstated and stabilised during construction. This would minimise the risk of exposed soils creating sediment runoff and entering the stormwater drainage system.

The proposed road widening would result in an increase in impermeable surfaces, however the volume of surface water runoff is not expected to increase substantially. The proposal would install drainage infrastructure to ensure the operational performance would be consistent with the existing performance.

Mitigation measures for surface water quality impacts would include the preparation and implementation of a Soil and Water Management Plan, including a site-specific Erosion and Sediment Control Plan prior to construction. Measures would also include the implementation of erosion and sediment control measures during construction, ensuring vehicle wash down and/or cement truck washout occur in a designated bunded area and the appropriate storage of any fuel, oils or other liquids on site, and preventing materials from entering drain inlets or waterways.

Potential surface water impacts of the proposal are expected to be mitigated by the safeguards detailed in this REF.

## **Justification and conclusion**

This REF assessed the proposal against the 'do nothing' option, and it was assessed that the proposal's benefits, of easing traffic congestion and improving safety, justify the potential impacts. The proposal is expected to assist in reducing the average delays on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road during peak hours and improve the overall average delays at intersections. The proposal objectives are met and balanced with the minimisation of environmental and social impacts, which are briefly discussed in Section 8.1. It is expected that potential impacts during construction and operation can be satisfactorily mitigated, managed or offset. For these reasons, the proposal is considered to be justified.

The proposal has been assessed against the principles of Ecologically Sustainable Development and is considered to be a 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. Refer to Section 8.2.1 for more information.

## Display of the Review of Environmental Factors (REF)

This REF is on display for comment between 6 November 2023 and 6 December 2023. You can access the document in the following ways:

### Internet

The documents are available to download as PDF files from the Transport for NSW website at [transport.nsw.gov.au/wakehurst](https://transport.nsw.gov.au/wakehurst)

### Printed copies

The documents can be viewed at the following locations:

- Northern Beaches Council – Mona Vale Office  
Village Park, 1 Park Street, Mona Vale NSW 2103
- Transport for NSW  
20-44 Ennis Road, Milsons Point NSW 2061

### Copies by request

Printed and electronic copies are available by contacting the project team on 132 701 noting that there may be a charge for hard copies or USB.

### Staffed displays

Thursday 16 November 2023, 3pm to 6pm - Oxford Falls Main Hall in Oxford Falls Peace Park, 1 Dreadnought Road, Oxford Falls NSW 2099

Saturday 18 November 2023, 10am to 2pm - Bilarong Community Centre in Bilarong Reserve, Wakehurst Parkway, North Narrabeen NSW 2101

## How can I make a submission?

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

North Place Project Team

231 Elizabeth Street Sydney NSW 2000

Email: [northplace@transport.nsw.gov.au](mailto:northplace@transport.nsw.gov.au)

Submissions must be received by 6 December 2023. Submissions will be managed in accordance with the [Transport for NSW Privacy Statement](#). A copy can be made available upon request.

## What happens next?

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

A report will be developed and made publicly available, which will respond to all submissions received and outline any changes to the project as a result of feedback received.

After this consideration, Transport will determine whether or not the proposal should proceed as proposed and will inform the community and stakeholders of this decision.

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

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# 1. Introduction

This chapter introduces the proposal and provides context for the environmental assessment. In introducing the proposal, the objectives and project development history are detailed and the purpose of the report provided.

## 1.1 Proposal identification

Transport for NSW (Transport) proposes to carry out road improvements, including intersection upgrades, along Wakehurst Parkway between Frenchs Forest Road, Frenchs Forest and Pittwater Road, North Narrabeen (the proposal).

Wakehurst Parkway is a key link that connects Warringah Road, Frenchs Forest and Pittwater Road, North Narrabeen in the Northern Beaches Local Government Area (LGA). Wakehurst Parkway extends across Guringai land, passing primarily through undeveloped land forming part of the Oxford Falls Conservation Area, and various nature reserves and public recreation areas. The more developed and populated sections along Wakehurst Parkway experience busier traffic. These sections include the southern section of the proposal, extending from Trefoil Creek to Oxford Falls Road, and the northern section of the proposal between Elanora Road and Mirrool Street. The road corridor intersects Middle Creek, a key tributary of Narrabeen Lagoon. Wakehurst Parkway and surrounding areas are managed by the Northern Beaches Council (Council) and Transport.

Transport's Easing Sydney's Congestion (ESC) program aims to support Sydney's growing population by delivering improvements to reduce traffic congestion on Sydney's main roads. Sections of Wakehurst Parkway are subject to traffic congestion and an extensive crash history. The proposal would help reduce crashes, improve access to Northern Beaches Hospital, and save commuters time by improving the overall efficiency of the wider road network.

Key features of the proposal include:

### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

- widening of Wakehurst Parkway southbound between Trefoil Creek and Dreadnought Road to provide an additional southbound lane (resulting in two continuous southbound lanes from Oxford Falls Road to Frenchs Forest Road)

### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

- widening of Wakehurst Parkway on the northbound approach to Dreadnought Road intersection for 170 metres to accommodate a longer shared through and left turn lane, a new concrete median and new shoulders
- widening of Wakehurst Parkway to the west of the northbound lane from Dreadnought Road to Oxford Falls Road to accommodate an additional lane in each direction. The northbound kerbside lane would become a dedicated left turn on approach to Oxford Falls Road intersection
- widening of Oxford Falls Road intersection's southwest corner to accommodate a new dedicated left turn lane from Wakehurst Parkway northbound
- extension of the existing right turn bay on Wakehurst Parkway southbound onto Dreadnought Road to provide additional storage capacity
- construction of a new left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road with a pedestrian island and signalised pedestrian crossing at the north-eastern corner of the intersection
- installation of a dedicated right turn bay from Wakehurst Parkway southbound onto Oxford Falls Road
- construction of a rock cutting wall on Wakehurst Parkway southbound, opposite Oxford Falls Road intersection to facilitate road widening
- installation of a new northbound bus bay north of Dreadnought Road intersection, on Wakehurst Parkway
- installation of a new southbound bus bay north of Dreadnought Road intersection, at the end of the new left turn slip lane onto Dreadnought Road
- installation of signalised pedestrian crossings on the western, eastern and southern legs of Dreadnought Road intersection.

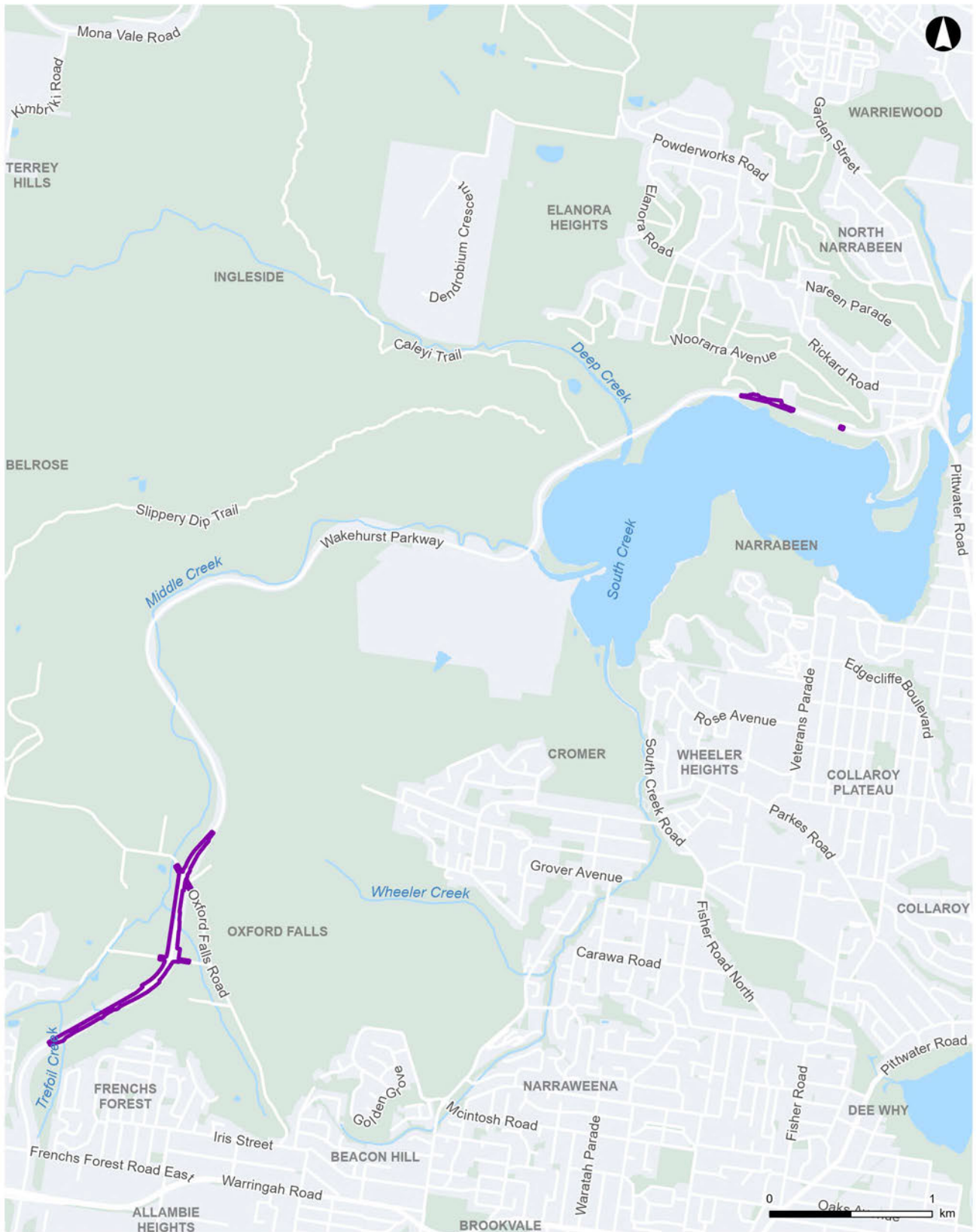
**Wakehurst Parkway from Elanora Road to Mirrool Street**


- localised widening of Wakehurst Parkway southbound at the Mirrool Street intersection to allow through traffic to pass vehicles waiting to turn right into Mirrool Street
- widening of Wakehurst Parkway northbound between Elanora Road and Mirrool Street to accommodate a new left turn bay
- conversion of the existing kerbside through lane on northbound approach to Elanora Road into a dedicated left turn lane
- banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left-in and left-out only.

The location of the proposal is shown in Figure 1-1 and a depiction of the proposal areas are provided in Figure 1-2 to Figure 1-5. Chapter 3 describes the proposal in more detail.

Construction of the proposal is planned to commence in mid to late 2024, with a staged approach.





Legend  
 Proposal area

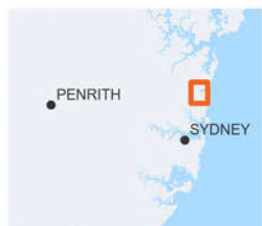
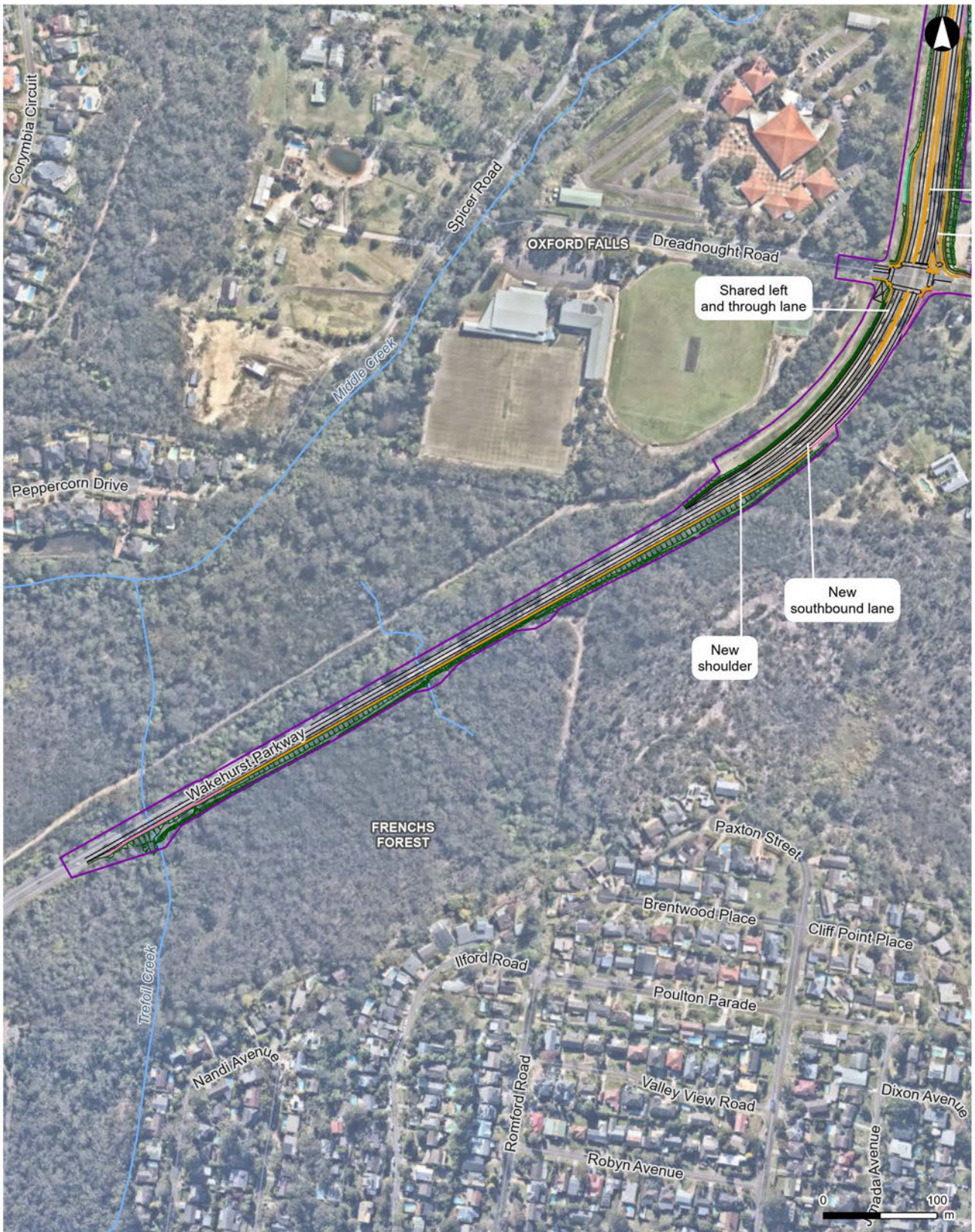


Figure 1-1, Location of the proposal

1:35,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 4, 2023





**Legend**

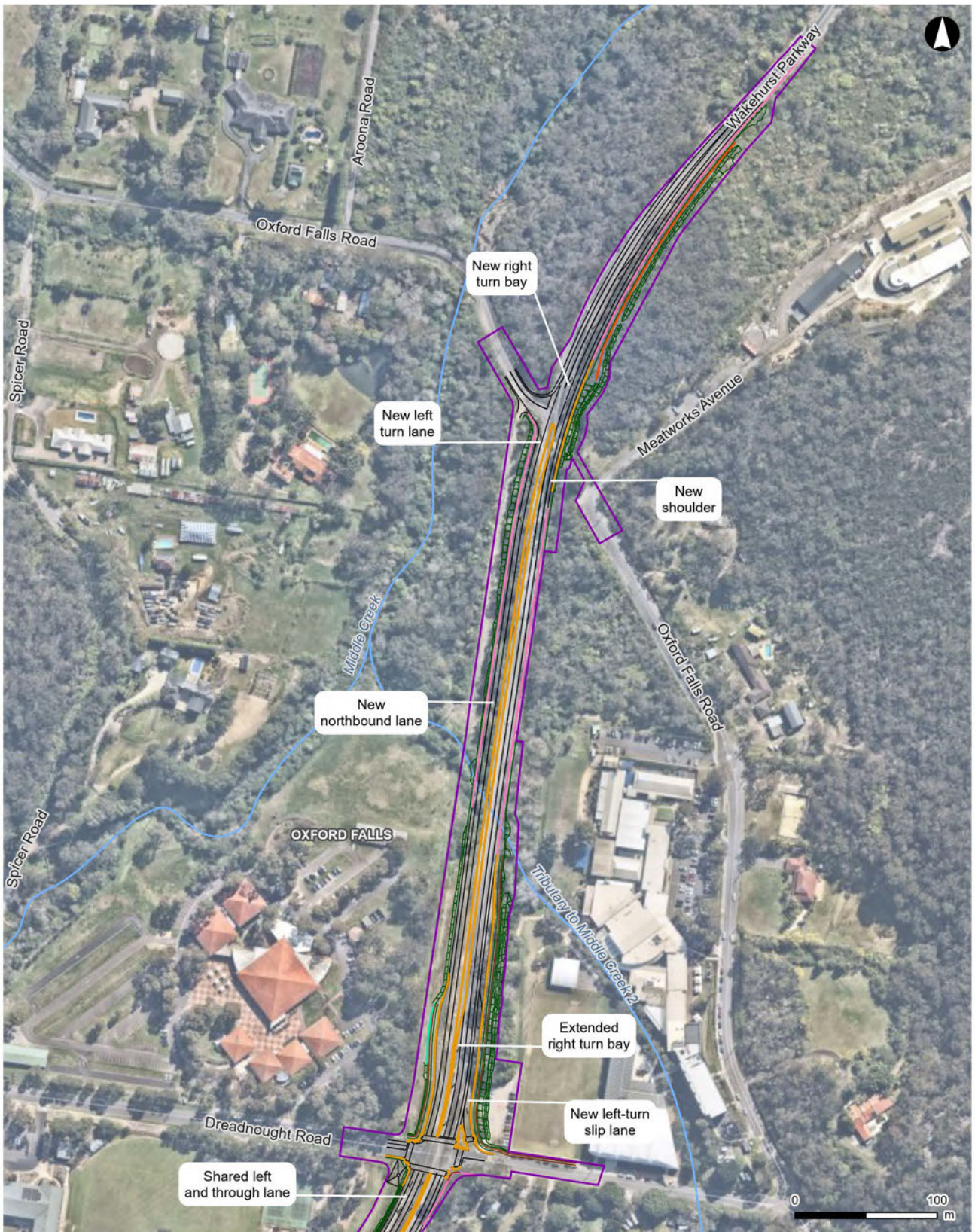
Proposal area	Proposal	Kerb/Median
Watercourse	Line marking	Road design
	Footpath	
	Safety barrier	
	Retaining wall	
	Earthworks	



1:5,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022



Figure 1-2, The proposal - Wakehurst Parkway from Trefoil Creek to Dreadnought Road



Legend

- |               |                |             |
|---------------|----------------|-------------|
| Proposal area | Proposal       | Earthworks  |
| Watercourse   | Line marking   | Kerb/Median |
|               | Footpath       | Road design |
|               | Safety barrier |             |
|               | Retaining wall |             |
|               | Rock cutting   |             |



1:4,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022



Figure 1-3, The proposal - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road



Legend

 Proposal area	 Proposal	 Kerb/Median
	 Line Marking	 Road design
	 Footpath	
	 Safety barrier	
	 Retaining wall	
	 Earthworks	

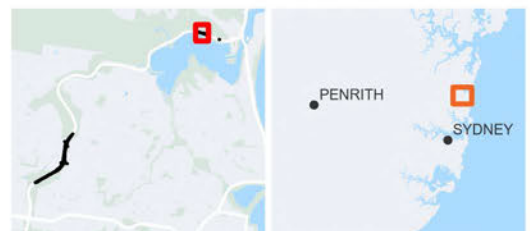
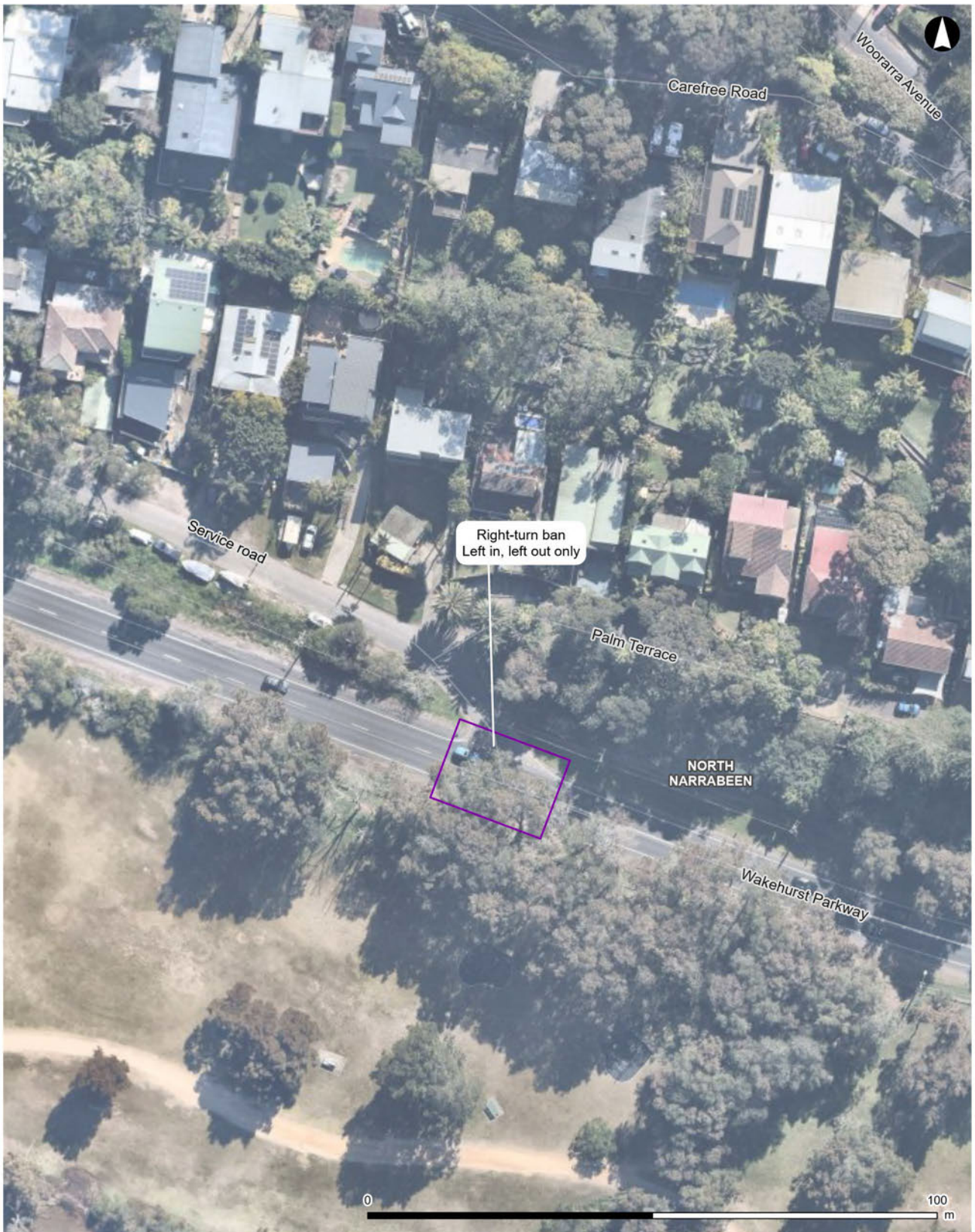


Figure 1-4  
The proposal - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 1 of 2)

1:2,000 at A4  
Coordinate System: GDA2020 MGA Zone 56  
Date issued: October 3, 2023  
Imagery: Nearmap 2022





Legend  
 [Purple box] Proposal area



Figure 1-5,  
 The proposal - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 2 of 2)

## 1.2 Purpose of the report

This Review of Environmental Factors (REF) has been prepared by Sustain JV on behalf of Transport. For the purposes of the work, Transport is the proponent and determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979 (NSW)* (EP&A Act).

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

The description of the proposed work and assessment of associated environmental impacts has been undertaken in the context of Section 171 of the Environmental Planning and Assessment Regulation 2021, the factors in *Guidelines for Division 5.1 assessments, (DPE 2022)*, *Roads and Related Facilities EIS Guideline* (DUAP 1996), the *Biodiversity Conservation Act, 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)* (EPBC Act).

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

- section 5.5 of the EP&A Act including that Transport examine and take into account, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval sought from the Minister for Planning 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 (BDAR)
- the significance of any impact on nationally-listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and if offsets are required and able to be secured.
- the potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

## 2. Need and options considered

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

### 2.1 Strategic need for the proposal

Wakehurst Parkway is a State Road and is a key arterial road, providing access from Pittwater Road at North Narrabeen, via the Northern Beaches Hospital on Warringah Road at Frenchs Forest through to Seaforth and the Spit Bridge. It forms a key part of an alternate route to the CBD from the upper part of the Northern Beaches. Wakehurst Parkway is served by the bus route 155, which runs between Frenchs Forest and Bayview, though this route does not currently stop within the limits of the proposal.

Traffic performance along Wakehurst Parkway is largely limited by single lane traffic in each direction, a low Level of Service (LoS) at the intersection with Dreadnought Road due to insufficient turning and through traffic capacity. The proposal would improve AM peak delays by introducing a dedicated southbound through lane, extending the southbound right turn lane onto Dreadnought Road, and adding a southbound left-turn slip lane onto Dreadnought Road. PM peak delays would be improved by increasing capacity for through traffic at Dreadnought Road intersection. These improvements would result in an overall improvement in the LoS.

Traffic performance at Oxford Falls Road would be improved by the proposed right turn lane for southbound motorists and an accompanying through lane to add capacity and reduce queuing.

At Mirrool Street, the provision of a passing lane for southbound motorists similarly would add capacity and reduce queuing on Wakehurst Parkway. A dedicated northbound left turn bay at this intersection would allow vehicles to decelerate and turn onto Mirrool Street without impeding the flow of traffic northbound on Wakehurst Parkway.

The broader network performance of Wakehurst Parkway is expected to deteriorate in its existing configuration in response to higher traffic volumes. The network performance data shows that proposal would improve traffic performance of the overall road network of Wakehurst Parkway between Frenchs Forest Road and Pittwater Road. In 2026, the proposal is expected to reduce travel time on Wakehurst Parkway by up to 1.5 minutes in the AM peak (southbound) and up to 0.6 minutes in the PM peak (northbound), as well as reduce the number of stops by up to 44 per cent. In 2046, the travel time reduction is estimated to be up to 5.7 minutes in the AM peak (southbound) and up to 2 minutes in the PM peak (northbound). The model shows that the number of stops would reduce by up to 76 per cent during the peak periods in 2046.

The proposal would introduce two new bus stops north of Dreadnought Road intersection to service the bus route 155, providing public transport access from Oxford Falls to the Northern Beaches Hospital, Frenchs Forest, and to Narrabeen Beach, Narrabeen. The proposal would provide overall improvements to public transport by reducing travel times for buses through the area. The proposal would also introduce new footpath pavement connections and signalised pedestrian crossings at Dreadnought Road. The proposal would provide on-road cycle lanes on approach to Dreadnought Road intersection and would provide shoulders which on-road cyclists could use. These measures would encourage the uptake of public and active transport for people travelling to schools, sport playing fields, and the C3 SYD Church and other land uses in this area. This would reduce the reliance on cars to access these areas and would reduce the associated vehicle movements along Wakehurst Parkway.

The proposal would improve safety for motorists and pedestrians along Wakehurst Parkway. There is an extensive crash history, with 82 recorded crashes between January 2017 and December 2021. By increasing the capacity for traffic flow through the addition of dedicated turning lanes, passing lanes, and through lanes, as well as banning right-turn movements into and out of the service lane near Palm Terrace, vehicle queueing would be reduced resulting in a lower risk of rear-end crashes and head-on collisions. Upgraded traffic signals at Dreadnought Road intersection would permit pedestrian crossings on all legs of the intersection, improving pedestrian safety. Vehicles entering Wakehurst Parkway from Elanora Road and Mirrool Street, as well as vehicles turning right into and out of Oxford Falls Road would benefit from improved lines of sight.

The proposal would reduce delays and improve safety for customers travelling through this location, and would meet the proposal objectives (refer to Section 2.3.1). The proposal would also address objectives for Sydney's important urban roads as outlined in:

- *Future Transport Strategy* (Transport for NSW, 2022)

- Our Greater Sydney 2056 Central City District Plan – connecting communities (Greater Sydney Commission, 2018)
- Greater Sydney Services and Infrastructure Plan (Transport for NSW, 2018)
- Staying Ahead: State Infrastructure Strategy 2022 – 2042 (Infrastructure NSW, 2022)
- 2026 Road Safety Action *Plan Toward zero trauma on NSW roads* (Transport for NSW, 2022)

### 2.1.1 Future Transport Strategy

The *Future Transport Strategy* replaces *Future Transport 2056: Shaping the Future*, which was published in 2018. The refreshed *Future Transport Strategy* (the Strategy) takes pivotal events within the last few years, including the COVID-19 pandemic, drought, bushfires and floods, into account alongside population growth and global megatrends.

Easing Sydney's Congestion Program Office supports the *Future Transport Strategy* as the NSW Government's vision for the next 40 years of transport in NSW. The vision is based on the following high-level outcomes:

- connecting our customers' whole lives
- successful places for communities
- enabling economic activity.

The purpose of the Strategy is to set out the strategic directions for Transport to achieve world-leading mobility for customers, communities, businesses and our people. It is part of a suite of government strategies, policies and plans that integrate and guide land use and transport planning across NSW.

The Strategy is supported by a suite of issue-specific and place-based plans that focus on the role transport plays in the land use, tourism and economic development of towns and cities. Plans under the Strategy include the *Greater Sydney Services and Infrastructure Plan*, *Regional NSW Services and Infrastructure Plan* and the *Road Safety Plan*.

A key priority and direction under the Strategy relates to movement and place; balancing the efficient movement of people and goods with the liveability of places on the transport network. A part of the vision for Greater Sydney is that of a 30-minute city where anyone can reach their nearest Metropolitan and Strategic centre within 30 minutes by public transport seven days a week. Enhanced centre to centre networks and movement corridors are identified as important to in achieving that vision.

The Strategy's vision is to support NSW achieve its economic potential by providing better and safer journeys for transport customers around Greater Sydney. A future direction under the Strategy is to optimise the network and make better use of existing infrastructure. Congestion in this Strategy is identified as contributing to increased travel times, reduced reliability and a poorer customer experience.

The proposal aligns with the outcomes sought in the *Future Transport Strategy* by improving safety, travel time and reliability for customers along Wakehurst Parkway.

### 2.1.2 Our Greater Sydney 2056 Central City District Plan – connecting communities

The Greater Sydney Commission's five District Plans support the implementation of *A Metropolis of Three Cities – the Greater Sydney Region Plan* at a District level.

These 20-year plans are a bridge between regional and local planning initiatives. The District Plans inform local environmental plans, community strategic plans and the assessment of planning proposals. The District Plans also help councils to plan and deliver for growth and change, and to align their local planning strategies to place-based outcomes.

The five district boundaries are:

- *Western City*: comprises of Blue Mountains, Hawkesbury, Penrith, Camden, Campbelltown, Fairfield, Liverpool and Wollondilly
- *Central City*: comprises of Blacktown, Cumberland, Parramatta and The Hills
- *Eastern City*: comprises of Bayside, Burwood, Canada Bay, Inner West, Randwick, Strathfield, Woollahra, Waverley and City of Sydney
- *North*: comprises of Hornsby, Hunter's Hill, Ku-ring-gai, Lane Cove, Northern Beaches, Mosman, Willoughby, Ryde and North Sydney
- *South*: comprises of Georges River, Canterbury-Bankstown and Sutherland.



The proposal is situated in the North District Plan area. A key related planning priority is planning for a city supported by infrastructure; including infrastructure adapting to meet future needs and the optimisation of infrastructure.

Improvements to Wakehurst Parkway align with the outcomes sought in the North District Plan by optimising the existing infrastructure to meet the current and future demand as well as improve safety outcomes, travel time and reliability through key intersections along Wakehurst Parkway.

### 2.1.3 Greater Sydney Services and Infrastructure Plan

The *Greater Sydney Services and Infrastructure Plan* forms part of the Future Transport Strategy and sets the customer outcomes for Greater Sydney for the movement of people and freight to meet customer needs and deliver responsive, innovative services. The Plan defines the network required to achieve the service outcomes under the Future Transport Strategy.

The *Greater Sydney Services and Infrastructure Plan* is a 40-year plan for transport in Greater Sydney. It is designed to support the land use vision for Greater Sydney. Building on State-wide transport outcomes identified in the Future Transport Strategy, the Plan establishes the specific outcomes transport customers in Greater Sydney can expect and identifies the policy, service and infrastructure initiatives to achieve these.

The focus of this Plan is to enable people and goods to move safely, efficiently and reliably around Greater Sydney, including having access to their nearest centre within 30 minutes of public transport, seven days a week. The transport system would also support the liveability, productivity and sustainability of places on our transport networks. To support this, investment is targeted towards new transport links, better utilising existing capacity, prioritising road space for more efficient vehicles and ensuring the transport network balances the efficient movement of people and goods and sustains the liveability and sustainability of centres it passes through.

The *Greater Sydney Services and Infrastructure Plan* customer outcomes include:

- convenient and responsive to customer needs
- sustaining and enhancing the liveability of our places
- connecting people and places in the growing city
- safely, efficiently and reliably moving people and goods
- accessible for all customers
- makes the best use of available resources and assets.

Of particular relevance to the proposal are outcomes relating to safety, efficiency and reliability for all transport users. The proposal aligns with the customer outcomes by improving safety outcomes, reducing travel times and improving reliability through key intersections along Wakehurst Parkway.

### 2.1.4 State Infrastructure Strategy 2022-2043: Staying Ahead

The *State Infrastructure Strategy 2022-2042* (the 2022 SIS) developed by Infrastructure NSW provides the NSW Government with advice about infrastructure policy and investment priorities, in line with the requirements of the *Infrastructure NSW Act 2011*.

The 2022 SIS is a 20 year investment plan for the NSW Government which identifies and prioritises the delivery of critical public infrastructure to drive productivity and economic growth. The assessment of the State's existing infrastructure capacity against forecasted population growth (which informed the *State Infrastructure Strategy 2018-2038* (Infrastructure NSW, 2018)) highlighted critical deficiencies in urban road capacity and provides strategic options to meet the challenges of population growth and substantial increases in freight volumes. The 2022 SIS recommendations take the strategic directions from the *State Infrastructure Strategy 2018-2038* and critical initiatives of the NSW Government to the next level and identify new challenges and opportunities for the NSW Government.

The proposal aligns with the 2022 SIS. One of the sector-based infrastructure directions for transport is to deliver efficient transport networks to support thriving cities, businesses and communities, including addressing existing inefficiencies and pinch points for freight and service networks and overcoming local constraints on the regional road network.

### 2.1.5 2026 Road Safety Action Plan

The *2026 Road Safety Action Plan* builds on the previous plan by focusing on stronger local government action, engagement and education programs and using technology in the fight to end road trauma. The 2026 Road Safety Action Plan features new targets to halve deaths and reduce serious injuries by 30 per cent on NSW roads by 2030.

The Plan delivers on five priority areas, two of which are relevant to the proposal:

- creating safer country roads and urban places – integrating road safety assessment, safety features and requirements into broader transport infrastructure planning and delivery to ensure early and ongoing assessment and management of road safety risks
- ensuring the safety of vulnerable and other at-risk road users – treating urban places and local streets with safety measures such as pedestrian crossing facilities, raised safety platforms, and safer speed settings particularly 30 kilometre per hour and 40 kilometre per hour zones.

The Plan also aligns with *Future Transport Strategy*, the NSW Government’s transport planning strategy, which aims to ensure safety is designed into the transport network as NSW grows.

The proposal is consistent with the intent and priorities of this Plan as it would improve the safety for customers along Wakehurst Parkway.

## 2.2 Limitations of existing infrastructure

Existing issues and limitations of Wakehurst Parkway include:

- delays for traffic travelling through Wakehurst Parkway and Dreadnought Road intersection in the morning and evening peaks. The high through traffic volumes on Wakehurst Parkway and right turn traffic from Dreadnought Road (east) contributes to substantial delays at this intersection in both AM and PM peak scenarios
- delays for general traffic travelling southbound on Wakehurst Parkway towards the intersection with Dreadnought Road during both AM and PM peaks. The left turn traffic onto Dreadnought Road (east) shares a lane with through traffic which does not provide enough storage capacity for left turn vehicles
- limited infrastructure for pedestrians at Wakehurst Parkway and Dreadnought Road intersection. Pedestrian facilities are limited to one signalised pedestrian crossing on the northern leg of the intersection
- limited infrastructure for public transport. There are no bus stops located within the proposal area
- limited infrastructure for cyclists along Wakehurst Parkway. There is a short on-road dedicated cycle lane on the northbound approach to Dreadnought Road intersection, and no other cycling facilities provided within the proposal area
- shared southbound lane on Wakehurst Parkway used by right turn traffic onto Oxford Falls Road, causing delays for through traffic travelling south
- shared northbound lane on Wakehurst Parkway used by left turn traffic onto Oxford Falls Road, causing delays for through traffic travelling north
- shared southbound lane on Wakehurst Parkway used by right turn traffic onto Mirrool Street, causing delays for through traffic travelling south
- shared northbound lane on Wakehurst Parkway used by left turn traffic onto Mirrool Street, causing delays for through traffic travelling north
- poor visibility for turning traffic travelling from Elanora Road onto Wakehurst Parkway
- poor visibility for turning traffic travelling from Oxford Falls Road onto Wakehurst Parkway
- crash analysis over a five-year period suggests queuing, merge and diverge decision points, and line of sight through the intersections may be a contributing factor to vehicle crashes
- there are frequent flooding events that occur along Wakehurst Parkway. Closures along the road corridor can occur up to seven times per year.

The limitations of the existing infrastructure demonstrate a clear need to improve road safety, ease traffic congestion and improve the consistency of travel times for motorists, particularly during peak periods.

While flooding is an existing concern, it is currently being addressed through a separate project by Northern Beaches Council that aims to enhance flood immunity on Wakehurst Parkway, among other surface water and flood risk improvement works. The Northern Beaches Council project aims to improve the current flood frequency. The flood risk improvement works do not form part of the scope of this proposal.

## 2.3 Proposal objectives and development criteria

### 2.3.1 Proposal objectives

The objectives of the proposal include:

- improve network efficiency and increase utilisation of Wakehurst Parkway corridor
- improve road safety along the corridor with targeted reduction in crashes in key cluster areas
- provide capacity for future traffic growth
- improved active transport accessibility
- encourage mode shift to public and active transport.

### 2.3.2 Development criteria

The development criteria for the proposal include:

- constructability including impacts to utilities and services
- minimise land use and community impacts
- minimise property acquisition
- minimise environmental impacts.

### 2.3.3 Urban design objectives

The urban design objectives for the proposal include:

- ensure the design and character of the proposal is integrated with the adjoining landscape and urban conditions
- provide connectivity between areas beyond the road corridor and improve definition of streets and landmarks
- ensure the design, construction and management of the project responds to the living environment
- unlock potential for urban regeneration, landscape improvements and active transport upgrades along the project corridor
- embed sustainability considerations into the design and delivery of the project in order to minimise environmental and social impacts.

Urban design objectives were considered throughout design development to ensure the integration of the proposal with the surrounding landscape.

## 2.4 Alternatives and options considered

### 2.4.1 Methodology for selection of preferred option

Transport investigated several options to upgrade key areas of Wakehurst Parkway to address existing congestion issues. The options at each key area were considered against the proposal objectives and development criteria. These options are detailed below in Section 2.4.2 and an options analysis is provided in Section 2.4.3.

### 2.4.2 Identified options

The options identified for each area of the proposal are detailed below. For ease of reference, these areas have been assigned the letters, A, B, C and D within this section of the report.

**Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Area A)**

- **Option A1 'Do nothing'**: Involves doing no works to the road corridor
- **Option A2 'The proposal'**: As described in Chapter 1
- **Option A3**: Widening Wakehurst Parkway to the west between Trefoil Creek and Dreadnought Road for about 800 metres to provide an additional southbound lane, a shoulder and a safety barrier. This would result in two southbound through lanes between Dreadnought Road and Frenchs Forest Road.
- **Option A4**: Widening Wakehurst Parkway to the west between Frenchs Forest Road and Dreadnought Road for about 1480 metres to provide an additional northbound lane and a shoulder. This would provide two northbound lanes between Frenchs Forest Road and Dreadnought Road.

The characteristics of Options A2, A3 and A4 are summarised in Table 2-1 and illustrated in Figure 2-1 and Figure 2-2.

Table 2-1: Overview and comparison of options – Area A

Road design features	Option A1	Option A2	Option A3	Option A4
Widening Wakehurst Parkway to the east between Trefoil Creek and Dreadnought Road for about 700 metres to provide an additional southbound lane and shoulder		✓		
Two southbound through lanes between Dreadnought Road and Frenchs Forest Road		✓	✓	
Two northbound through lanes between Dreadnought Road and Frenchs Forest Road				✓
Widening of Wakehurst Parkway to the west between Trefoil Creek and Dreadnought Road for about 800 metres to provide an additional southbound lane, a shoulder and a safety barrier			✓	
Widening of Wakehurst Parkway to the west between north of Frenchs Forest Road and south of Dreadnought Road for about 1480 metres to provide an additional northbound lane and a shoulder				✓

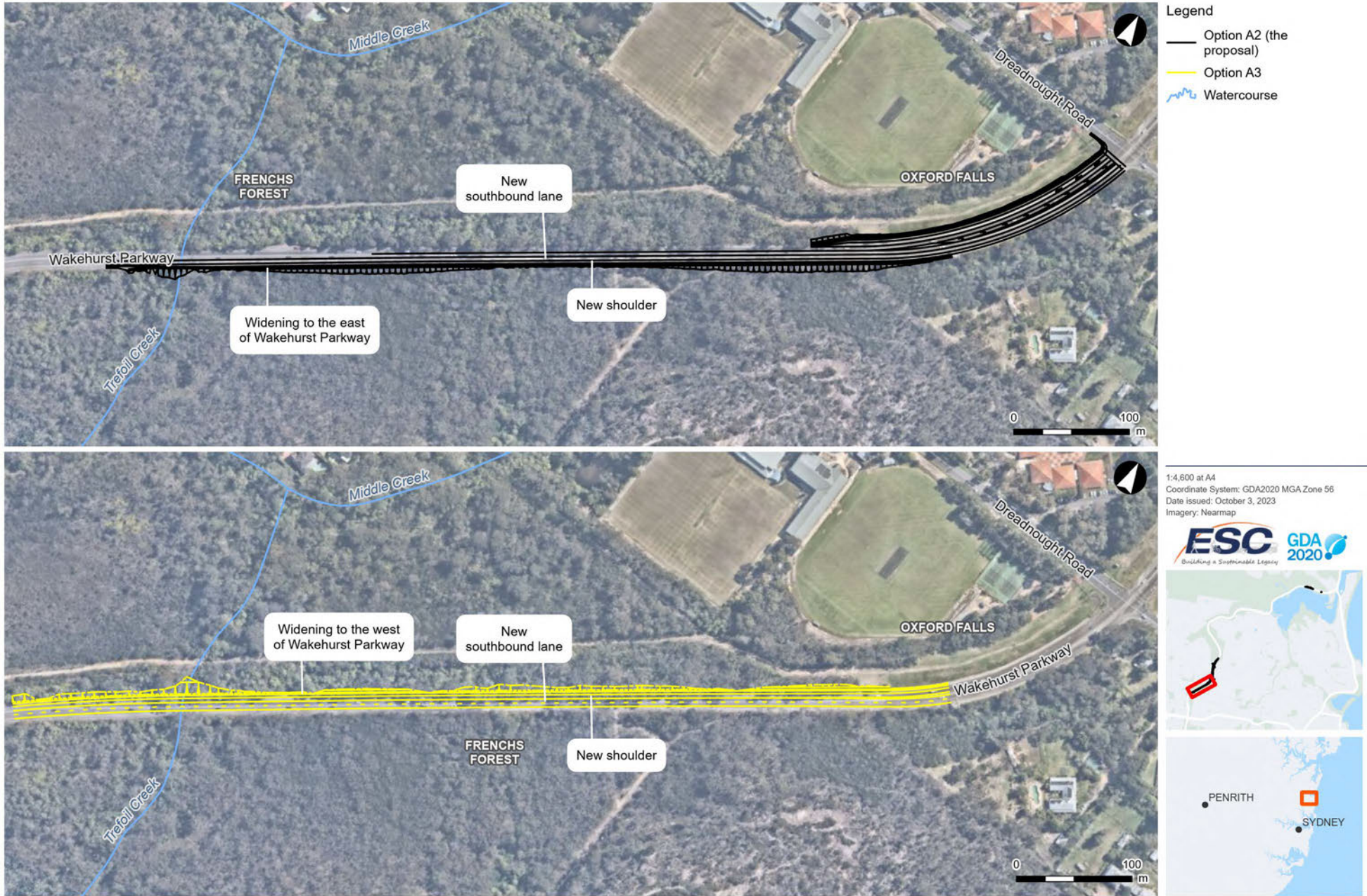


Figure 2-1, Wakehurst Parkway from Trefoil Creek to Dreadnought Road - Options A2 to A3



Figure 2-2, Wakehurst Parkway from Trefoil Creek to Dreadnought Road - Option A4

**Wakehurst Parkway and Dreadnought Road intersection (Area B)**

Four options were considered as a part of the proposal including:

- **Option B1 ‘Do nothing’:** Involves doing no works to the existing intersection
- **Option B2 ‘The proposal’:** As described in Chapter 1.
  - during development of the design of Wakehurst Parkway northbound duplication from Dreadnought Road to Oxford Falls Road, an option was considered whereby the kerbside lane of the northbound duplication terminated before the left turn slip lane to Oxford Falls Road, meaning that the two were separate elements. As the design progressed, the decision was taken to continue the kerbside lane of the northbound duplication all the way to Oxford Falls Road, with the section of this lane on the approach becoming a ‘trapped’ left turn lane. It was considered that this design would maximise use of the kerbside lane and improve traffic capacity through the area.
- **Option B3:** Involves the following works:
  - widening of Wakehurst Parkway southbound for about 210 metres to accommodate an extension of the existing southbound dual lane on approach to Dreadnought Road intersection
  - construction of new left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road with a pedestrian island and unsignalised pedestrian crossing
  - widening of Wakehurst Parkway northbound, north of Dreadnought Road intersection, for about 120 metres to accommodate two northbound lanes. The two lanes would then merge back to one northbound lane
  - widening of Dreadnought Road westbound for about 65 metres to accommodate one westbound left turn and through lane and one dedicated right turn lane on approach to Dreadnought Road intersection
  - conversion of the kerbside lane on the northbound approach to Dreadnought Road intersection from a left turn lane to a shared left and through lane
  - installation of a new northbound bus bay north of Dreadnought Road intersection, on Wakehurst Parkway
  - installation of a new southbound bus bay north of Dreadnought Road intersection, at the end of the new left turn slip lane onto Dreadnought Road
  - installation of signalised pedestrian crossings on the western, eastern and southern legs of Dreadnought Road intersection
- **Option B4 ‘No bus stops, no left turn slip lane to Dreadnought Road’:** Same as Option B3 without the southbound left turn slip lane onto Dreadnought Road. There is no allowance for bus stops in this option.

The characteristics of each option are summarised and compared in Table 2-2 and intersection layouts are illustrated in Figure 2-3.

Table 2-2: Overview and comparison of options – Area B

Road design features	Option B1	Option B2	Option B3	Option B4
Widening Wakehurst Parkway on the northbound approach to Dreadnought Road intersection for about 210 metres to accommodate a longer shared through and left turn lane, a new raised median and shoulder		✓		
Widening Wakehurst Parkway southbound from Dreadnought Road to Oxford Falls Road to accommodate an extension of the existing southbound dual lane on approach to Dreadnought Road intersection		✓		
Widening Wakehurst Parkway northbound, north of Dreadnought Road intersection, to accommodate two northbound lanes. The two lanes would then merge back to one northbound lane			✓	✓

Road design features	Option B1	Option B2	Option B3	Option B4
Widening Wakehurst Parkway southbound for about 210 metres to accommodate an extension of the existing southbound dual lane on approach to Dreadnought Road intersection			✓	✓
Widening Dreadnought Road westbound for about 65 metres to accommodate one westbound left turn and through lane and one dedicated right turn lane on approach to Dreadnought Road intersection			✓	✓
Conversion of the kerbside lane on the northbound approach to Dreadnought Road intersection from a left turn lane to a shared left and through lane		✓	✓	✓
Installation of a median along Wakehurst Parkway between Dreadnought Road and Oxford Falls		✓		
Extension of the existing right turn bay on Wakehurst Parkway southbound onto Dreadnought Road to provide additional storage capacity		✓		
Construction of new left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road with a pedestrian island and a pedestrian crossing at the north-eastern corner of the intersection		✓	✓	
Provision of a shoulder to the northbound and southbound kerbside lanes on Wakehurst Parkway between Dreadnought Road to Oxford Falls Road to facilitate on-road cycling		✓		
Addition of a new northbound bus bay north of Dreadnought Road intersection, on Wakehurst Parkway		✓	✓	
Addition of a new southbound bus bay north of Dreadnought Road intersection, at the end of the new left turn slip lane onto Dreadnought Road		✓	✓	
Installation of the signalised pedestrian crossings on the western, eastern and southern legs of Dreadnought Road intersection		✓	✓	✓



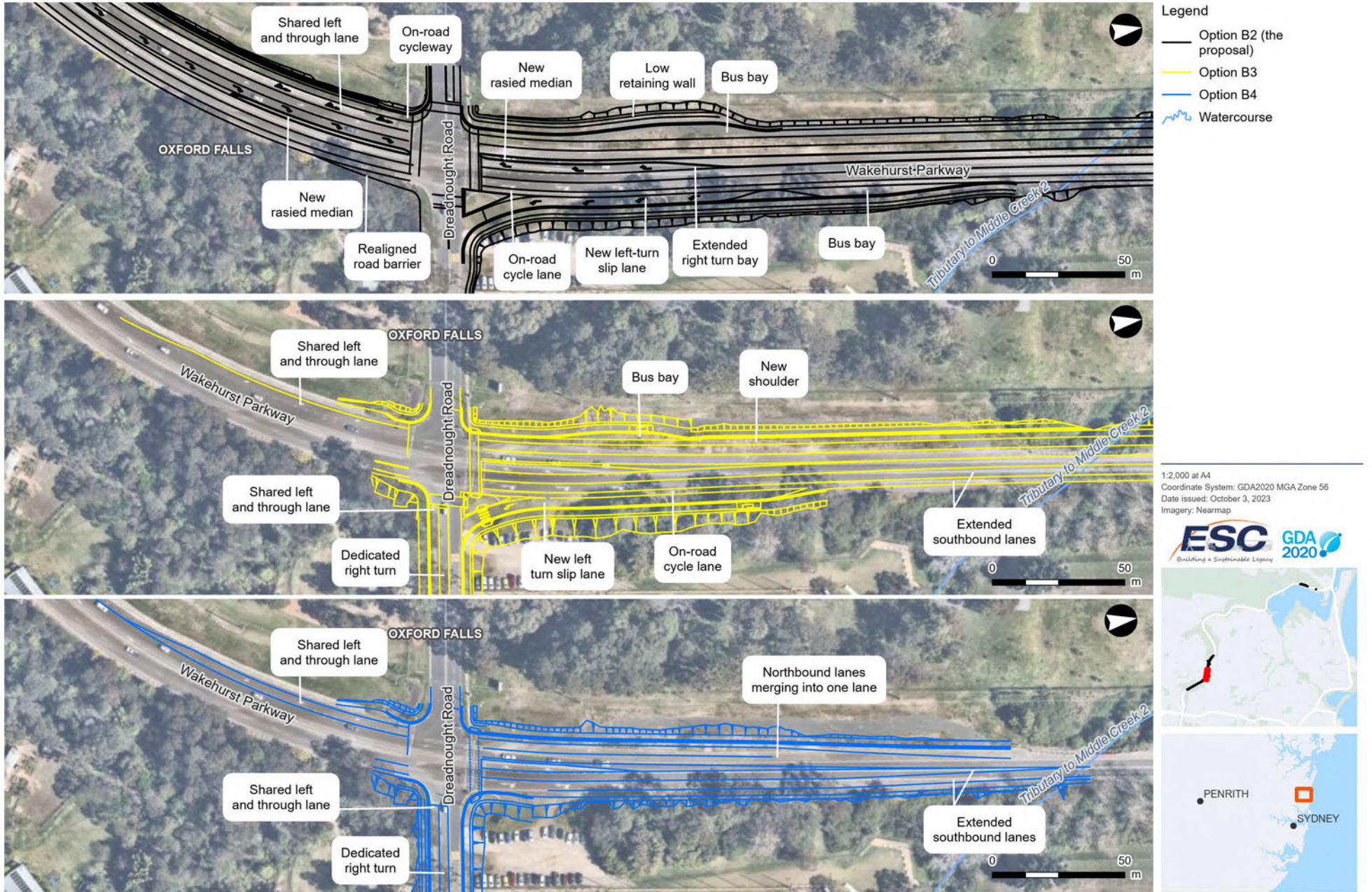


Figure 2-3, Wakehurst Parkway and Dreadnought Road intersection - Options B2 to B4

**Wakehurst Parkway and Oxford Falls Road intersection (Area C)**

- **Option C1 ‘Do nothing’:** Involves doing no work to the existing intersection
- **Option C2 ‘The proposal’:** As described in Chapter 1
- **Option C3:** Conversion of Oxford Falls Road intersection into a signalised intersection.

Details of each option are summarised and compared in Table 2-3 and the intersection layout for Option C2 is shown in Figure 2-4. Given that the volumes of traffic generated by Oxford Falls Road during options assessment identified that they are not sufficient to justify the traffic signals proposed by Option C3. As such, design drawings for this option were not developed.

Table 2-3: Overview and comparison of options – Area C

Road design features	Option C1	Option C2	Option C3
Conversion of the northbound kerbside lane on Wakehurst Parkway to a dedicated left turn on approach to Oxford Falls Road intersection		✓	
Widening of Oxford Falls Road westbound for about 40 metres to accommodate the new dedicated left turn from Wakehurst Parkway northbound		✓	
Installation of a new right turn bay from Wakehurst Parkway southbound onto Oxford Falls Road		✓	
Installation of a new line-marked median north of Oxford Falls Road intersection		✓	
Conversion of Oxford Falls Road intersection into a signalised intersection			✓

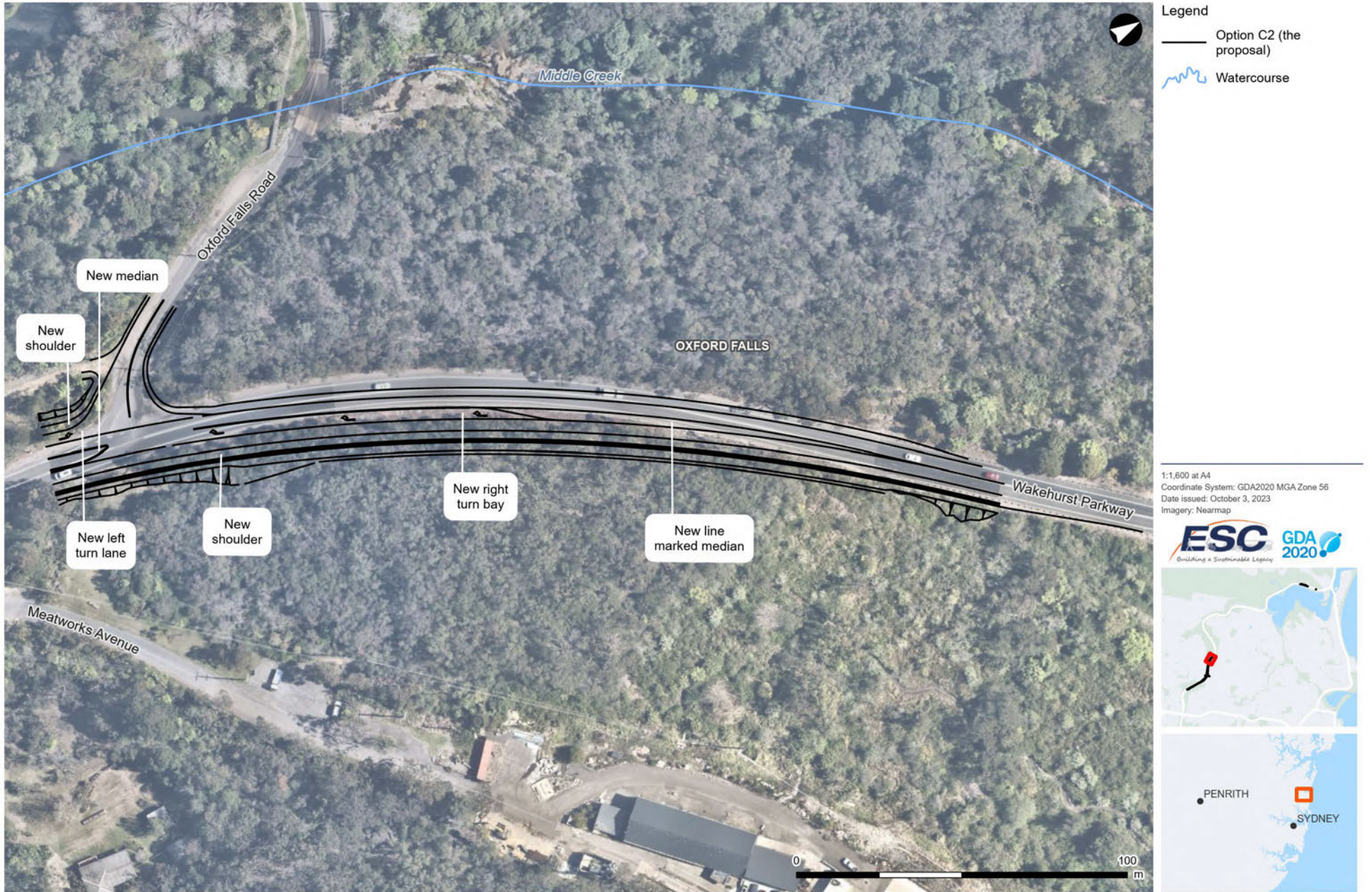


Figure 2-4, Wakehurst Parkway and Oxford Falls Road intersection - Option C2

**Wakehurst Parkway from Elanora Road to Mirrool Street (Area D)**

- **Option D1 ‘Do nothing’:** Involves doing no work to the existing intersection
- **Option D2 ‘The proposal’:** As described in Chapter 1
- **Option D3:** Provision of a roundabout at the intersection of Wakehurst Parkway and Elanora Road. Banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection of Wakehurst Parkway, converting the intersection to left-in and left-out only.
- **Option D4:** Provision of a roundabout at the intersection of Wakehurst Parkway and Mirrool Street. Banning right turn movements from Elanora Road onto Wakehurst Parkway, redirecting traffic wishing to travel southbound on Wakehurst Parkway to the Mirrool Street roundabout where traffic can perform a U-turn. Banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection of Wakehurst Parkway, converting the intersection to left-in and left-out only.
- **Option D5:** Involves the following work:
  - maintain the existing operation of the Elanora Road and Mirrool Street intersections, however adopting a seagull intersection layout compliant with Austroads design standards (similar to the entrance to the nearby Sports Academy)
  - widening both sides of Wakehurst Parkway for about 800 metres from west of Elanora Road to east of Mirrool Street
  - provision of raised medians to separate the eastbound and westbound Wakehurst Parkway lanes from about 420 metres west of the Elanora Road intersection to the Mirrool Street intersection
  - provision of dedicated right turn bays from Wakehurst Parkway westbound onto Mirrool Street and Elanora Road
  - provision of a protected right turn and acceleration lane from Elanora Road to Wakehurst Parkway, allowing for about 405 metres of acceleration and merging distance for Elanora Road traffic joining the southbound lane on Wakehurst Parkway.

The characteristics of each option are summarised and compared in Table 2-4 and intersection layouts are illustrated in Figure 2-5 and Figure 2-6.

**Table 2-4: Overview and comparison of options – Area D**

Road design features	Option D1	Option D2	Option D3	Option D4	Option D5
Localised widening of Wakehurst Parkway southbound at the Mirrool Street intersection for about 95 metres to allow through traffic to pass vehicles waiting to turn right onto Mirrool Street		✓			
Widening of Wakehurst Parkway northbound between Elanora Road and Mirrool Street to accommodate a new left turn bay, about 80 metres in length		✓			
Conversion of the existing kerbside through lane on eastbound approach to Elanora Road into a dedicated left turn lane		✓			
Adjustment of the give way line on Elanora Road about 2.5 metres further forward into Wakehurst Parkway to improve sight distance and construction of a new concrete median		✓			
Construction of a low retaining wall on Wakehurst Parkway southbound, opposite Mirrool street intersection		✓			

Road design features	Option D1	Option D2	Option D3	Option D4	Option D5
Banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left-in and left-out only		✓	✓	✓	✓
Installation of a footpath between Elanora Road and Mirrool Street on the northern side of Wakehurst Parkway		✓			
Provision of a roundabout at the intersection of Wakehurst Parkway and Elanora Road			✓		
Provision of a roundabout at the intersection of Wakehurst Parkway and Mirrool Street				✓	
Banning right turn movements from Elanora Road onto Wakehurst Parkway, redirecting traffic wishing to travel southbound on Wakehurst Parkway to the Mirrool Street roundabout where traffic can perform a U-turn				✓	
Adopt a seagull intersection layout at the Elanora Road and Mirrool Street intersections					✓
Widening on both sides of Wakehurst Parkway for about 800 metres from west of Elanora Road to east of Mirrool Street					✓
Provision of raised medians to separate the northbound and southbound Wakehurst Parkway lanes from about 420 metres west of the Elanora Road intersection to the Mirrool Street intersection					✓
Provision of dedicated right turn bays from Wakehurst Parkway southbound onto Mirrool Street and Elanora Road					✓
Provision of a protected right turn and acceleration lane from Elanora Road to Wakehurst Parkway, allowing for about 405 metres of acceleration and merging distance for Elanora Road traffic joining the southbound lane on Wakehurst Parkway					✓



Figure 2-5, Wakehurst Parkway from Elanora Road to Mirrool Street - Options D2 to D4



Figure 2-6, Wakehurst Parkway from Elanora Road to Mirrool Street - Option D5

### 2.4.3 Analysis of options

An analysis of options for the improvements along Wakehurst Parkway is provided in Table 2-5: to Table 2-8: below. The analysis of options was informed by the preliminary Environmental, Planning and Sustainability Investigation Report (TfNSW, 2022), traffic modelling and crash data from 2017 to 2021, and preliminary ecological surveys carried out for the Wakehurst Parkway corridor between Frenchs Forrest and Narrabeen (October 2022 and January 2023). The options were assessed against the project objectives and design criteria as set out in Section 2.3.



Table 2-5: Analysis of options - Area A

Objective/criteria	Option A1 'Do nothing'	Option A2	Option A3	Option A4
<p><b>Proposal objective:</b> Improve network efficiency and increase utilisation of Wakehurst Parkway corridor</p>	<p>Option A1 would not improve network efficiency or increase utilisation of Wakehurst Parkway.</p> <p><b>Does not meet objective.</b></p>	<p>Option A2 would improve network efficiency and increase utilisation of the corridor by increasing capacity for future traffic growth.</p> <p><b>Meets objective.</b></p>	<p>Same as Option A2.</p> <p><b>Meets objective.</b></p>	<p>Same as Option A2, except this option would provide greater traffic benefit and capacity due to the increased widening of Wakehurst Parkway.</p> <p><b>Meets objective.</b></p>
<p><b>Proposal objective:</b> Improve road safety along the corridor with targeted reduction in crashes in key cluster areas</p>	<p>Option A1 would not improve road safety.</p> <p><b>Does not meet objective.</b></p>	<p>Option A2 would improve network efficiency of the corridor which, along with improvements to lines of sight and merge points, would improve road safety.</p> <p><b>Meets objective.</b></p>	<p>Same as Option A2, except Option A3 would introduce reverse curves on either end of the widening, presenting a safety risk for vehicles on Wakehurst Parkway.</p> <p><b>Meets objective.</b></p>	<p>Same as Option A2.</p> <p><b>Meets objective.</b></p>
<p><b>Proposal objective:</b> Provide capacity for future traffic growth</p>	<p>Option A1 would not provide capacity for future traffic growth.</p> <p><b>Does not meet objective.</b></p>	<p>Option A2 would provide additional capacity to support future traffic growth through the provision of an additional southbound lane.</p> <p><b>Meets objective.</b></p>	<p>Same as Option A2.</p> <p><b>Meets objective.</b></p>	<p>Same as Option A2.</p> <p><b>Meets objective.</b></p>
<p><b>Proposal objective:</b> Improved active transport accessibility</p>	<p>Option A1 would not provide new cyclist or pedestrian facilities along Wakehurst Parkway.</p> <p><b>Does not meet objective.</b></p>	<p>Option A2 provides a shoulder along both the southbound and northbound lanes, which can facilitate on-road cycling.</p> <p><b>Meets objective.</b></p>	<p>Option A3 provides a shoulder alongside the northbound lane, facilitating on-road cycling.</p> <p><b>Meets objective.</b></p>	<p>Same as Option A3.</p> <p><b>Meets objective.</b></p>

Objective/criteria	Option A1 'Do nothing'	Option A2	Option A3	Option A4
<b>Proposal objective:</b> Encourage mode shift to public and active transport	Option A1 would not provide new cyclist, pedestrian or bus facilities along Wakehurst Parkway.  <b>Does not meet objective.</b>	Option A2 facilitates on-road cycling through the provision of a shoulder along both of the southbound and northbound lanes. This option encourages a mode shift to active transport.  <b>Meets objective.</b>	Same as Option A2.  <b>Meets objective.</b>	Same as Option A2.  <b>Meets objective.</b>
<b>Development criteria:</b> Constructability including impacts to utilities and services	Option A1 avoids construction work, ensuring no impacts to utilities, services, road users, or residents.  <b>Meets criteria.</b>	Under Option A2, impacts to utilities would include work on drainage and cross drainage elements. Disruptions during construction would be largely limited to Wakehurst Parkway southbound.  <b>Partially meets criteria.</b>	Similar to Option A2, except Option A3 would cause disruption to both the northbound and southbound lanes of Wakehurst Parkway during construction.  <b>Partially meets criteria.</b>	Same as Option A2.  <b>Partially meets criteria.</b>
<b>Development criteria:</b> Minimise land use and community impacts	Option A1 would not impact existing land use or generate impacts to the community.  <b>Meets criteria.</b>	Road closures during construction may impact community access to trails or parking areas.  No permanent land use impacts are anticipated.  <b>Partially meets criteria.</b>	Same as Option A2.  <b>Partially meets criteria.</b>	Same as Option A2.  <b>Partially meets criteria.</b>
<b>Development criteria:</b> Minimise property acquisition	No property acquisition would be required under Option A1 as there would be no construction or changes to Wakehurst Parkway.  <b>Meets criteria.</b>	Option A2 would not require property acquisition.  <b>Partially meets criteria.</b>	Same as Option A2.  <b>Meets criteria.</b>	Same as Option A2.  <b>Meets criteria.</b>
<b>Development criteria:</b> Minimise environmental impacts	No environmental impacts would result from Option A1 as no development would occur.  <b>Meets criteria.</b>	Environmental impacts are expected from Option A2, such as traffic, noise and vibration, air quality, tree removal and erosion and runoff. Option A2 requires about 7391 m <sup>2</sup> of vegetation	Similar to Option A2, except Option A3 would require about 5038 m <sup>2</sup> of vegetation clearing on the eastern side of Wakehurst Parkway.	Similar to Option A2, except Option A4 would require about 1.34 ha of vegetation clearing on the eastern side of Wakehurst Parkway.

Objective/criteria	Option A1 'Do nothing'	Option A2	Option A3	Option A4
		clearing on the western side of Wakehurst Parkway. Environmental impacts would be managed throughout construction and minimised where possible.  <b>Partially meets criteria.</b>	<b>Partially meets criteria.</b>	<b>Partially meets criteria.</b>

Table 2-6: Analysis of options – Area B

Objective/criteria	Option B1 'Do nothing'	Option B2	Option B3	Option B4
<b>Proposal objective:</b> Improve network efficiency and increase utilisation of Wakehurst Parkway corridor	Option B1 would not improve network efficiency or increase utilisation of Wakehurst Parkway.  <b>Does not meet objective.</b>	Option B2 would provide improvements to the LoS and delays in the future AM and PM peak periods for this intersection through traffic signal upgrades, providing additional storage for traffic travelling through the intersection, and providing additional storage for traffic travelling along Wakehurst Parkway between Oxford Falls Road and Dreadnought Road.  <b>Meets objective.</b>	Option B3 would provide improvements to the LoS and delays in the future AM and PM peak periods for this intersection through traffic signal upgrades and providing additional storage for traffic travelling through the intersection.  <b>Meets objective.</b>	Option B4 would provide improvements to the LoS and delays in the future AM and PM peak periods for this intersection through traffic signal upgrades.  <b>Meets objective.</b>
<b>Proposal objective:</b> Improve road safety along the corridor with targeted reduction in crashes in key cluster areas	Option B1 would not improve road safety.  <b>Does not meet objective.</b>	Option B2 would improve traffic flow at this intersection and in turn reduce crash frequency.  This option would increase safety for pedestrians with the provision of signalised pedestrian crossings on the eastern, western and southern legs of the intersection and a signalised pedestrian across the new left turn slip lane.	Option B3 would improve traffic flow and in turn reduce crash frequency.  This option would increase safety for pedestrians with the provision of signalised pedestrian crossings on the eastern, western and southern legs of the intersection and an unsignalised pedestrian crossing across the new left turn slip lane.  <b>Meets objective.</b>	Option B4 would improve traffic flow and in turn reduce the risk of rear end crashes. This would reduce crash frequency.  This option would increase safety for pedestrians with the provision of signalised pedestrian crossings on the eastern, western and southern legs of the intersection.  <b>Meets objective.</b>

Objective/criteria	Option B1 'Do nothing'	Option B2	Option B3	Option B4
		<b>Meets objective.</b>		
<b>Proposal objective:</b> Provide capacity for future traffic growth	Option B1 would not provide capacity for future traffic growth.  <b>Does not meet objective.</b>	Option B2 would provide greater capacity to support future traffic growth along Wakehurst Parkway between Oxford Falls Road and Dreadnought Road.  <b>Meets objective.</b>	Same as Option B2.  <b>Meets objective.</b>	Same as Option B2.  <b>Meets objective.</b>
<b>Proposal objective:</b> Improved active transport accessibility	Option B1 would not provide new cyclist or pedestrian facilities along Wakehurst Parkway.  <b>Does not meet objective.</b>	Option B2 provides signalised pedestrian crossings on the eastern, western and southern legs of the intersection and across the new left turn slip lane, improving accessibility for pedestrians.  Provision of a shoulder on the southbound and northbound lanes from Dreadnought Road to Oxford Falls Road facilitates on-road cycling.  <b>Meets objective.</b>	Option B3 provides signalised pedestrian crossings on the eastern, western and southern legs of the intersection and an unsignalised pedestrian crossing across the new left turn slip lane, improving accessibility for pedestrians.  Provision of a shoulder on the southbound and northbound lanes, north of the intersection, facilitates on-road cycling.  <b>Meets objective.</b>	Same as Option B3, except without the unsignalised pedestrian crossing across the new left turn slip lane.  <b>Meets objective.</b>
<b>Proposal objective:</b> Encourage mode shift to public and active transport	Option B1 would not provide new cyclist, pedestrian or bus facilities along Wakehurst Parkway.  <b>Does not meet objective.</b>	Option B2 allows for additional pedestrian crossings, promoting and encouraging active pedestrian movement. This option also facilitates on-road cycling through the provision of a shoulder to the southbound and northbound lanes.  The provision of a bus bay and bus stop on both sides of Wakehurst Parkway allows for greater accessibility to public transport.	Option B3 allows for additional pedestrian crossings, promoting and encouraging active pedestrian movement. This option also facilitates on-road cycling through the provision of a shoulder to the southbound and northbound lanes.  The provision of a bus bay and stop on both sides of Wakehurst Parkway allows for greater accessibility to public transport.	Similar to Option B3. This option provides the same benefits in relation to encouraging mode shift to active transport as Option B3.  However, Option B4 does not encourage mode shift to public transport as there is no allowance for bus stops.  <b>Meets objective.</b>

Objective/criteria	Option B1 'Do nothing'	Option B2	Option B3	Option B4
		<b>Meets objective.</b>	<b>Meets objective.</b>	
<b>Development criteria:</b> Constructability including impacts to utilities and services	Option B1 avoids construction work, ensuring no impacts to utilities, services, road users, or residents.  <b>Meets criteria.</b>	Under Option B2, there are potential impacts to existing utilities including overhead and underground power, communications and high-pressure gas assets.  <b>Partially meets criteria.</b>	Same as Option B2.  <b>Partially meets criteria.</b>	Same as Option B2.  <b>Partially meets criteria.</b>
<b>Development criteria:</b> Minimise land use and community impacts	Option B1 would not impact existing land use or generate impacts to the community.  <b>Meets criteria.</b>	Road and lane closures during construction may impact community access to trails or parking areas.  No permanent land use impacts are anticipated.  <b>Partially meets criteria.</b>	Same as Option B2.  <b>Partially meets criteria.</b>	Same as Option B2.  <b>Partially meets criteria.</b>
<b>Development criteria:</b> Minimise property acquisition	No property acquisition would be required under Option B1 as there would be no construction or changes to Wakehurst Parkway.  <b>Meets criteria.</b>	Option B2 would not require property acquisition.  <b>Meets criteria.</b>	Same as Option B2.  <b>Meets criteria.</b>	Same as Option B2.  <b>Meets criteria.</b>
<b>Development criteria:</b> Minimise environmental impacts	No environmental impacts would result from Option B1 as no development would occur.  <b>Meets criteria.</b>	Environmental impacts are expected from Option B2, such as traffic, noise and vibration, air quality, tree removal and erosion and runoff. Option B2 requires about 1339 m <sup>2</sup> of vegetation clearing on both sides of Wakehurst Parkway and Dreadnought Road. These impacts would be managed throughout construction and minimised where possible.	Similar to Option B2, except Option B3 would require about 1444 m <sup>2</sup> of vegetation clearing on both sides of Wakehurst Parkway and Dreadnought Road.  <b>Partially meets criteria.</b>	Similar to Option B2, except Option B4 would require about 876 m <sup>2</sup> of vegetation clearing on both sides of Wakehurst Parkway and Dreadnought Road.  <b>Partially meets criteria.</b>

Objective/criteria	Option B1 'Do nothing'	Option B2	Option B3	Option B4
		Partially meets criteria.		

Table 2-7: Analysis of options - Area C

Objective/criteria	Option C1 'Do nothing'	Option C2	Option C3
<b>Proposal objective:</b> Improve network efficiency and increase utilisation of Wakehurst Parkway corridor	Option C1 would not improve network efficiency or increase utilisation of Wakehurst Parkway.  <b>Does not meet objective.</b>	Option C2 would provide overall end to end improvements to travel time, increasing utilisation of Wakehurst Parkway.  <b>Meets objective.</b>	Same as Option C2.  <b>Meets objective.</b>
<b>Proposal objective:</b> Improve road safety along the corridor with targeted reduction in crashes in key cluster areas	Option C1 would not improve road safety.  <b>Does not meet objective.</b>	Option C2 would improve safety for vehicles entering and exiting Oxford Falls Road through the adjustment of sight lines at Oxford Falls Road and addition of a right turn bay from Wakehurst Parkway southbound onto Oxford Falls Road.  <b>Meets objective.</b>	Option C3 would improve safety for vehicles turning onto Oxford Falls Road through the provision of traffic control signals.  <b>Meets objective.</b>
<b>Proposal objective:</b> Provide capacity for future traffic growth	Option C1 would not provide capacity for future traffic growth.  <b>Does not meet objective.</b>	Option C2 would provide overall end to end improvements to travel time.  <b>Meets objective.</b>	Same as Option C2.  <b>Meets objective.</b>

Objective/criteria	Option C1 'Do nothing'	Option C2	Option C3
<b>Proposal objective:</b> Improved active transport accessibility	Option C1 does not provide pedestrian or cyclist facilities along Wakehurst Parkway.  Only one signalised pedestrian crossing is provided in the northern leg of the intersection.  <b>Does not meet objective.</b>	Option C2 provides a shoulder along the southbound lane on Wakehurst Parkway, facilitating on-road cycling.  <b>Meets objective.</b>	Same as Option C1.  <b>Does not meet objective.</b>
<b>Proposal objective:</b> Encourage mode shift to public and active transport	Option C1 does not provide new cyclist, pedestrian or bus facilities along Wakehurst Parkway.  <b>Does not meet objective.</b>	Option C2 provides benefits to cyclists with the provision of a shoulder along the southbound lane on Wakehurst Parkway.  <b>Meets objective.</b>	Same as Option C1.  <b>Does not meet objective.</b>
<b>Development criteria:</b> Constructability including impacts to utilities and services	Option C1 avoids construction work, ensuring no impacts to utilities, services, road users, or residents.  <b>Meets criteria.</b>	Under Option C2, there are potential impacts to existing utilities including overhead power, underground communications and high-pressure gas main assets.  <b>Partially meets criteria.</b>	Similar to Option C2, except Option C3 would have greater impacts to utilities and services due to the provision of traffic control signals.  <b>Does not meet criteria.</b>
<b>Development criteria:</b> Minimise land use and community impacts	Option C1 would not impact existing land use or generate impacts to the community.  <b>Meets criteria.</b>	Road and lane closures during construction may impact community access to trails or parking areas.  No permanent land use impacts are anticipated.  <b>Partially meets criteria.</b>	Same as Option C2.  <b>Partially meets criteria.</b>
<b>Development criteria:</b> Minimise property acquisition	No property acquisition would be required under Option C1 as there would be no construction or changes to Wakehurst Parkway.  <b>Meets criteria.</b>	Option C2 may require some property acquisition of crown land, located opposite Oxford Falls Road intersection.  <b>Meets criteria.</b>	Same as Option C1.  <b>Meets criteria.</b>

Objective/criteria	Option C1 'Do nothing'	Option C2	Option C3
<b>Development criteria:</b>  Minimise environmental impacts	No environmental impacts would result from Option C1 as no development would occur.  <b>Meets criteria.</b>	Environmental impacts are expected from Option C2, such as traffic, noise and vibration, air quality, tree removal and erosion and runoff. These impacts would be managed throughout construction and minimised where possible.  <b>Partially meets criteria.</b>	Environmental impacts are expected from Option C2, such as traffic, noise and vibration, air quality, tree removal and erosion and runoff. These impacts would be managed throughout construction and minimised where possible.  <b>Partially meets criteria.</b>

Table 2-8: Analysis of options - Area D

Objective/criteria	Option D1 'Do nothing'	Option D2	Option D3	Option D4	Option D5
<b>Proposal objective:</b>  Improve network efficiency and increase utilisation of Wakehurst Parkway corridor	Option D1 would not improve network efficiency or increase utilisation of Wakehurst Parkway.  <b>Does not meet objective.</b>	Option D2 would provide improvements to LoS for both AM and PM peak periods at the intersections.  Option D2 includes widening of Wakehurst Parkway southbound to allow traffic to pass vehicles waiting to turn right into Mirrool Street. This improvement, along with new left turn bays into Mirrool Street and Elanora Road, enhances motorist experience and has the potential to increase utilisation of Wakehurst Parkway.  <b>Meets objective.</b>	Option D3 would improve efficiency for local road access. However, Option D3 would require vehicles travelling on Wakehurst Parkway to give way to vehicles coming out of Elanora Road. This would therefore decrease the network efficiency along Wakehurst Parkway.  <b>Does not meet objective.</b>	Option D4 would provide improvements to LoS for both AM and PM peak periods at the intersections, improving efficiency for local road access.  However, Option D3 would require vehicles travelling on Wakehurst Parkway to give way to vehicles coming out of Mirrool Street. This would therefore decrease the network efficiency along Wakehurst Parkway.  <b>Does not meet objective.</b>	Option D5 would provide improvements to LoS for both AM and PM peak periods at the Elanora Road intersection, though this option would not improve LoS in either scenario at the Mirrool intersection.  <b>Meets objective.</b>



Objective/criteria	Option D1 'Do nothing'	Option D2	Option D3	Option D4	Option D5
<p><b>Proposal objective:</b> Improve road safety along the corridor with targeted reduction in crashes in key cluster areas</p>	<p>Option D1 would not improve road safety.</p> <p><b>Does not meet objective.</b></p>	<p>Option D2 would provide safety benefits through linemarking changes at the intersections, thereby enhancing sight lines for better visibility.</p> <p>Localised widening of the southern side of Wakehurst Parkway at the Mirrool Street intersection would improve safe access to Mirrool Street.</p> <p>Banning right turn movements into and out of the parallel service road would also improve safety for turning vehicles.</p> <p><b>Meets objective.</b></p>	<p>Option D3 would provide safety benefits through the provision of a roundabout at the Elanora Road intersection, thereby slowing down vehicles.</p> <p><b>Meets objective.</b></p>	<p>Option D4 would provide safety benefits through the provision of a roundabout at the Mirrool Street intersection, thereby slowing down vehicles.</p> <p><b>Meets objective.</b></p>	<p>Option D5 would provide safety benefits through the seagull arrangement of the intersections, allowing right turns out of Elanora Road to be completed in two steps and enhancing sight lines for better visibility.</p> <p><b>Partially meets objective.</b></p>
<p><b>Proposal objective:</b> Provide capacity for future traffic growth</p>	<p>Option D1 would not provide capacity of future traffic growth.</p> <p><b>Does not meet objective.</b></p>	<p>Option D2 would provide improvements to LoS at the intersections. This option would not provide capacity for future traffic growth, though it would increase efficiency with the short southbound lane.</p> <p><b>Partially meets objective.</b></p>	<p>Option D3 would improve access to Elanora Road from Wakehurst Parkway with the provision of a roundabout. However, Option D3 would decrease network efficiency on Wakehurst Parkway.</p> <p><b>Does not meet objective.</b></p>	<p>Option D4 would improve access to Mirrool Street from Wakehurst Parkway with the provision of a roundabout. However, Option D3 would decrease network efficiency on Wakehurst Parkway.</p> <p><b>Does not meet objective.</b></p>	<p>Option D5 would provide substantial improvements to LoS at the Elanora Road intersection but not at the Mirrool Street intersection.</p> <p><b>Meets objective.</b></p>

Objective/criteria	Option D1 'Do nothing'	Option D2	Option D3	Option D4	Option D5
<p><b>Proposal objective:</b> Improved active transport accessibility</p>	<p>Option D1 does not provide pedestrian or cyclist facilities along Wakehurst Parkway.</p> <p><b>Does not meet objective.</b></p>	<p>Option D2 provides a footpath on the northern side of Wakehurst Parkway between Elanora Road and Mirrool Street to facilitate pedestrian movement.</p> <p>This option does not propose cyclist facilities.</p> <p><b>Partially meets objective.</b></p>	<p>Same as Option D1.</p> <p><b>Does not meet objective.</b></p>	<p>Same as Option D1.</p> <p><b>Does not meet objective.</b></p>	<p>Same as Option D2.</p> <p><b>Partially meets objective.</b></p>
<p><b>Proposal objective:</b> Encourage mode shift to public and active transport</p>	<p>Option D1 does not provide new cyclist, pedestrian or bus facilities along Wakehurst Parkway.</p> <p><b>Does not meet objective.</b></p>	<p>Option D2 provides a footpath on the northern side of Wakehurst Parkway between Elanora Road and Mirrool Street to facilitate pedestrian movement.</p> <p>Option D2 would not improve cycling or bus facilities.</p> <p><b>Partially meets objective.</b></p>	<p>Same as Option D1.</p> <p><b>Does not meet objective.</b></p>	<p>Same as Option D1.</p> <p><b>Does not meet objective.</b></p>	<p>Same as Option D2.</p> <p><b>Partially meets objective.</b></p>
<p><b>Development criteria:</b> Constructability including impacts to utilities and services</p>	<p>Option D1 avoids construction work, ensuring no impacts to utilities, services, road users, or residents.</p> <p><b>Meets criteria.</b></p>	<p>Under Option D2, there are potential impacts to existing utilities including sewer, water, electricity, communications and high-pressure gas assets. The design footprint does not substantially encroach on vegetation nor does it extend onto wetlands or the Narrabeen Lagoon.</p> <p><b>Partially meets criteria.</b></p>	<p>Under Option D3, there are substantial constructability constraints related to developing on wetlands or lagoon, including additional engineering related to foundation establishment and working in close proximity to waterways. There would also be impacts to existing utilities including sewer, water, electricity, communications and high-pressure gas assets.</p>	<p>Same as Option D3.</p> <p><b>Does not meet criteria.</b></p>	<p>Same as Option D2.</p> <p><b>Partially meets criteria.</b></p>

Objective/criteria	Option D1 'Do nothing'	Option D2	Option D3	Option D4	Option D5
			<b>Does not meet criteria.</b>		
<b>Development criteria:</b> Minimise land use and community impacts	Option D1 would not impact existing land use or generate impacts to the community.  <b>Meets criteria.</b>	Road and lane closures during construction may impact community access to trails or parking areas.  No permanent land use impacts are anticipated.  <b>Partially meets criteria.</b>	Same as Option D2, with additional long term impacts to land use with the loss of vegetation along Wakehurst Parkway southbound lanes.  <b>Does not meet criteria.</b>	Same as Option D3.  <b>Does not meet criteria.</b>	Same as Option D2.  <b>Partially meets criteria.</b>
<b>Development criteria:</b> Minimise property acquisition	No property acquisition would be required under Option D1 as there would be no construction or changes to Wakehurst Parkway.  <b>Meets criteria.</b>	Option D2 would not require property acquisition.  <b>Meets criteria.</b>	Same as Option D2.  <b>Meets criteria.</b>	Option D4 would have potential property impacts.  <b>Does not meet criteria.</b>	Same as Option D2.  <b>Meets criteria.</b>
<b>Development criteria:</b> Minimise environmental impacts	No environmental impacts would result from Option D1 as no development would occur.  <b>Meets criteria.</b>	Environmental impacts are expected from Option D2, such as traffic, noise and vibration, air quality, and erosion and runoff. These impacts would be managed throughout construction and minimised where possible.  Option D2 would result in vegetation removal but has been designed to avoid impact to the adjacent coastal wetlands.  <b>Partially meets criteria.</b>	Environmental impacts are expected from Option D3 such as traffic, noise and vibration, air quality, tree removal and erosion and runoff. These impacts would be managed throughout construction and minimised where possible.  Option D3 would have substantial impacts to Threatened Ecological Communities (TECs) and the adjacent coastal wetlands due to the extent of widening required.  <b>Does not meet criteria.</b>	Same as Option D3.  <b>Does not meet criteria.</b>	Similar to Option D2, Option D5 would have environmental impacts including traffic, noise and vibration, air quality, tree removal and erosion and runoff.  Option D5 would have a substantial impact on TECs and coastal wetlands due to the extent of widening required.  <b>Does not meet criteria.</b>

## 2.5 Preferred option

### Area A

Although Option A1 had no impacts on utilities, land use, the community or land acquisition, this option would not meet the proposal objectives of improving network efficiency, road safety and active transport accessibility, increasing utilisation of Wakehurst Parkway corridor, providing capacity for future traffic growth and encouraging mode shift to public and active transport. As such, Option A1 was discounted.

As detailed in Section 2.4.2, Options A2, A3 and A4 would increase storage capacity along Wakehurst Parkway through the provision of an additional northbound or southbound lane. All options would result in two through lanes, either northbound or southbound, between Dreadnought Road and Frenchs Forest Road. The increase in storage capacity would result in improvements to traffic efficiency and support future traffic growth. Option A4 would provide greater traffic benefit and capacity compared to Options A2 and A3 due to the increased widening of Wakehurst Parkway.

As outlined above, Options A2, A3 and A4 would increase traffic storage capacity along the corridor, facilitating better traffic flow and in turn, providing safety improvements for motorists. However, Option A3 would introduce a set of reverse curves at either end of the widening, posing a safety risk for vehicles travelling along Wakehurst Parkway. As such, Option A3 was discounted.

Options A2 and A4 would improve active transport accessibility through the provision of a shoulder alongside the additional northbound or southbound lane. This would facilitate on-road cycling and encourage a mode shift to active transport.

However, Option A4 would require a substantially higher amount of vegetation encroachment and removal (about 1.34 hectares) compared to other options due to the larger scale of work proposed, therefore Option A4 was discounted.

Option A2 is the preferred option.

### Area B

Although Option B1 had no impacts on utilities, land use, the community or land acquisition, this option would not meet the proposal objectives of improving network efficiency, road safety and active transport accessibility, increasing utilisation of Wakehurst Parkway corridor, providing capacity for future traffic growth and encouraging mode shift to public and active transport. As such, Option B1 was discounted.

Options B2, B3 and B4 would result in improvements to traffic efficiency at the intersection of Wakehurst Parkway and Dreadnought Road. The upgrade in traffic signals at this intersection, as proposed by all three options, would be a key driver in improving traffic efficiency. The addition of a dedicated southbound left turn slip lane proposed by Option B2 and Option B3 would increase the number of dedicated through lanes to two, both decreasing queue lengths as well as improving capacity for left turning vehicles. Traffic modelling indicates that B2 would provide the greatest improvements to LoS in the future AM and PM peak period. Option B4 provides less traffic storage capacity compared to Option B2 and Option B3 due to the absence of the southbound left turn slip lane. Option B4 would therefore result in the least improvements to traffic efficiency at the intersection compared to Option B2 and Option B3.

Traffic signal upgrades, as proposed by Options B2, B3 and B4, would provide safety improvements by increasing traffic efficiency and installing a concrete median at various points of the road to further delineate northbound and southbound traffic. Options B2, B3 and B4 would also provide safety improvements for pedestrians through the provision of signalised pedestrian crossings on all legs of the intersection. Options B2 and B3 also provide a pedestrian crossing for the left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road.

Under Option B2 and Option B3, an increase in traffic capacity would be achieved through the addition of turning lanes at the intersection. However, as outlined above Option B2 would provide the greatest storage capacity to support future traffic growth. With the absence of new turning lanes, Option B4 would provide the least storage capacity for future traffic growth.

Options B2, B3 and B4 would improve active transport accessibility through the provision of a shoulder on the southbound and northbound lanes which facilitate on-road cycling. Additionally, Options B2 and B3 would allow for two bus bays with bus stops on both sides of Wakehurst Parkway, north of the intersection at Dreadnought Road. Option B4 would not improve accessibility to active or public transport.

Options B2 and B3 require more vegetation clearing than Option B4 but better meet the proposal objectives compared to Option B4. Given that the traffic benefits of Option B2 outweigh those of Options B3 and B4, Option B2 is the preferred

option. Note that this option forms part of Wakehurst Parkway from Dreadnought Road to Oxford Falls Road section in the rest of this document.

### Area C

Although Option C1 had no impacts on utilities, land use, the community or land acquisition, this option would not meet the proposal objectives of improving network efficiency, road safety and active transport accessibility, increasing utilisation of Wakehurst Parkway corridor, providing capacity for future traffic growth and encouraging mode shift to public and active transport. As such, Option C1 was discounted.

Options C2 and Option C3 would provide overall end to end improvements to travel time, particularly when considered alongside other proposed improvements to Wakehurst Parkway. Option C2 and Option C3 meet the objective to provide capacity for future traffic growth.

The adjustment of sight lines and the addition of a right turn bay from Wakehurst Parkway southbound, as proposed by Option C2, would enhance safety for vehicles entering and exiting Oxford Falls Road. Option C3 would improve safety through the provision of traffic control signals, whilst Option C1 would not meet this objective.

Option C2 would improve active transport accessibility through the provision of a shoulder along the southbound lane on Wakehurst Parkway, facilitating on-road cycling. This benefit would not be provided by Option C1 and Option C3.

Option C2 would require partial property acquisition of land along Wakehurst Parkway southbound, opposite Oxford Falls Road intersection, whilst Option C1 and Option C3 would not require property acquisition.

Option C3 would have greater impacts to the environment, utilities and services compared to Option C2 despite having similar traffic benefits, due to the extensive work required to convert Oxford Falls Road intersection to a signalised intersection. As such, Option C3 is unjustified.

Therefore Option C2 is the preferred option.

### Area D

Although Option D1 had no impacts on utilities, land use, the community or land acquisition, this option would not meet the proposal objectives of improving network efficiency, road safety and active transport accessibility, increasing utilisation of Wakehurst Parkway corridor, providing capacity for future traffic growth and encouraging mode shift to public and active transport. As such, Option D1 was discounted.

Option D2 would provide less improvements to traffic efficiency than Option D5. However, Option D2 includes widening of Wakehurst Parkway southbound to allow traffic to pass vehicles waiting to turn right into Mirrool Street. This improvement, along with the new left turn bays into Mirrool Street and Elanora Road, enhances the efficiency of the intersections by removing stoppage points caused by turning vehicles, and has the potential to increase utilisation of the corridor in this area. Options D3 and Option D4 would improve traffic efficiency for local road access, though both options would slow down the efficiency of Wakehurst Parkway due to the provision of a roundabout. As such, Option D3 and Option D4 do not meet the proposal objective and were discounted.

Option D2 would provide safety benefits through the provision of the right turn bay from Wakehurst Parkway southbound onto Mirrool Street. Additionally, linemarking changes at the Elanora Road intersection would increase sight lines for better visibility, decreasing the risk of crashes for turning vehicles. Option D5 would improve safety for motorists turning right onto Wakehurst Parkway from Elanora Road by allowing the right turn to be completed in two steps and improve sight lines for better visibility.

Option D2 provides a footpath on the northern side of Wakehurst Parkway between Elanora Road and Mirrool Street to improve pedestrian accessibility. Option D5 would not provide this benefit.

Option D5 would have a greater constructability impact compared to Option D2 due to the encroachment of this option into Bilarong Reserve, located to the south of Wakehurst Parkway. Under Option D5, there would be substantial constructability constraints related to developing on wetlands or lagoon, including additional engineering related to foundation establishment and working in close proximity to waterways. There would also be impacts to existing utilities including sewer, water, electricity, communications and high-pressure gas assets.

Option D5 would have relatively higher environmental impact to TECs and the adjacent coastal wetlands due to the extent of widening required. Comparatively, Option D2 would have no impact on the adjacent coastal wetlands.

Therefore Option D2 is the preferred option.

### 2.5.1 Summary

The following options were selected for each section of the proposal:

- Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Area A) – Option A2
- Wakehurst Parkway and Dreadnought Road intersection (Area B) – Option B2
- Wakehurst Parkway and Oxford Falls Road intersection (Area C)– Option C2
- Wakehurst Parkway from Elanora Road to Mirrool Street (Area D) – Option D2

These four design options collectively form the proposal, which is further detailed in Chapter 3 and assessed in Chapter 6.

## 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 proposes to undertake carry out road improvement work, including intersection upgrades, along Wakehurst Parkway between Frenchs Forest Road and Pittwater Road. Sections of Wakehurst Parkway are subject to traffic congestion and have an extensive crash history. Key features of the proposal are shown in Figure 3-1 to Figure 3-3 (Trefoil Creek to Dreadnought Road), Figure 3-4 to Figure 3-7 (Dreadnought Road to Oxford Falls Road), and Figure 3-8 to Figure 3-10 (Elanora Road and Mirrool Street), and are described below:

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

- widening of Wakehurst Parkway southbound between Trefoil Creek and Dreadnought Road for about 700 metres to provide an additional southbound lane (resulting in two continuous southbound lanes from Oxford Falls Road to Frenchs Forest Road)

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

- widening of Wakehurst Parkway on the northbound approach to Dreadnought Road intersection for 170 metres to accommodate a longer shared through and left turn lane, a new concrete median and new shoulders
- widening of Wakehurst Parkway to the west of the northbound lane from Dreadnought Road to Oxford Falls Road to accommodate an additional lane in each direction. The northbound kerbside lane would become a dedicated left turn on approach to Oxford Falls Road intersection
- widening of Oxford Falls Road intersection's southwest corner to accommodate a new dedicated left turn lane from Wakehurst Parkway northbound
- extension of the existing right turn bay on Wakehurst Parkway southbound onto Dreadnought Road from 60 metres to about 95 metres to provide additional storage capacity
- construction of a new left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road with a pedestrian island and signalised pedestrian crossing at the north-eastern corner of the intersection
- installation of a dedicated right turn bay, about 125 metres in length, from Wakehurst Parkway southbound onto Oxford Falls Road
- construction of a rock cutting wall on Wakehurst Parkway southbound, opposite Oxford Falls Road intersection to facilitate road widening, about 194 metres in length and up to 6 metres in height
- construction of a low retaining wall about 42 metres in length and 1.5 metres in height on Wakehurst Parkway northbound, adjacent to the new northbound bus bay
- installation of a new northbound bus bay about 35 metres north of Dreadnought Road intersection, on Wakehurst Parkway
- installation of a new southbound bus bay about 100 metres north of Dreadnought Road intersection, at the end of the new left turn slip lane to Dreadnought Road
- installation of the signalised pedestrian crossings on the western, eastern and southern legs of Dreadnought Road intersection
- installation of a new concrete median on Wakehurst Parkway, about 70 metres in length, to the south of Dreadnought Road intersection
- installation of a new landscaped median along Wakehurst Parkway between Dreadnought Road and Oxford Falls Road
- installation of a new line-marked median, about 120 metres in length, north of Oxford Falls Road intersection
- footpath adjustments to support the new signalised pedestrian crossings

- new kerb ramps and adjustments to stop lines
- adjustments to, and new utilities, traffic control signals, street lighting, drainage, signage and road marking

**Wakehurst Parkway from Elanora Road to Mirrool Street**

- localised widening of Wakehurst Parkway southbound at the Mirrool Street intersection for about 95 metres to allow through traffic to pass vehicles waiting to turn right into Mirrool Street
- widening of Wakehurst Parkway northbound between Elanora Road and Mirrool Street to accommodate a new left turn bay, about 80 metres in length
- conversion of the existing kerbside through lane on northbound approach to Elanora Road into a dedicated left turn lane
- banning right turn movements into and out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left-in and left-out only and redirecting right turn movements to the Mirrool intersection
- adjustment of the give way line on Elanora Road about 2.5 metres further forward into Wakehurst Parkway
- construction of a new concrete median, about 40 metres in length on Elanora Road
- construction of a low retaining wall on the southern side of Wakehurst Parkway, opposite the Mirrool Street intersection, about 73 metres in length and 0.5 metres in height
- installation of a footpath between Elanora Road and Mirrool Street on the northern side of Wakehurst Parkway
- adjustments to, and new utilities, street lighting, drainage, signage and road marking





Figure 3-1, Key features of the proposal - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 1 of 3)



Figure 3-2, Key features of the proposal - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 2 of 3)



Figure 3-3, Key features of the proposal - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 3 of 3)

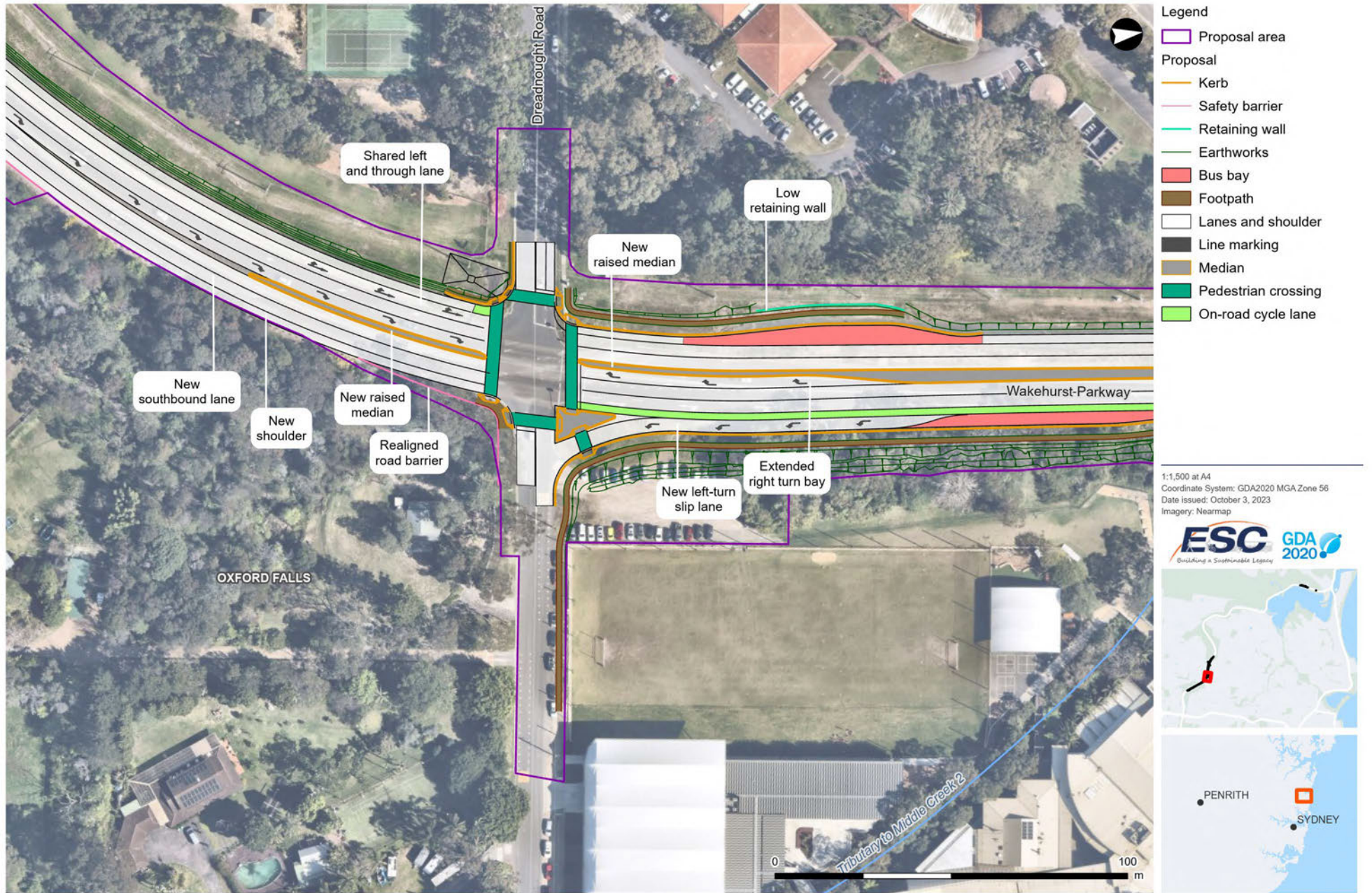


Figure 3-4, Key features of the proposal - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 1 of 4)



Figure 3-5, Key features of the proposal - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 2 of 4)

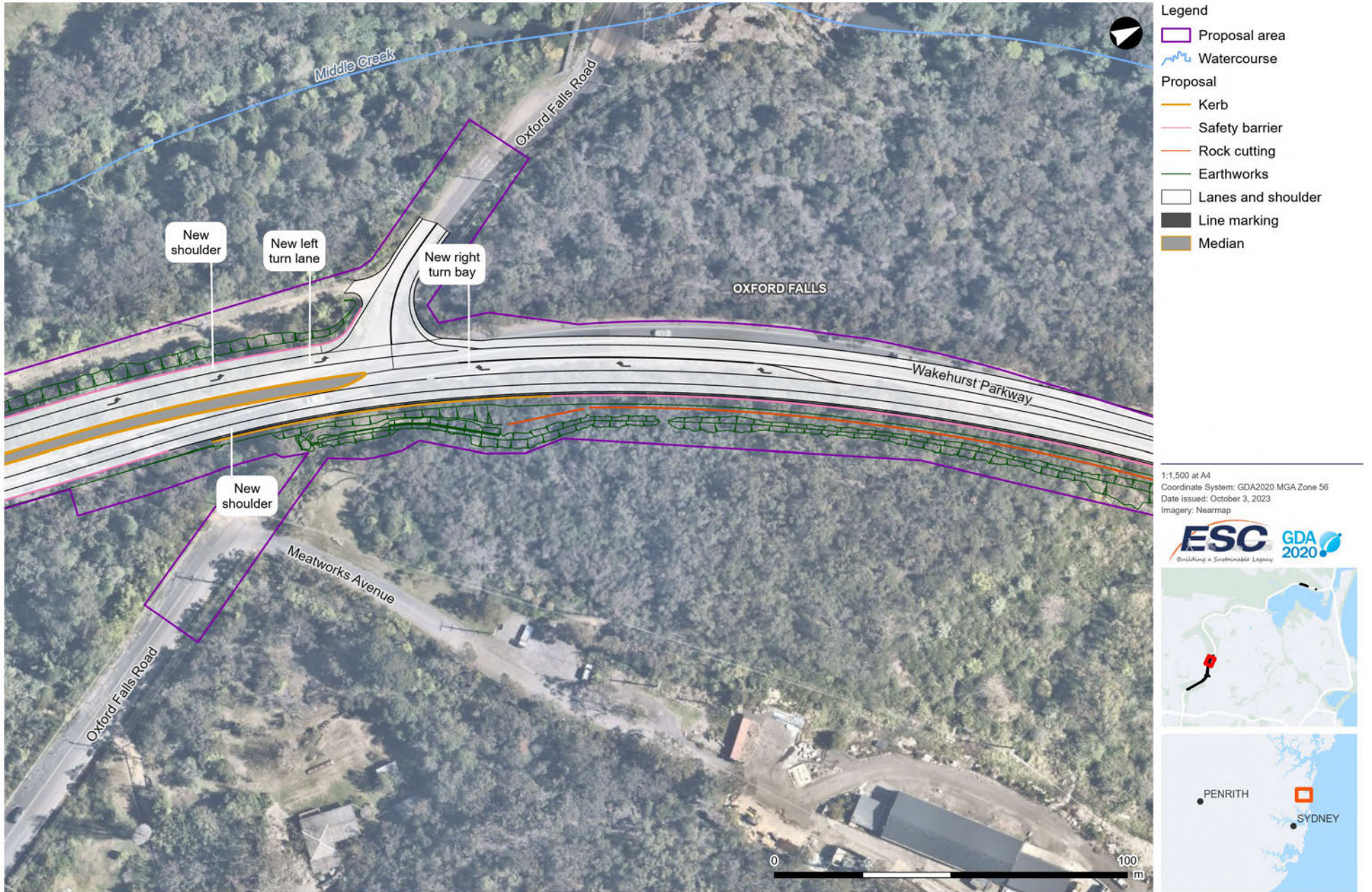


Figure 3-6, Key features of the proposal - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 3 of 4)



Figure 3-7, Key features of the proposal - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 4 of 4)



Figure 3-8, Key features of the proposal - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 1 of 3)





Figure 3-9, Key features of the proposal - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 2 of 3)



Figure 3-10, Key features of the proposal - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 3 of 3)

## 3.2 Design

### 3.2.1 Design criteria

#### **Standards**

The concept design of the proposal was prepared in accordance with the following standards:

- Transport for NSW Supplements to Austroads Guide to Road Design
- Austroads Guide to Road Design
- Transport for NSW Delineation Manual
- AS 1428.1:2021 Design for access and mobility, Part 1: General requirements for access – New building work
- relevant Transport for NSW and Sydney Buses signage and linemarking
- Northern Beaches Council signage requirements for bus shelters and waiting areas
- Australian Rainfall and Runoff Guideline
- Austroads Pavement Design Guide Part 2
- Transport for NSW Pavement Design Supplement to Austroads Guide to Pavement Design – Part 2 and Part 5
- Transport for NSW roadworks, materials and maintenance specifications
- Transport for NSW Technical Guide – Standard Pavement Subsurface Drainage Details
- AS/NZS 1158.0:2005 Lighting for roads and public spaces
- AS/NZS 1158.1.1:2022 Lighting for roads and public spaces, Part 1.1: Vehicular traffic (Category V) lighting – Performance and design requirements
- AS/NZS 1158.1.2:2010 Lighting for roads and public spaces Vehicular traffic (Category–V) lighting - Guide to design, installation, operation and maintenance
- Ausgrid Standards and Standard Drawings
- AS1428 Design for access and mobility, Part 1: General requirements for access – new building work
- Transport for NSW QA Specification R44 Earthworks
- Transport for NSW QA Specification R64 Soil Nailing
- AS1726:2017 Geotechnical site investigation
- AS4678:2002 Earth-retaining structures
- Technical Direction – Geotechnology TS 02087 Geotechnical design for remediation of existing slopes and embankments
- Transport for NSW Geotechnical Technical Directions (where relevant)
- typical elements proposed in the Transport for NSW Particular Specification (e.g. PS221).

#### **Design Criteria**

The design criteria used for the development of the concept design are detailed in Table 3-1. The southern section refers to the area extending from Trefoil Creek to Dreadnought Road and to Oxford Falls Road, while the northern section refers to the area between Elanora Road to Mirrool Street.

Table 3-1: Design criteria

Design Element	Design criteria – Northern section	Design criteria – Southern section
Design speed	Wakehurst Parkway – posted speed 80 km/h, design speed 90 km/h	Wakehurst Parkway – posted speed 80 km/h, design speed 90 km/h
	Elanora Road – posted speed 50 km/h, design speed 60 km/h	Dreadnought Road – posted speed 50 km/h, design speed 60 km/h
	Mirrool Street – posted speed 50 km/h, design speed 60 km/h	Oxford Falls Road – posted speed 50 km/h, design speed 60 km/h
Design Vehicle	Wakehurst Parkway – 26m B-double	Wakehurst Parkway – 26m B-double
	Elanora Road – 8.8m service vehicle	Dreadnought Road – 12.5m SU truck
	Mirrool Street – 8.8m service vehicle	Wakehurst Parkway into Dreadnought Road – 12.5m SU truck
	Wakehurst Parkway Service Road – 8.8m service vehicle	Dreadnought Road into Wakehurst Parkway – 12.5m SU truck
		Oxford Falls Road – 12.5m SU truck
Check Vehicle	Wakehurst Parkway – 26m B-double	Wakehurst Parkway – 26m B-double
	Elanora Road – 12.5m SU truck	Dreadnought Road – 19m semi-trailer
	Mirrool Street – 12.5m SU truck	Wakehurst Parkway into Dreadnought Road – 19m semi-trailer
	Wakehurst Parkway Service Road – 12.5m SU truck	Dreadnought Road into Wakehurst Parkway – 19m semi-trailer
		Oxford Falls Road – 19m semi-trailer
Minimum lane width	Wakehurst Parkway – 3.5m through lanes and 3.3m turn lanes	Wakehurst Parkway – 4.0m bus lane, 3.5m through lanes, and 2.0m cycle lanes (2.5m adjacent barrier)
	Elanora Road – to match existing	Dreadnought Road – 2.8m-3.0m to match existing
	Mirrool Street – to match existing	Oxford Falls Road – 2.8m-3.0m to match existing
Minimum path width	n/a	n/a
Minimum median width	n/a	1.8m
Minimum median width for Staged Pedestrian Crossing	n/a	n/a

### 3.2.2 Engineering constraints

A number of engineering constraints were identified during the development of the concept design, including the construction and operational phases of the proposal. The main constraints associated with the proposal include:

- undulating and steep topography on either side of Wakehurst Parkway
- creek crossings under Wakehurst Parkway including Trefoil Creek and an unnamed tributary of Middle Creek

- evidence of pavement cracking and pavement failures at Wakehurst Parkway and Dreadnought Road intersection
- potential impacts to existing utilities including overhead and underground power, communication and high-pressure gas assets
- need to avoid impact to property boundaries near Wakehurst Parkway and Dreadnought Road intersection, Wakehurst Parkway and Oxford Falls Road intersection, and Wakehurst Parkway intersections with Elanora Road and Mirrool Street
- need to avoid impact to Oxford Falls Conservation Area at Wakehurst Parkway and Oxford Falls Road intersection
- need for construction to be staged to minimise impacts to traffic
- need to avoid areas of coastal wetlands, vegetation and TECs
- constraints due to limited corridor width and construction footprint.

### 3.2.3 Major design features

#### Road configuration

##### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

The proposal would provide an additional southbound lane on Wakehurst Parkway between Dreadnought Road and Trefoil Creek to allow for two continuous southbound lanes from Oxford Falls Road to Frenchs Forest Road (refer to Figure 3-1 to Figure 3-3). To accommodate the additional lane, the southbound carriageway on Wakehurst Parkway would be widened by up to seven metres between Dreadnought Road and Trefoil Creek (about 600 metres in length). The two southbound lanes would be about 3.5 metres in width and the shoulder would be about 2.5 metres in width. The shoulder would facilitate safer on-road cycling, serve as an emergency stopping lane for road users, improve safety of access for road maintenance work, and provide a safer environment for through traffic.

##### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

The proposal would realign the three northbound lanes on Wakehurst Parkway on approach to Dreadnought Road intersection to accommodate the new raised median and a southbound shoulder, located south of intersection (refer to Figure 3-4). These items would require the widening of the northbound carriageway on Wakehurst Parkway by about 240 metres in length and five metres in width. The raised median would be about 70 metres in length from Dreadnought Road intersection and would separate southbound and northbound traffic. The left turn and through northbound lanes would be about 3.5 metres in width and the right turn northbound lane would be about three metres in width. The shoulder to the kerbside northbound and southbound lanes would be about 2.5 metres in width. The shoulder would protect the edges of the road pavement from traffic damage, facilitate on-road cycling and serve as an emergency stop lane for traffic.

The road curvature of Wakehurst Parkway has been improved at the curve to the south of Dreadnought Road intersection. In combination with the duplicated lanes to the north of Dreadnought Road intersection, this has introduced an improvement to safety in terms of sight distance on the northbound and southbound approaches to the intersection.

The proposal would also provide an additional lane in both directions, and a new landscaped median, between Dreadnought Road and Oxford Falls which would require the widening of the southbound (about 10 metres in width) and northbound (up to 15 metres in width) carriageways on Wakehurst Parkway for about 500 metres (refer to Figure 3-4 to Figure 3-6). The new median would be about 500 metres in length and feature native grass planting. The two northbound and the two southbound through lanes would be about 3.5 metres in width. The right turn lane on Wakehurst Parkway southbound onto Dreadnought Road would be extended from 60 metres to about 95 metres, with a width of about 3.2 metres.

Widening on both sides of Wakehurst Parkway would accommodate two new bus bays north of Dreadnought Road intersection and the addition of a southbound left turn slip lane (refer to Figure 3-4 and Figure 3-5). The bus bay located on the western side of Wakehurst Parkway would be about 35 metres north of the intersection and about five metres at its widest. The bus bay located on the eastern side would be about 100 metres north of the intersection, located in the southbound left turn slip lane. The left turn slip lane would be about 3.5 metres in width and the shoulder on either side of Wakehurst Parkway would be about 2.5 metres in width.

The proposal would provide a new southbound right turn bay and a new northbound left turn lane from Wakehurst Parkway onto Oxford Falls Road (refer to Figure 3-6). The southwestern corner of Oxford Falls Road intersection would require widening to accommodate the new dedicated left turn lane from Wakehurst Parkway northbound. The lane widths on Oxford Falls Road would be about 3.8 metres in width.

Northbound and southbound traffic on Wakehurst Parkway would be separated by a new line-marked median located about 90 metres north of Oxford Falls intersection. This new median would be about 120 metres in length.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

The proposal would provide an adjustment to the give way line on Elanora Road about 2.5 metres further forward into Wakehurst Parkway and a new raised median at the intersection of Elanora Road with Wakehurst Parkway (refer to Figure 3-8). The new median would be about 40 metres in length. The proposal would provide left turn lane markings at the existing deceleration lane on northbound approach to Elanora Road. At this location, the lane widths on Wakehurst Parkway and Elanora Road would remain as existing.

The proposal would require localised widening at Mirrool Street intersection for 95 metres by about five metres in width to extend the road shoulder to a total width of about three metres, allowing through traffic to pass vehicles waiting to turn right into Mirrool Street. The proposal would also provide a northbound left turn bay onto Mirrool Street, about 110 metres in length and 2.5 metres in width, which would require widening of the northern side of Wakehurst Parkway between Elanora Road and Mirrool Street for about 100 metres.

The proposal would ban right turn movements into or out of the parallel service road (about 380 metres east of the Mirrool Street intersection, near Palm Terrace) at the intersection with Wakehurst Parkway, redirecting all right turn movements to Mirrool Street (refer to Figure 3-10). Left-in and left-out movements from the service road onto Wakehurst Parkway would be maintained.

#### **Drainage**

##### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

South of Dreadnought Road intersection, it is proposed to replace an existing culvert located at Trefoil Creek relative to the proposed road widening work on Wakehurst Parkway at this location. New headwalls would be installed and a vegetated drainage channel would be constructed from the headwall. New stormwater drainage pipes, drainage pits and concrete drainage channels are to be installed along the southbound alignment of Wakehurst Parkway.

On Wakehurst Parkway, two existing culverts north of Trefoil Creek would be replaced.

Figure 3-11 shows the proposed stormwater drainage infrastructure within and around the proposal area between Dreadnought Road and Trefoil Creek.

##### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

South of Dreadnought Road intersection, a vegetated drainage channel is to be installed alongside Wakehurst Parkway northbound.

At Dreadnought Road intersection adjacent to the Oxford Falls Peace Park, an existing drainage pit is to be removed and drainage pipe replaced with a headwall and vegetated drainage channel. New drainage pipe and pits are to be installed within the intersection and along the new medians to connect to existing and replaced drainage services.

A vegetated drainage channel is to be installed alongside Wakehurst Parkway southbound, from southbound bus bay to Dreadnought Road intersection.

An existing drainage culvert between Dreadnought Road and Oxford Falls Road would be extended to accommodate road widening of southbound lanes of Wakehurst Parkway, and a new headwall would be constructed on the western side of the road.

New drainage pipes and drainage pits would be installed along the concrete median between Dreadnought Road and Oxford Falls Road.

At Oxford Falls Road intersection, an existing culvert would be replaced with drainage pipe extending to the concrete median. The pipe would end in a headwall and a new vegetated drainage channel on the eastern side of Wakehurst Parkway. The pipe would be extended into Oxford Falls Road westbound, where it would end in a new drainage pit.

A new drainage pipe would be installed alongside Wakehurst Parkway southbound from the intersection to the northern end of the proposed road alignment.

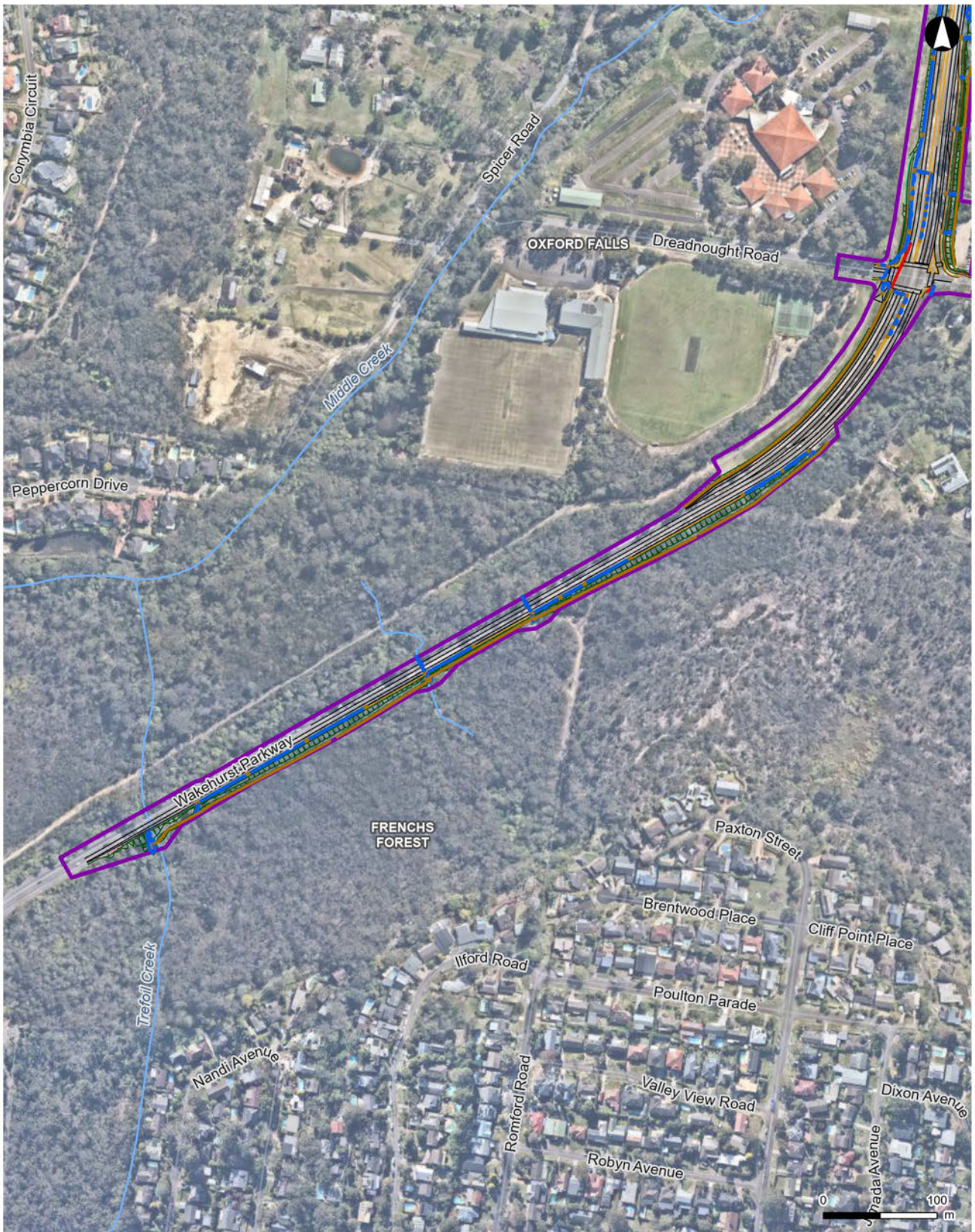
Figure 3-12 shows the proposed stormwater drainage infrastructure within and around the proposal area at Wakehurst Parkway from Dreadnought Road to Oxford Falls Road.

Wakehurst Parkway, Elanora Road and Mirrool Street intersections

Drainage pipes and pits would be installed along the new landscaped median at Elanora Road intersection. This drainage pipe would extend to the northern side of Wakehurst Parkway, where it would end in a headwall and a new vegetated drainage channel.

At Mirrool Street, existing drainage pipe would be replaced, and a new drainage pit installed.

Figure 3-13 shows the proposed stormwater drainage infrastructure within and around the proposal area at Wakehurst Parkway, Elanora Road and Mirrool Street intersections.



Legend

- |                                |                |             |
|--------------------------------|----------------|-------------|
| Proposal area                  | Proposal       | Earthworks  |
| Proposed drainage              | Line marking   | Kerb/Median |
| Drainage pipe                  | Footpath       | Road design |
| Drainage channel               | Safety barrier |             |
| Drainage to remove and replace | Retaining wall |             |

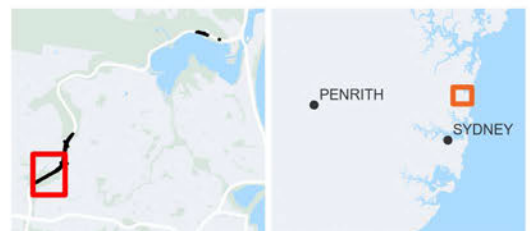
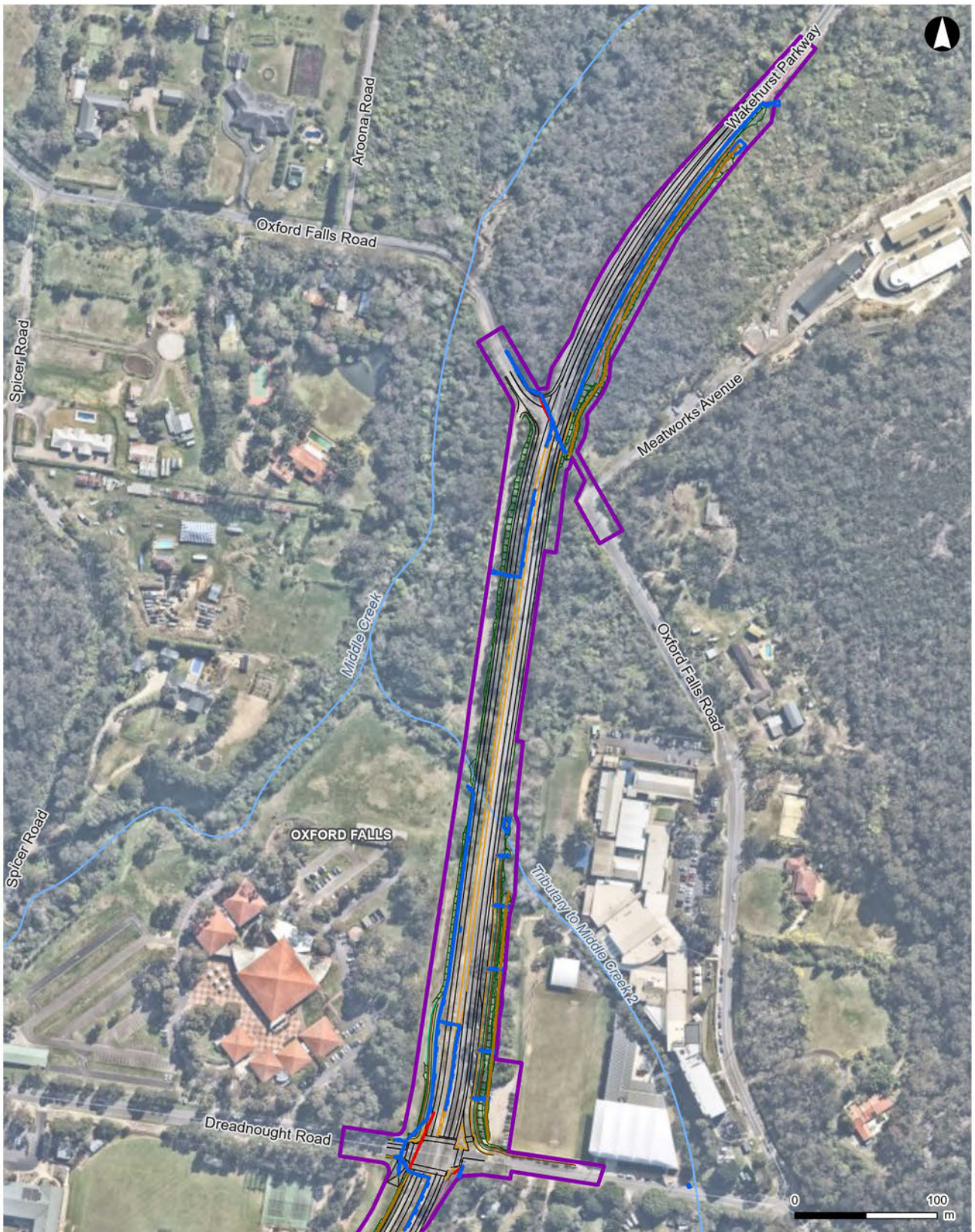


Figure 3-11, Drainage within and around the proposal area - Wakehurst Parkway from Trefoil Creek to Dreadnought Road

1:5,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 14, 2023  
 Imagery: Nearmap 2022







Legend

- |                     |                |              |
|---------------------|----------------|--------------|
| Proposal area       | Proposal       | Rock cutting |
| Proposed drainage   | Line marking   | Earthworks   |
| Drainage pipe       | Footpath       | Kerb/Median  |
| Drainage channel    | Safety barrier | Road design  |
| Drainage to removed | Retaining wall |              |



Figure 3-12, Drainage within and around the proposal area - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

1:4,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 26, 2023  
 Imagery: Nearmap 2022





Legend

- |                        |                |             |
|------------------------|----------------|-------------|
| Proposal area          | Proposal       | Earthworks  |
| Proposed drainage      | Line Marking   | Kerb/Median |
| Drainage pipe          | Footpath       | Road design |
| Drainage channel       | Safety barrier |             |
| Drainage to be removed | Retaining wall |             |

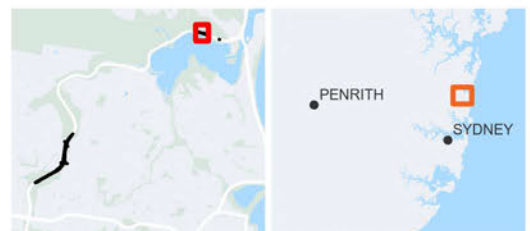


Figure 3-13, Drainage within and around the proposal area - Wakehurst Parkway from Elanora Road to Mirrool Street

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 14, 2023  
 Imagery: Nearmap 2022



### Signage

Existing signage within the proposal boundary would be relocated relative to the new kerbs with damaged signs to be replaced. Additional signage would be incorporated to meet the requirements of the new road design, and any redundant signage would be removed. Any existing signs that do not meet current specifications would be replaced.

### Retaining structures

One low retaining wall, about 50 metres in length and 1.5 metres in height, would be constructed on Wakehurst Parkway northbound, adjacent to the new bus bay, to minimise impacts to an existing gas main. This retaining wall would be built using sandstone logs or blocks, though this would respond to the material available through excavations. This retaining wall would be situated in a low cut and is shown in Figure 3-14.

A rock cutting wall would be constructed on Wakehurst Parkway southbound, opposite Oxford Falls Road intersection, to facilitate road widening. This rock cutting wall would be about 230 metres in length and up to six metres in height, as shown in Figure 3-15. The rock cutting wall would expose the underlying sandstone consistent with other sandstone cutting walls along Wakehurst Parkway. The wall would include rock bolts and potential areas of shotcrete for further stabilisation. Shotcreting, if required, would be based on Transport *Shotcrete Design Guideline* (2016) for blending the natural stone colour and texture.

One low retaining wall, about 73 metres in length and 0.5 metres in height, would be constructed on Wakehurst Parkway southbound, opposite Mirrool Street intersection, to prevent impacts to the adjacent coastal wetlands. This retaining wall would be filled in and would therefore not be visible from Wakehurst Parkway. This retaining wall is shown in Figure 3-16.



- Legend
- Proposal area
  - Footpath
  - Earthworks
  - Retaining wall
  - Kerb/Median
  - Line marking
  - Road design



1:850 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022



Figure 3-14, Retaining structures - Wakehurst Parkway and Dreadnought Road intersection



- Legend
- Proposal area
  - Safety barrier
  - Earthworks
  - Rock cutting
  - Kerb/Median
  - Line marking
  - Road design



1:850 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022



Figure 3-15, Retaining structures - Wakehurst Parkway and Oxford Falls Road intersection



- Legend
- |                |                |
|----------------|----------------|
| Proposal area  | Footpath       |
| Proposal       | Safety barrier |
| Retaining wall | Earthworks     |
| Line Marking   | Road design    |



1:850 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022



Figure 3-16, Retaining structures - Wakehurst Parkway from Elanora Road and Mirrool Street

### Cycling and walking facilities

A shared pedestrian and cycle path is provided along Wakehurst Parkway between Middle Creek Reserve and Pittwater Road (Narrabeen Lagoon Trail) (Northern Beaches Council, 2023). No existing dedicated cycle paths or pedestrian footpaths are provided along Wakehurst Parkway, Oxford Falls Road, Elanora Road and Mirrool Street within the proposal area with the exception of the on-road cycle facility on the northbound approach to Dreadnought Road intersection. There are pedestrian footpaths provided on either side of Dreadnought Road, west of Dreadnought Road intersection.

The proposal would realign the existing east-west pedestrian crossing at Dreadnought Road intersection. The pedestrian crossing would be shifted about two metres north, angled across the intersection and connecting to the new pedestrian island at the northeastern corner of the intersection. A signalised pedestrian crossing would connect the new pedestrian island to the eastern kerb of Wakehurst Parkway.

New signalised pedestrian crossings would be provided along the eastern, western and southern legs of Dreadnought Road intersection.

Pedestrian footpaths are proposed at the south-eastern and south-western corners of Dreadnought Road intersection to tie into the new signalised pedestrian crossings. The south-western footpath would also tie into the existing footpath on Dreadnought Road, providing pedestrian access to St Pius X Treacy Education Complex and Sporting Fields. Proposed footpaths on the north-eastern and north-western corners of the intersection would connect with the new signalised pedestrian crossings and extend to the bus stops north of the intersection on Wakehurst Parkway. The north-eastern footpath would also provide pedestrian access to Oxford Falls Grammar school, extending east into Dreadnought Road.

Figure 3-4 shows the proposed pedestrian crossings and footpaths at Dreadnought Road intersection.

A pedestrian footpath would also be constructed between Elanora Road and Mirrool Street on the northern side of Wakehurst Parkway (refer to Figure 3-8).

The proposal would remove the on-road cycleway between the left turn and through lanes on the northbound approach to Dreadnought Road intersection. However, the proposal would provide a shoulder on the northbound approach to Dreadnought Road intersection which would facilitate on-road cycling (refer to Figure 3-4). Cyclist pavement markings are provided at the intersection, along with a stop line placed in the northbound shoulder offset slightly ahead of the stop line for vehicles. This ensures that cyclists waiting at the stop line are clearly visible to vehicles on Wakehurst Parkway on approach to Dreadnought Road intersection.

The proposal would also provide a shoulder to the southbound lane on Wakehurst Parkway from Trefoil Creek to Dreadnought Road (refer to Figure 3-1 to Figure 3-4), and to the northbound and southbound lanes between Dreadnought Road to Oxford Falls Road (refer to Figure 3-4 to Figure 3-7). The southbound shoulder would facilitate on-road cycling and would become a line-marked on-road cycling facility on the approach to Dreadnought Road intersection, ending at the intersection.

### Landscaping and vegetation

About 2.38 hectares of native vegetation would be removed to facilitate the proposed work. Further detail on vegetation removal is provided in Section 6.1. The proposal includes revegetation and landscaping of the construction footprint to mitigate these impacts.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

The proposal would include revegetation in the southbound verge on Wakehurst Parkway between Trefoil Creek and Dreadnought Road intersection.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

The proposal would provide improved urban amenity, reinforce the local character and contribute to a sense of 'Place' for Oxford Falls. The urban design for Dreadnought Road intersection would provide an integrated solution that is reflective of both the natural and built local character and is of a high quality and finish.

The proposal would include sandstone walls at the north-eastern, north-western, and south-western corners of Dreadnought Road intersection to visually frame the intersection. The shape and material of the walls would align with the existing sandstone walls at Oxford Falls Peace Park.

Turf and informal tree planting in verge areas would be provided to reflect the open and more urban character north and south of Dreadnought Road intersection. Ginkgo trees (*Ginkgo biloba*) would be planted at the south-eastern corner of

Dreadnought Road intersection to match the existing trees along Dreadnought Road. Feature planting would be used to further define the landscape character around the intersection, and local species would be used for the remainder of the planting types.

The vacant disturbed road reserve area adjacent to Oxford Falls Grammar school would be removed and replaced with turf and native tree planting. The existing Oxford Grammar School sign currently located in the road reserve would need to be removed and potentially relocated pending future discussion with the school.

The new median on Wakehurst Parkway, extending from Dreadnought Road intersection to Oxford Falls Road intersection, would feature landscaped areas with native grass mass planting.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

The proposal would introduce turf and trees at the Mirrool Street intersection as a replacement for the vegetation buffer along Wakehurst Parkway. Bush regeneration would be carried out along Wakehurst Parkway southbound, featuring Forested Wetland species and trees behind safety barriers to provide a continuous avenue of planting. This work would be limited to the construction footprint to avoid any adverse impacts on the protected coastal wetland zone.

#### **Bus facilities**

Two new bus bays would be constructed north of Dreadnought Road intersection as shown in Figure 3-4.

On the western side of Wakehurst Parkway, the new bus bay would be located about 30 metres north of the intersection and accommodate a new bus stop. A new bus bay is also proposed about 200 metres north of Dreadnought Road intersection, on the eastern side of Wakehurst Parkway. This bus bay would be located at the end of the new left turn slip lane and would be delineated by linemarking. The northbound carriageway of Wakehurst Parkway would require further widening than the southern carriageway to accommodate the new bus bay.

The bus route 155 would service both bus stops (refer to Figure 6-31).

#### **CCTV upgrades**

A Closed-circuit Television (CCTV) camera is proposed to be installed on the traffic control signal post located on the new pedestrian island on the north-eastern corner of Dreadnought Road intersection.

An existing CCTV camera at Wakehurst Parkway and Oxford Falls Road intersection is proposed to be relocated on the realigned verge of the intersection.

## 3.3 Construction activities

This section provides a summary of the likely construction methodology, staging, work hours, plant and equipment that would be used to construct the proposal and associated activities. For the purpose of this REF, an indicative construction plan and methodology are provided. The detailed construction staging plans and methods would be determined by the construction contractor(s) prior to commencement of construction.

### 3.3.1 Work methodology

The proposed construction work and methodology provided is indicative only. A Traffic Management Plan (TMP) would be prepared and implemented as part of the Construction Environment Management Plan (CEMP) by the construction contractor(s) in consultation with Transport. The TMP would include detailed construction staging plans and methodologies developed during future design development and construction planning. If construction activities result in environmental impacts above those assessed in this REF, further environmental assessment would be required and approved by Transport prior to work commencing.

The proposal would involve the work methodology and staging shown in Figure 3-17 to Figure 3-37 and discussed below.

There are four stages of work proposed –

1. Stage 0: Predominantly night work under traffic control
2. Stage 1: Day and night work
3. Stage 2: Day and night work



4. Stage 3: Day and night work

**Wakehurst Parkway between Trefoil Creek to Dreadnought Road**

Stage 0 would comprise site establishment (site offices, storage and stockpiles, security fencing) at the selected construction compound(s), location and potential relocation of utilities, installation of environmental controls (sedimentation controls, boundary marking for vegetation clearing, etc), and placement of roadwork signage and temporary linemarking. Drainage work at Trefoil Creek and the two other culverts along Wakehurst Parkway would commence. Any required clearing and grubbing would occur at this stage.

Construction access points would be established, and traffic barriers placed along the southbound lane in preparation for the Stage 1 traffic switch. Traffic signal adjustments would be implemented to enable safe passage of vehicles through the construction areas. Some of the work on and around the existing alignment would be carried out at night to minimise traffic impacts. Traffic would remain on the existing alignment during this stage.

Stage 1 would involve earthwork and pavement work along the southbound lane between Trefoil Creek to 140 metres south of Dreadnought Road intersection. To enable work on the southbound lane, Stage 1 would shift traffic towards the northbound side of the alignment and utilise part of the northbound shoulder to allow traffic to continue in both directions up until about 140 metres south of the Dreadnought Road intersection. Barriers and temporary lane marking established during Stage 0 would facilitate this arrangement. Construction vehicles would access the southbound construction site from the southbound lane of Wakehurst Parkway and the northbound construction site from the northbound lane of Wakehurst Parkway. Roadwork signage and re-linemarking for Stage 2 would be carried out. Most work would take place during daytime hours, however some work may be required at night to minimise traffic impacts, such as when work on areas difficult to access cannot be contained behind barriers and require additional traffic control.

Stage 2 would involve re-opening the second southbound lane on Wakehurst Parkway and opening a second northbound lane from about 270 metres south of Dreadnought Road intersection. To enable this, traffic signal modifications would occur, along with new lane marking carried out during Stage 1 and traffic barriers removed. Bollards, temporary road signage and lane marking would be established for Stage 3. Most work would take place during daytime hours, however some work may be required at night to minimise disruption to traffic, such as when work on areas difficult to access cannot be contained behind barriers and require additional traffic control.

Stage 3 would involve construction of the median south of Dreadnought Road intersection and laying of final asphalt. Finishing work such as landscaping, linemarking, installation of signage and final traffic signal modifications would occur. Most work would occur during daytime hours, however some work may be required at night to minimise disruption to traffic, such as when work on areas difficult to access cannot be contained behind barriers and require additional traffic control.

**Wakehurst Parkway between Dreadnought Road and Oxford Falls Road**

Stage 0 would comprise site establishment (site offices, storage and stockpiles, security fencing) at the selected construction compound(s), location and potential relocation of utilities, installation of environmental controls (sedimentation controls, boundary marking for vegetation clearing, etc), clearing and grubbing and placement of roadwork signage and temporary linemarking.

Traffic barriers would be placed along the edge of Wakehurst Parkway northbound lanes at Dreadnought Road intersection and also on the southbound lane at Oxford Falls Road intersection, and Wakehurst Parkway northbound at Dreadnought Road intersection in the north-western corner, as well as along the edge of the northbound lane between Dreadnought Road and Oxford Falls Road to protect workers conducting vegetation clearing, and Stage 1 work. Traffic signal adjustments would be implemented to enable safe passage of vehicles through the construction areas. Some of this work on and around the existing alignment would be carried out at night to minimise traffic impacts. Traffic would remain on the existing alignment during this stage.

Stage 1 would involve completion of utility adjustments and property adjustments at Lot 1051 and 1043 of DP752038. Work would commence within the road reserve on the northbound side from just south of Dreadnought Road intersection extending north to Oxford Falls Road intersection. This would involve earthworks and full depth pavement construction.

Traffic would be shifted away from the construction areas with the use of barriers and temporary lane marking established during Stage 0. This stage involves a cut along the southbound lane opposite the Oxford Falls Road intersection which would temporarily limit the road pavement available to traffic due to the need to provide safe working distances to live traffic. Some traffic diversions may be required to safely carry out work. Northbound traffic would be limited to one lane. Southbound traffic would also be limited to one lane up until 100 metres north of Dreadnought Road intersection where

dedicated left and right turn lanes are provided. To enable Stage 2, roadwork signage and linemarking, traffic signal adjustment and traffic barrier placement would occur. Most work would be carried out during daytime hours, however some may be carried out at night to minimise traffic impacts, particularly where large equipment may be required to facilitate earthworks at the cutting.

Stage 2 would involve earthworks and new pavement construction at the northeastern corner of Dreadnought Road intersection up to the unnamed tributary that crosses Wakehurst Parkway north of the intersection. Traffic barriers would be placed along Dreadnought Road east of the intersection and along the southbound lane between Dreadnought Road intersection and the unnamed tributary to protect workers and the general public. Along the northbound lane of Wakehurst Parkway, bollards would be installed between Dreadnought Road to about 60 metres south of Oxford Falls intersection. Northbound traffic would be limited to one lane between Dreadnought Road and Oxford Falls Road, where a separate left turn lane would be provided for traffic turning left on to Oxford Falls Road, after which northbound traffic would revert to one lane. Southbound traffic would be provided a right turn bay at Oxford Falls Road but would otherwise remain one lane until about 100 metres north of Dreadnought Road intersection.

Enabling work for Stage 3 would involve roadwork signage and linemarking, traffic signal adjustments and placement of traffic barriers for the Stage 3 traffic switch. Most work would be carried out during daytime hours, however some may be carried out at night to minimise traffic impacts.

Stage 3 work would involve construction of the median north of Dreadnought Road intersection either during daytime with bollards to protect workers where road width permits, or during night time work. Laying of final asphalt would occur at night. Finishing work such as landscaping, linemarking, installation of signage and final traffic signal modifications would occur. Due to median work, one lane of traffic in each direction would be open along Wakehurst Parkway.

### **Wakehurst Parkway from Elanora Road to Mirrool Street**

Stage 0 would comprise site establishment (site offices, storage and stockpiles, security fencing) at the selected construction compound(s), location and potential relocation of utilities, installation of environmental controls (sedimentation controls, boundary marking for vegetation clearing, etc), and placement of roadwork signage and temporary linemarking. Construction access points would be installed, and vegetation removal may commence adjacent to the southbound lane of Wakehurst Parkway and would involve placing traffic barriers for worker safety.

Stage 1 would involve vegetation clearing and earthworks along the southbound lane of Wakehurst Parkway, as well as full depth pavement work on the southern side of Wakehurst Parkway opposite Mirrool Street. Traffic along Wakehurst Parkway would be temporarily shifted to the north, utilising the existing northbound shoulder as a traffic lane. Construction vehicles would access the construction area via the existing southbound lane of Wakehurst Parkway. Most of this work would occur at night time due to narrow access and to minimise traffic impacts.

Stage 2 would involve vegetation clearing on the northwestern corner of Mirrool Street intersection, construction of a pedestrian footpath and a left turn bay, earthworks and pavement construction adjacent to the northbound lane of Wakehurst Parkway. Traffic would temporarily be switched towards the south, utilising the existing southbound shoulder as a traffic lane. Pedestrian exclusion fencing and traffic barriers would be installed for the duration of this work to protect construction workers and the general public. Construction vehicles would access the construction area via Mirrool Street. Enabling work for Stage 3 would commence, including temporary roadwork signage and linemarking, traffic signal adjustments and placement of traffic barriers in anticipation of the switch to Stage 3 traffic conditions.

Stage 3 would involve construction of the median west of Elanora Road intersection and laying of final asphalt. Work would occur at night and temporary bollards installed around the median work. Finishing work such as landscaping, permanent linemarking and installation of signage would also occur.



Legend

- |   |   |
|---|---|
|  Proposal area |  Traffic flow        |
|  Watercourse   |  Construction access |
|  Stage 1*      |  Southbound          |
| *Construction staging indicative only   |  Northbound          |

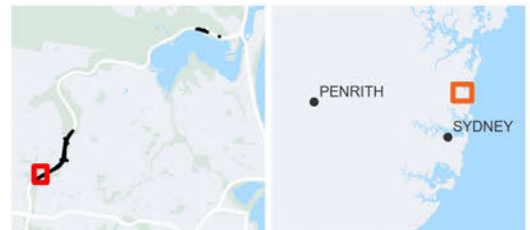








Figure 3-17, Construction stage 1 - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 1 of 2)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





**Legend**

- |   |   |
|---|---|
|  Proposal area | <b>Traffic flow</b>   |
|  Watercourse   |  Construction access |
|  Stage 1*      |  Southbound          |
| *Construction staging indicative only   |  Northbound          |

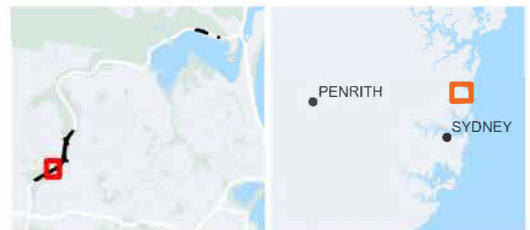


Figure 3-18, Construction stage 1 - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 2 of 2)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Neatmap 2022





**Legend**

- Proposal area
  - Watercourse
  - Stage 1\*
  - Construction access
  - Southbound
  - Northbound
- \*Construction staging indicative only

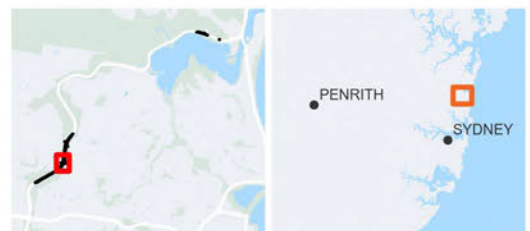
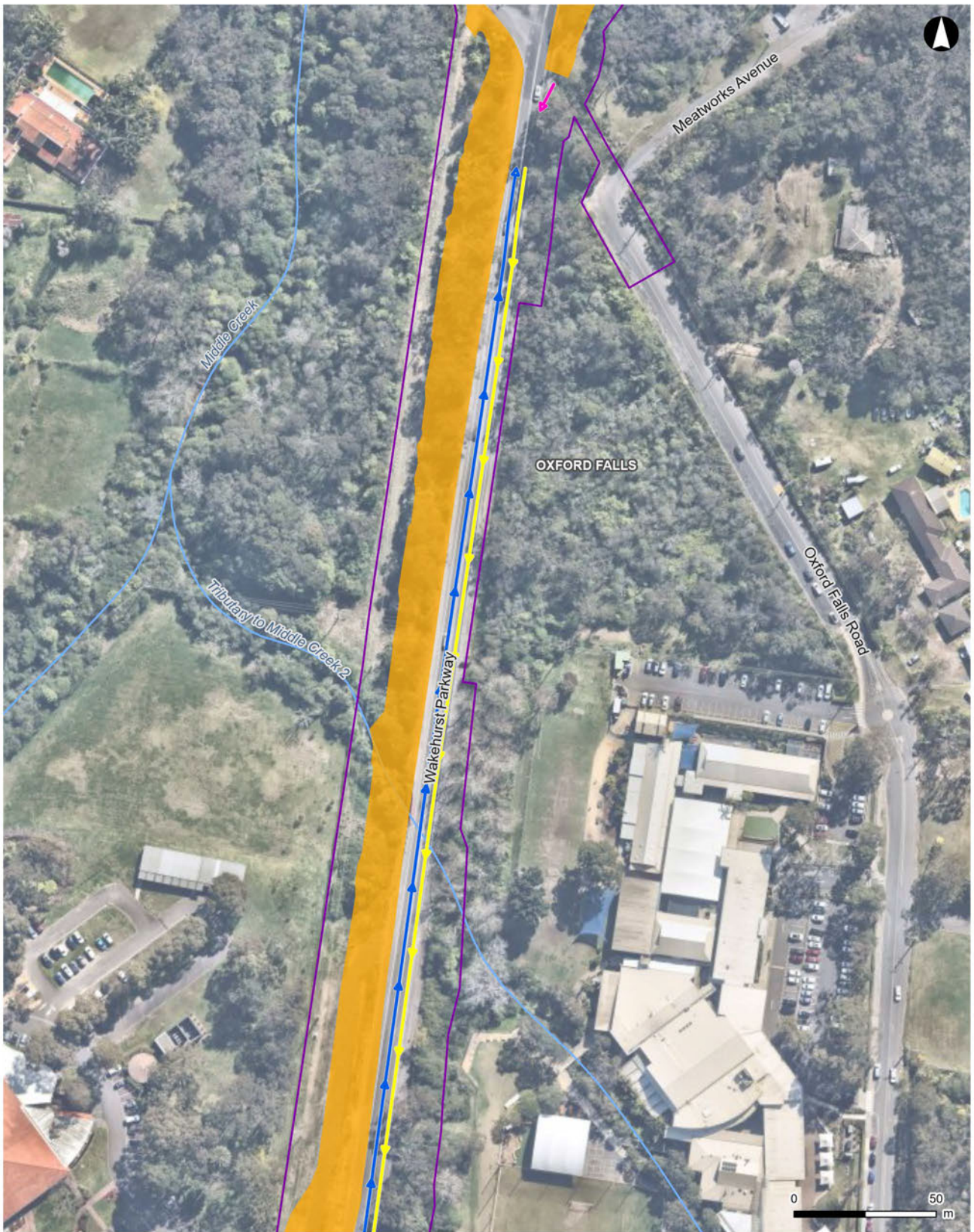


Figure 3-19, Construction stage 1 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 1 of 3)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 26, 2023  
 Imagery: Nearmap 2022





Legend

- |   |   |
|---|---|
|  Proposal area |  Construction access |
|  Watercourse   |  Southbound          |
|  Stage 1*      |  Northbound          |
- \*Construction staging indicative only

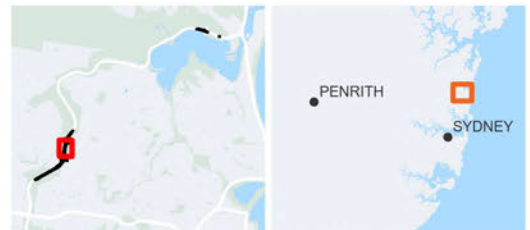


Figure 3-20, Construction stage 1 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 2 of 3)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





**Legend**

- |   |   |
|---|---|
|  Proposal area |  Construction access |
|  Watercourse   |  Southbound          |
|  Stage 1*      |  Northbound          |
- \*Construction staging indicative only

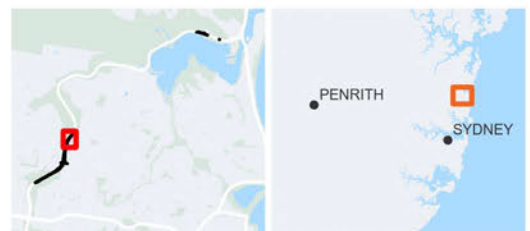


Figure 3-21, Construction stage 1 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 3 of 3)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





Legend

- |   |  |
|---|--|
|  Proposal area | <b>Traffic flow</b>  |
|  Watercourse   |  Southbound |
|   |  Northbound |

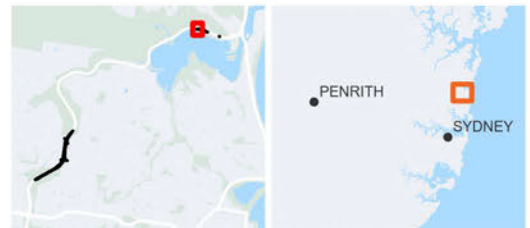


Figure 3-22, Construction stage 1 - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 1 of 2)

1:1,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022







**Legend**

- |   |   |
|---|---|
|  Proposal area |  Construction access |
|  Watercourse   |  Southbound          |
|  Stage 1*      |  Northbound          |
- \*Construction staging indicative only

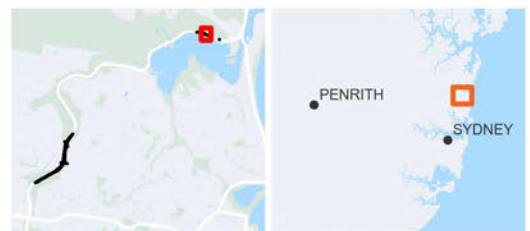


Figure 3-23, Construction stage 1 - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 2 of 2)

1:1,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearnmap 2022





- Legend**
- Proposal area
  - ~ Watercourse
  - Traffic flow
  - Southbound
  - ← Northbound



Figure 3-24, Construction stage 2 - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 1 of 2)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022

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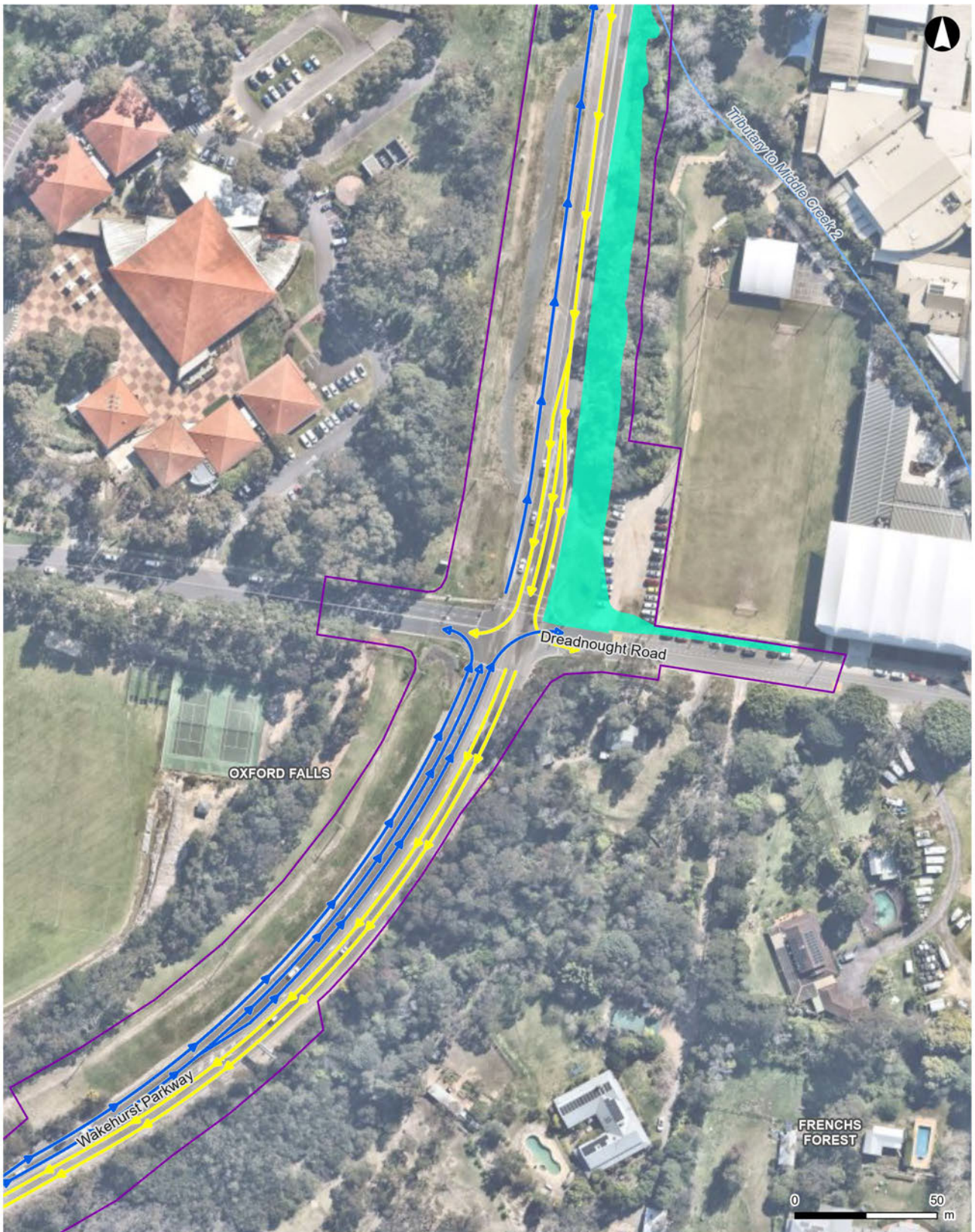
- Legend**
- Proposal area
  - ~ Watercourse
  - Traffic flow
  - Southbound
  - ← Northbound



Figure 3-25, Construction stage 2 - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 2 of 2)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





Legend

Proposal area

Watercourse

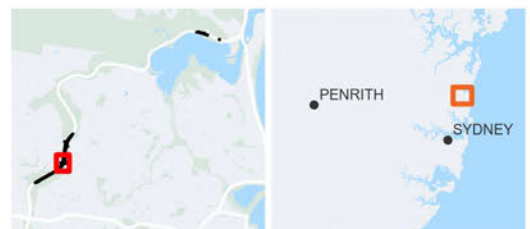
Stage 2\*

\*Construction staging indicative only

Traffic flow

Southbound

Northbound



1:2,000 at A4

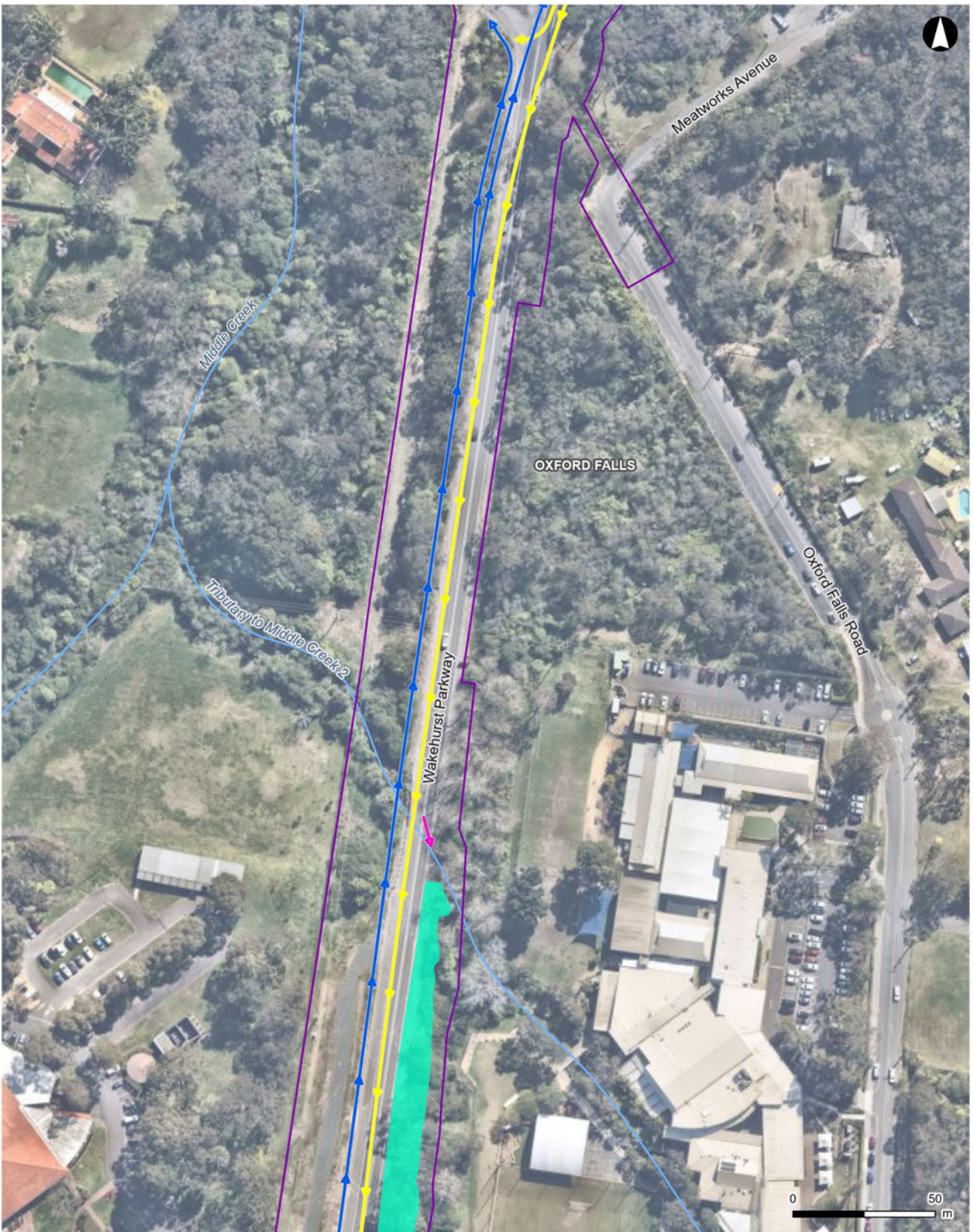
Coordinate System: GDA2020 MGA Zone 56

Date issued: September 13, 2023

Imagery: Nearmap 2022



Figure 3-26, Construction stage 2 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 1 of 3)



**Legend**

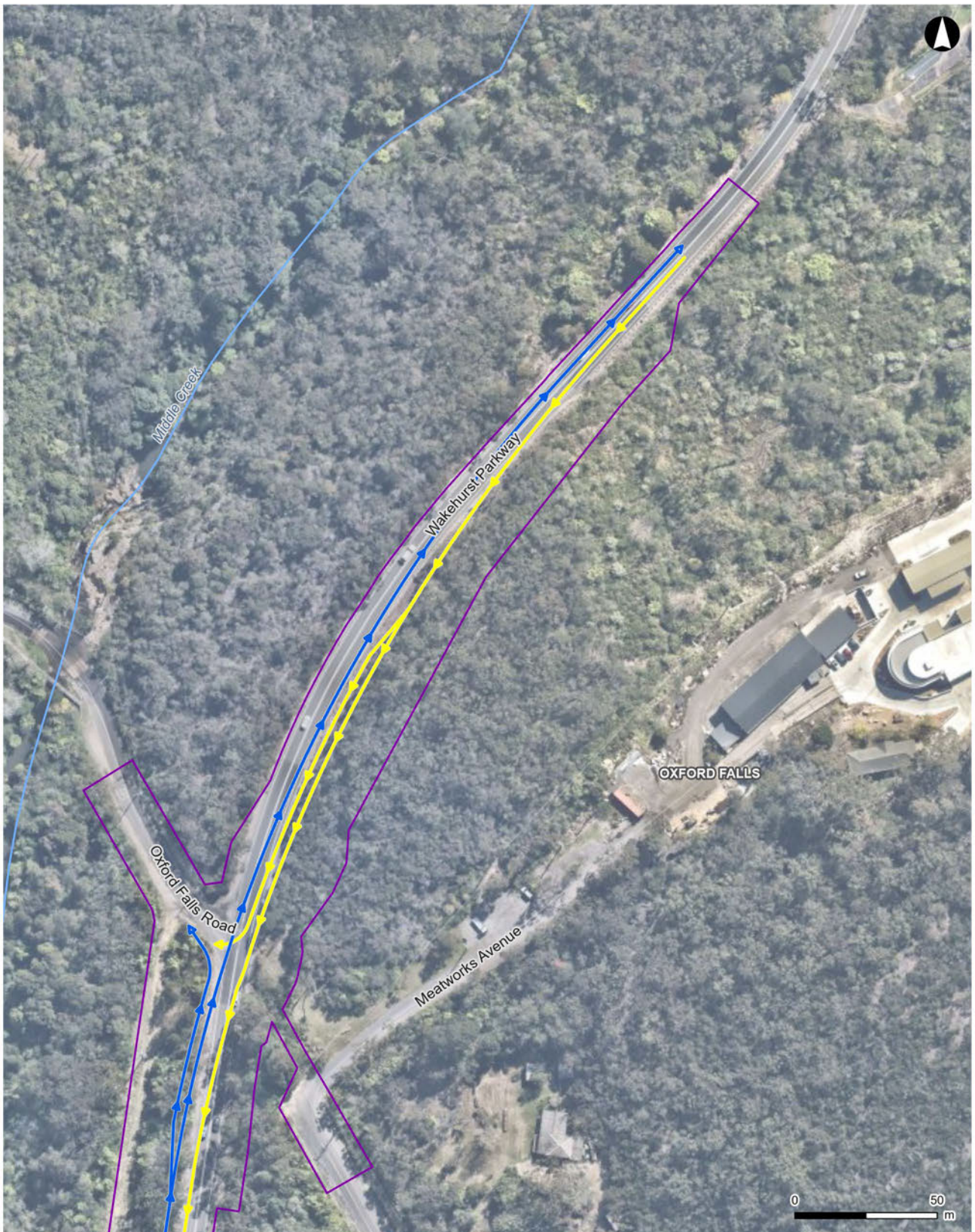
- |                                       |                     |
|---------------------------------------|---------------------|
| Proposal area                         | <b>Traffic flow</b> |
| Watercourse                           | Construction access |
| Stage 2*                              | Southbound          |
| *Construction staging indicative only | Northbound          |



Figure 3-27, Construction stage 2 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 2 of 3)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





Legend

- |   |  |
|---|--|
|  Proposal area |  Traffic flow |
|  Watercourse   |  Southbound   |
|   |  Northbound   |

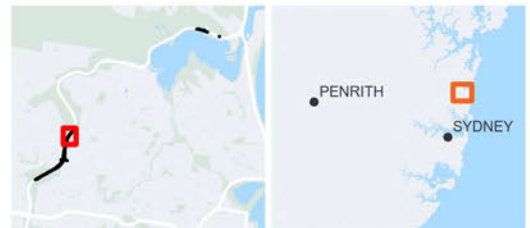
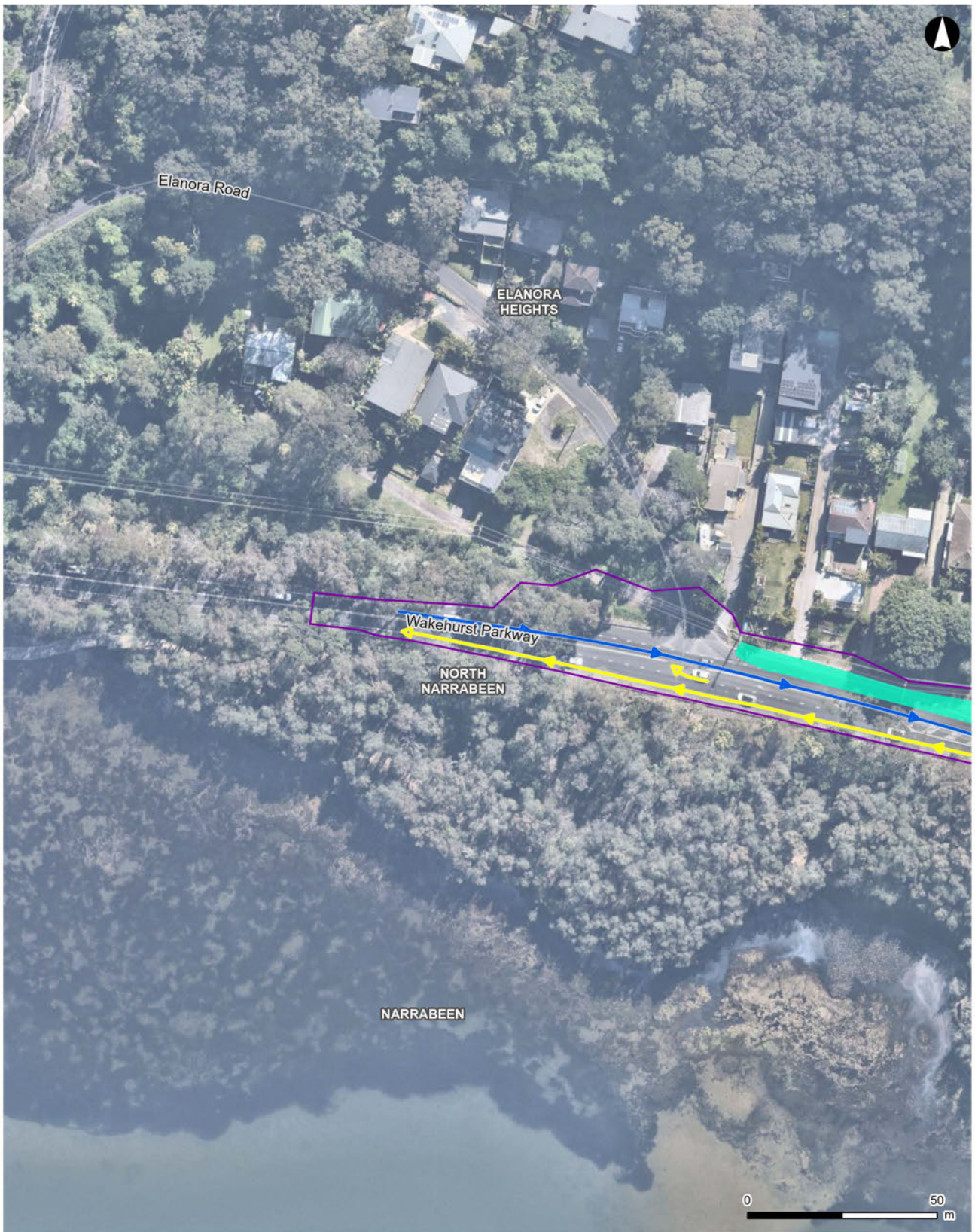


Figure 3-28, Construction stage 2 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 3 of 3)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





Legend

Proposal area

Watercourse

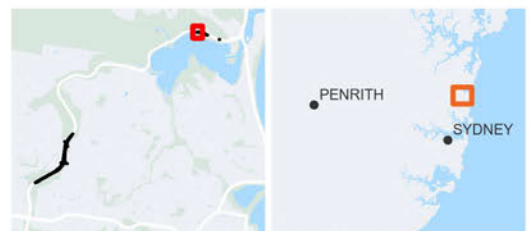
Stage 2\*

\*Construction staging indicative only

Traffic flow

Southbound

Northbound



1:1,500 at A4

Coordinate System: GDA2020 MGA Zone 56

Date issued: September 13, 2023

Imagery: Nearmap 2022



Figure 3-29, Construction stage 2 - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 1 of 2)



Legend

- |   |   |
|---|---|
|  Proposal area |  Construction access |
|  Watercourse   |  Southbound          |
|  Stage 2*      |  Northbound          |
| *Construction staging indicative only   |   |

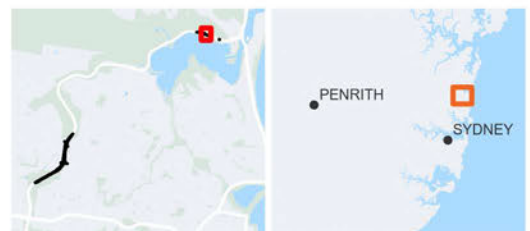


Figure 3-30, Construction stage 2 - Wakehurst Parkway from Elanora Road to Mirrool Street, (Figure 2 of 2)

1:1,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022







- Legend**
- Proposal area
  - ~ Watercourse
  - Traffic flow
  - Southbound
  - Northbound

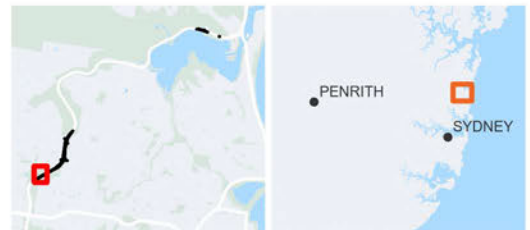
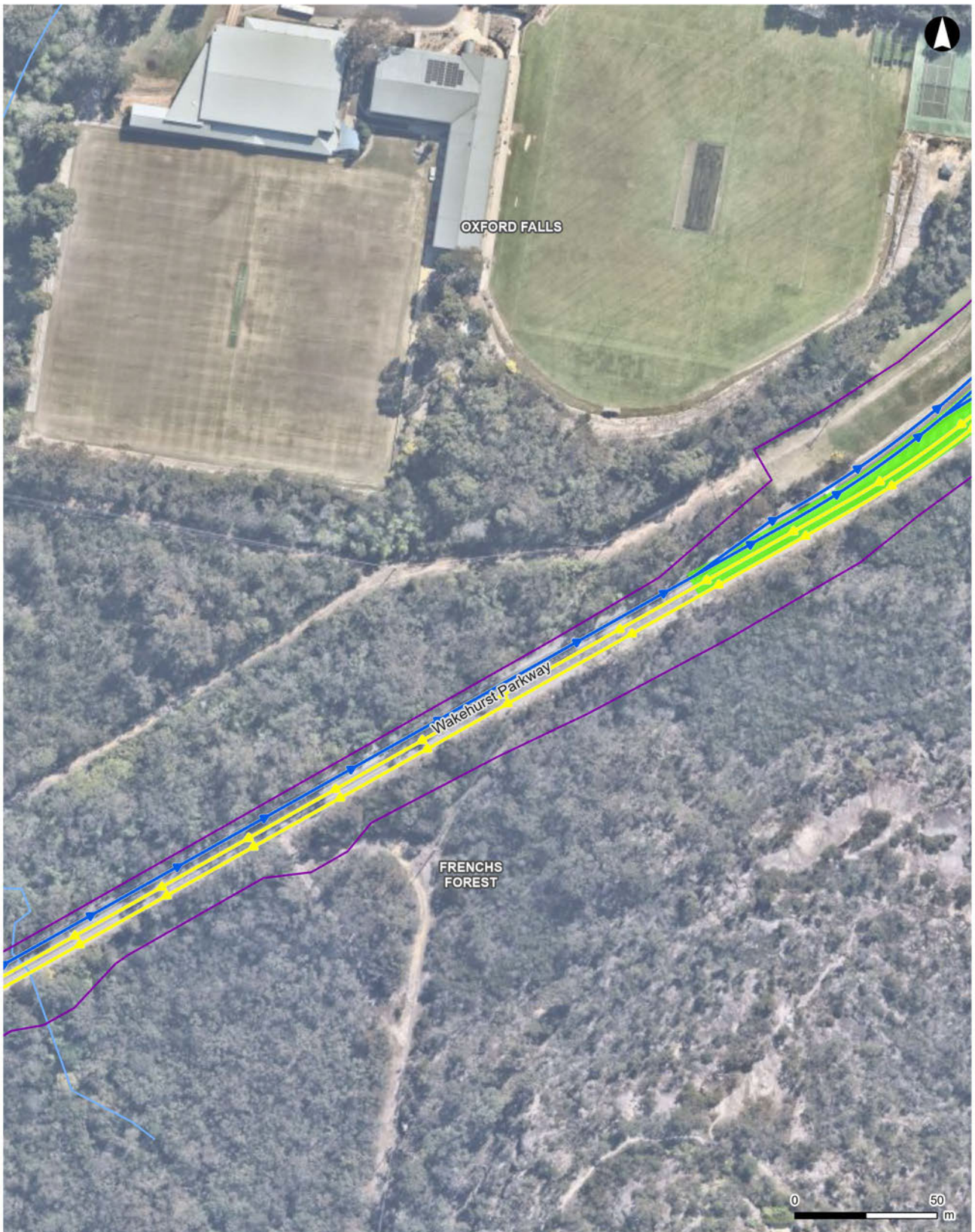


Figure 3-31, Construction stage 3- Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 1 of 2)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





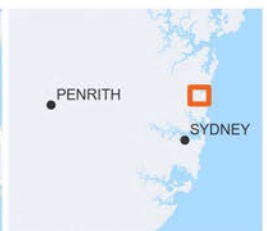
**Legend**

- Proposal area
- ~ Watercourse
- Stage 3\*

\*Construction staging indicative only

**Traffic flow**

- Southbound
- Northbound



1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022



Figure 3-32, Construction stage 3 - Wakehurst Parkway from Trefoil Creek to Dreadnought Road (Figure 2 of 2)



Legend

Proposal area

Watercourse

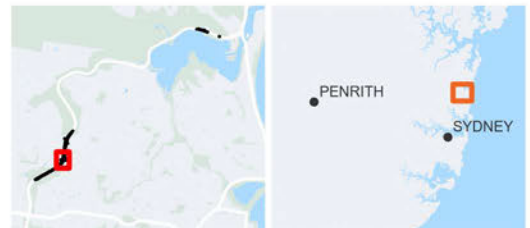
Stage 3\*

\*Construction staging indicative only

Traffic flow

Southbound

Northbound



1:2,000 at A4

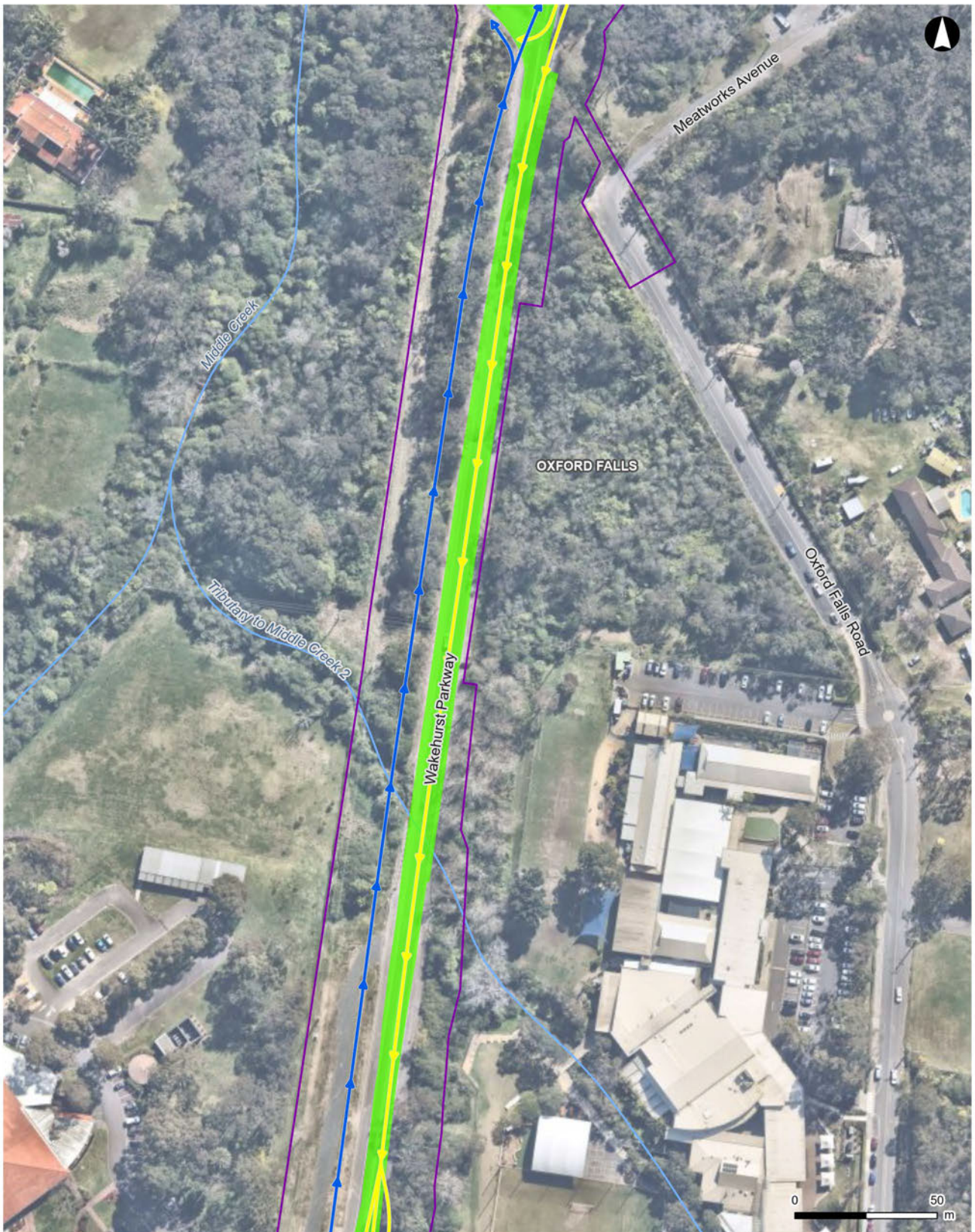
Coordinate System: GDA2020 MGA Zone 56

Date issued: September 13, 2023

Imagery: Nearmap 2022



Figure 3-33, Construction stage 3 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 1 of 3)



**Legend**

- Proposal area
- ~ Watercourse
- Stage 3\*

\*Construction staging indicative only

**Traffic flow**

- Southbound
- ← Northbound

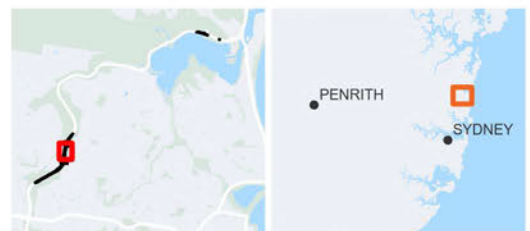
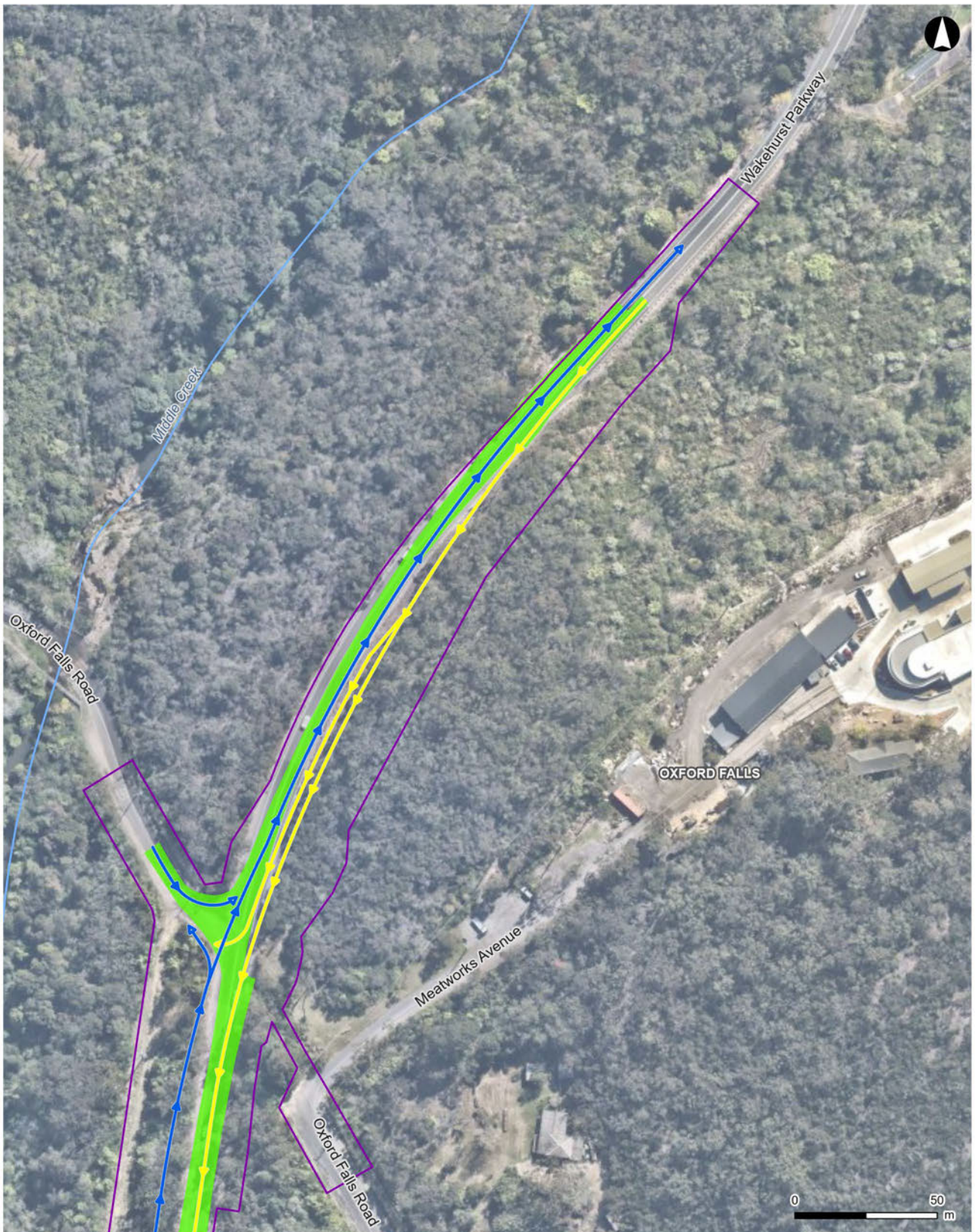


Figure 3-34, Construction stage 3 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 2 of 3)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





Legend

Proposal area

Watercourse

Stage 3\*

\*Construction staging indicative only

Traffic flow

Southbound

Northbound

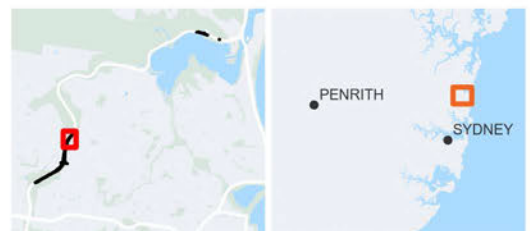


Figure 3-35, Construction stage 3 - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road (Figure 3 of 3)

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022





Legend

Proposal area

Watercourse

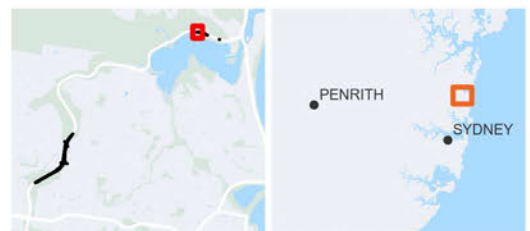
Stage 3\*

\*Construction staging indicative only

Traffic flow

Southbound

Northbound



1:1,500 at A4

Coordinate System: GDA2020 MGA Zone 56

Date issued: September 13, 2023

Imagery: Nearmap 2022



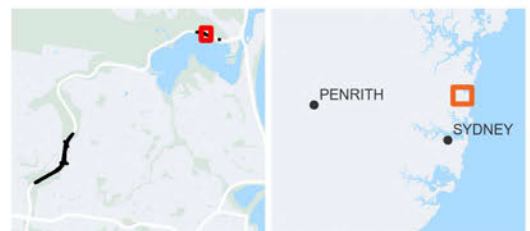
Figure 3-36, Construction stage 3 - Wakehurst Parkway from Elanora Road to Mirrool Street (Figure 1 of 2)



Legend

- Proposal area
- Watercourse
- Stage 3\*
- Traffic flow
- Southbound
- Northbound

\*Construction staging indicative only



1:1,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022



Figure 3-37, Construction stage 3 - Wakehurst Parkway from Elanora Road to Mirrool Street, (Figure 2 of 2)

### 3.3.2 Construction workforce

The size and arrangement of the construction workforce is expected to change throughout the duration of the proposal. The total number of construction and site management personnel would be dependent on each stage and the location on Wakehurst Parkway.

It has been estimated that about 25-30 people would be required for Wakehurst Parkway between Trefoil Creek and Oxford Falls Road, and about 10-15 people would be required for Wakehurst Parkway between Elanora Road and Mirrool Street. The final number of construction workers would be confirmed by the construction contractor.

### 3.3.3 Construction hours and duration

Construction of the proposal is planned to commence in mid to late 2024, with a staged approach.

Where possible, work would be carried out during standard construction hours as follows:

- Monday to Friday: 7:00 am to 6:00 pm
- Saturday: 8:00 am to 1:00 pm
- Sunday and public holidays: No work

To minimise traffic impacts and to ensure the safety of workers, it is expected that a number of activities would need to be undertaken outside of standard working hours. Noisier activities such as jackhammering and concrete cutting would be completed by midnight. These hours would be in accordance with the Road Occupancy Licence (ROL) issued by the Transport Management Centre and up to five nights a week as follows:

- evening / night work– Sunday to Thursday
- no work on public holidays

Any impacted residents or businesses would be consulted regarding the proposed construction hours at least five working days prior to work commencing in accordance with the Construction Noise and Vibration Guideline (Roads and Maritime, 2016) and EPA Interim Construction Noise Guideline (ICNG) (NSW DECC, 2009). The community would be kept informed of proposed upcoming work and contact information.

### 3.3.4 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:

- truck floats
- franna cranes
- hiab trucks
- hand tools
- excavators
- concrete agitator
- concrete vibrator
- road trucks
- rollers
- mulch truck
- jackhammer
- plate compactor
- light vehicles
- specialist trucks
- concrete saw
- asphalt paver
- kerb machine
- linemarking truck
- plate compactors
- skid steer loaders
- chainsaw
- vacuum truck

### 3.3.5 Earthworks

Earthworks for the proposal would include cut and fill of batters, excavation of road pavements, medians and road verges, utility relocations and upgrades, culvert installation, tree clearing, pavement installation and a rock cutting at Oxford Falls Road.



It is estimated that about 9,100 cubic metres of spoil would be exported for the proposal at Wakehurst Parkway between Oxford Falls Road and Trefoil Creek, and about 300 cubic metres for Wakehurst Parkway between Elanora Road and Mirrool Street.

### 3.3.6 Source and quantity of materials

The source and quantity of materials would be determined during the construction of the proposal by the Contractor.

The proposal would require water for activities such as the compaction of earthworks and pavement layers and for dust suppression. Water needed for the work would be obtained from authorised sources and would be recycled water where possible. No water would be extracted from any surface waterways. Surplus material that cannot be used on site would be disposed of according to the waste section of this REF (refer to Section 6.12).

### 3.3.7 Traffic management and access

The proposed work would be carried out both within and outside of standard working hours as outlined in Section 3.3.3.

Heavy vehicle movements would be used for the delivery of construction materials, the removal of spoil and waste material and the delivery and removal of construction equipment and machinery. Light vehicle movements would be required to facilitate the transport of construction personnel, including contractors, site labour force and specialist supervisory personnel.

Where possible, construction work would be arranged to minimise impacts on traffic, however Wakehurst Parkway, Dreadnought Road, Oxford Falls Road, Elanora Road and Mirrool Street would be impacted by partial road closures during construction. Standard traffic management measures would be employed to minimise the short-term traffic impacts expected. These measures would be identified in a Traffic Management Plan (TMP) for the proposal and would be developed in accordance with the *Traffic Control at Works Sites Manual* (RTA 2010) and Transport for NSW Specification G10 – Control of Traffic. 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 properties located between Elanora Road and Mirrool Street during construction. Some driveway adjustments for four properties on the northern side of Wakehurst Parkway, between Elanora Road and Mirrool Street, would be required. The existing arrangement for these driveways is left-in left-out, which would be reinstated upon completion of work.

The proposal would ban right turn movements into or out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, permanently impacting access to properties along the service road from this exit. Properties on the service road would still be accessible from Mirrool Street.

Affected residences/ businesses would be notified prior to work starting and impacts managed through the TMP. Pedestrian access is to be maintained at all times.

There would be no change to bus services during construction.

Further details and assessment of traffic and transport impacts are provided in Section 6.6.

## 3.4 Ancillary facilities

To support the proposed upgrade, ancillary construction compounds would be required for the following activities:

- site offices
- staff parking
- stockpile areas
- laydown areas for materials
- refuelling areas for plant.

Nine compound site options have been nominated for the proposal. These are detailed in Table 3-2 and shown in Figure 3-38 to Figure 3-43.

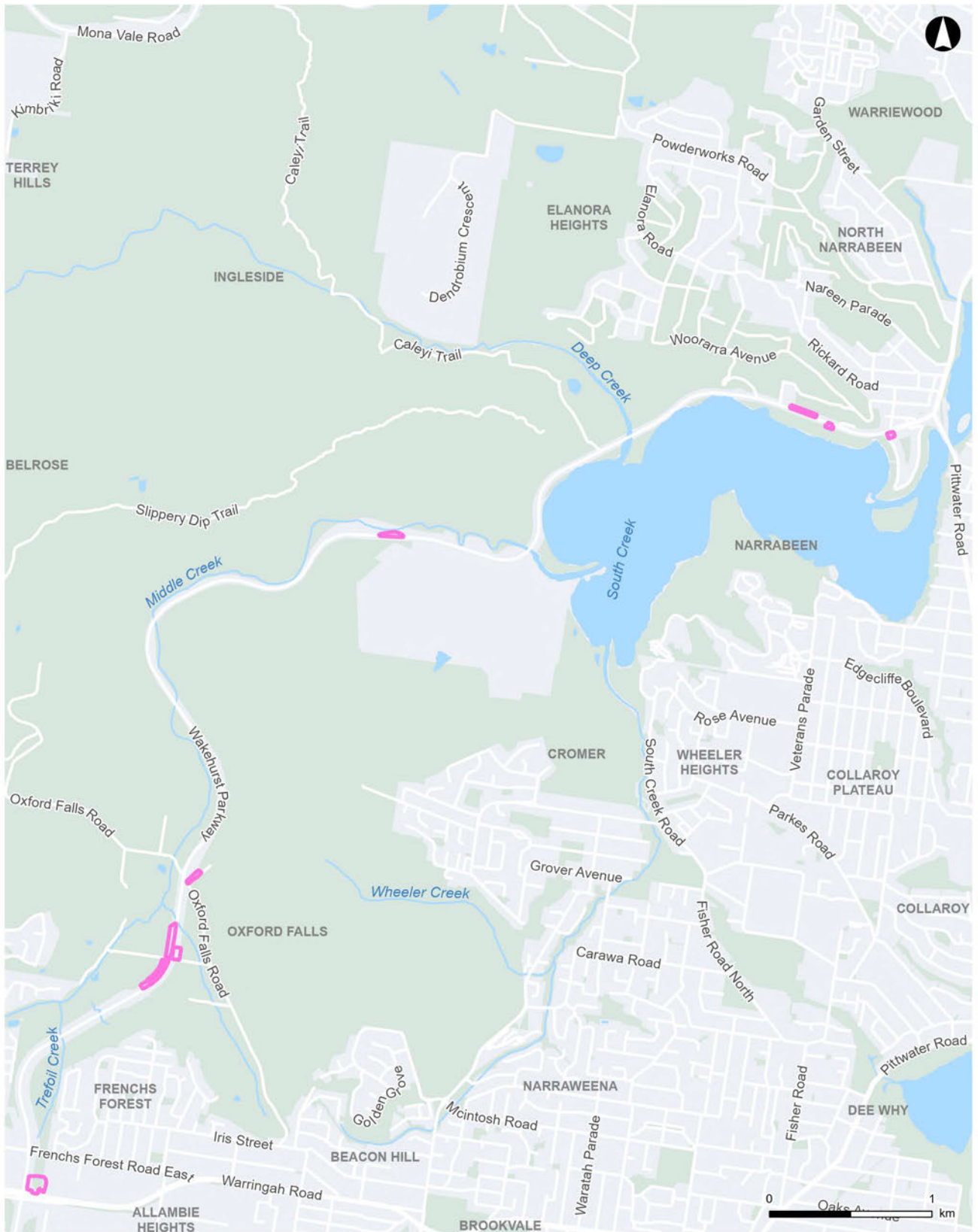
Table 3-2: Construction compounds

Construction compound ID	Total area	Lot and DP	Land use zone (LEP)	Description
CC1	6,330	Lot 11 and 12 of DP1092595	RE1 Public Recreation SP2 Infrastructure SP4 Enterprise	Transport owned land accessed from Warringah Road. Southernmost compound option. Existing hardstand areas and unsealed sparsely vegetated areas.
CC2a	3,893	N/A	SP2 Infrastructure	Western road verge of Wakehurst Parkway south of intersection with Dreadnought Road. Consists of grassed areas and informal vehicle access path for transmission lines.
CC2b	1,262	N/A	SP2 Infrastructure	Land owned by St Pius X school, adjacent to the St Pius X Treacy Education Complex and Sporting Fields playing fields. Consists of grassed areas and informal vehicle access path for transmission lines. Use of this compound option is subject to agreement with the land owner.
CC3	4,158	N/A	SP2 Infrastructure	Western road verge of Wakehurst Parkway north of intersection with Dreadnought Road. Adjacent to C3 SYD Church. Consists of grassed land and hardstand access road.
CC4	1,606	N/A	SP2 Infrastructure	Eastern road verge of Wakehurst Parkway north of intersection with Dreadnought Road. Adjacent to Oxford Falls Grammar playing fields. Existing unsealed gravel car parking area and some grassed areas.
CC5	991	Lot 1053 of DP752038 Lot 2591 of DP752038	DM Deferred Matter	Eastern side of Wakehurst Parkway located on Meatworks Avenue. Accessed via Oxford Falls Road East. Existing car parking area and some grassed areas.
CC6	1,429	Lot 888 of DP752038 Lot 7060 of DP1058878	SP2 Infrastructure	Northern side of Wakehurst Parkway about 360 metres west of the Sydney Academy of Sport and Recreation. Existing heavy vehicle checking hardstand.
CC7	1,526	N/A	SP2 Infrastructure	Northern side of Wakehurst Parkway east of intersection with Mirrool Street. Currently used as informal parking by residents.

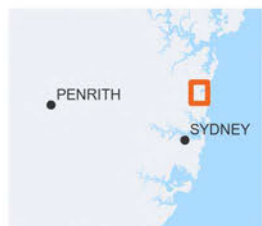
## Transport for NSW

Construction compound ID	Total area	Lot and DP	Land use zone (LEP)	Description
CC8	1,530	Lot 11 of DP749900	RE1 Public Recreation SP2 Infrastructure	Southern side of Wakehurst Parkway located within Bilarong Reserve adjacent to playground.
CC9	620	Lot 1 of DP348226	R2 Low Density Residential	Southern side of Wakehurst Parkway at intersection of Wimbledon Avenue. Northernmost compound option.

No tree clearing or excavation is proposed for establishment or operation of the compounds, with the exception of Construction Compound 4 (CC4). Vegetation within CC4 would be cleared, and would be revegetated after construction is completed. Existing grass would be protected by a layer of geofabric and hardstand. Tree protection measures would be implemented for trees to be retained (as detailed in Section 6.1).



**Legend**  
 Proposed compound site



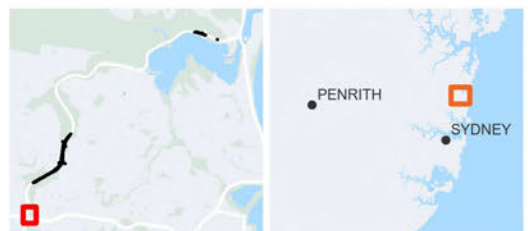
1:35,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 11, 2023  
 Imagery: Nearmap 2022  
 

Figure 3-38, Location of the proposed construction compounds



Legend

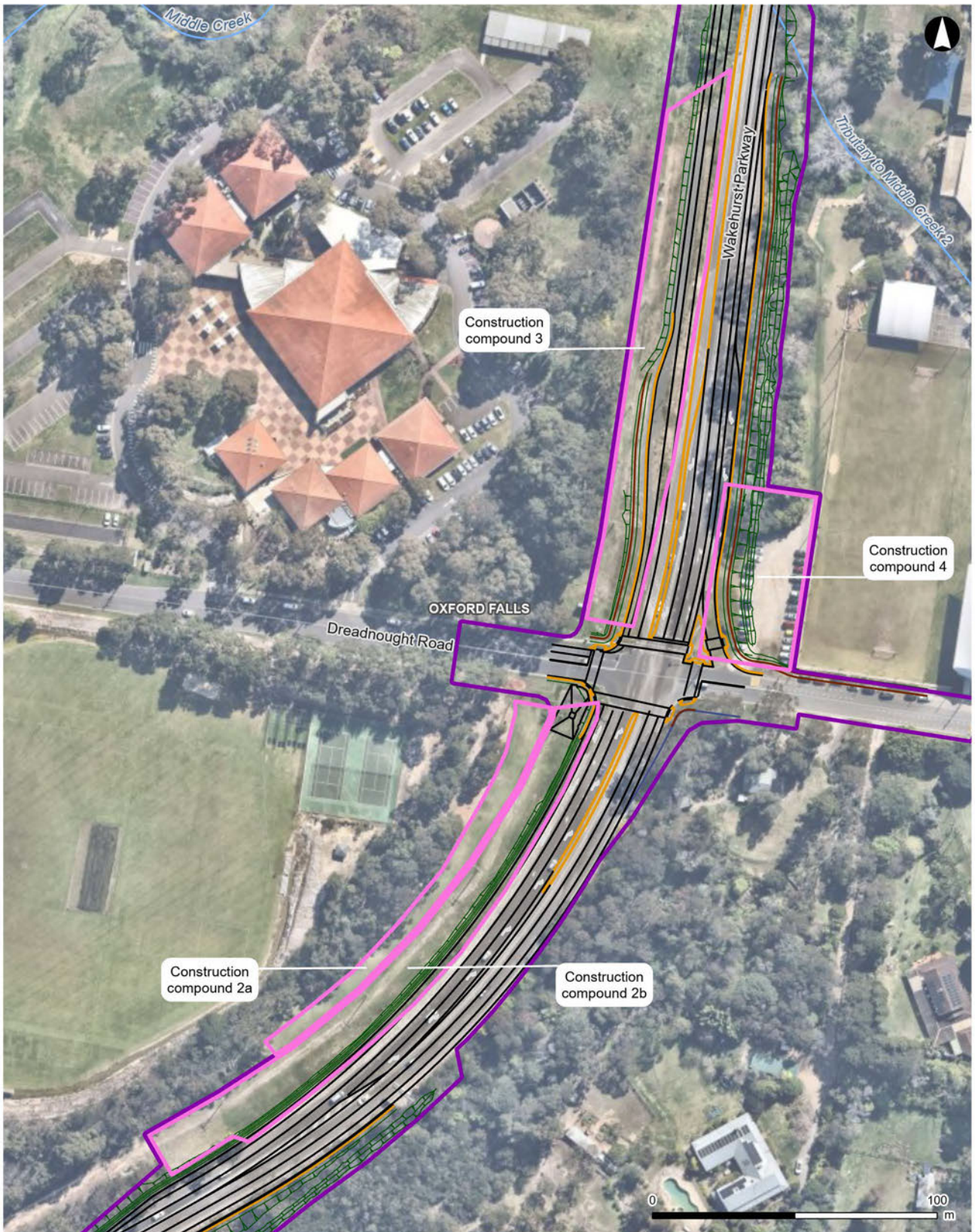
- Proposed compound site











1:2,000 at A4  
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 Date issued: October 3, 2023  
 Imagery: Nearmap 2022

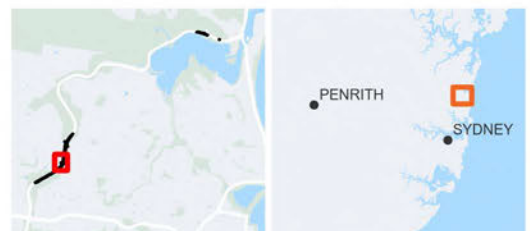


Figure 3-39, Ancillary facilities - Construction compound 1



Legend

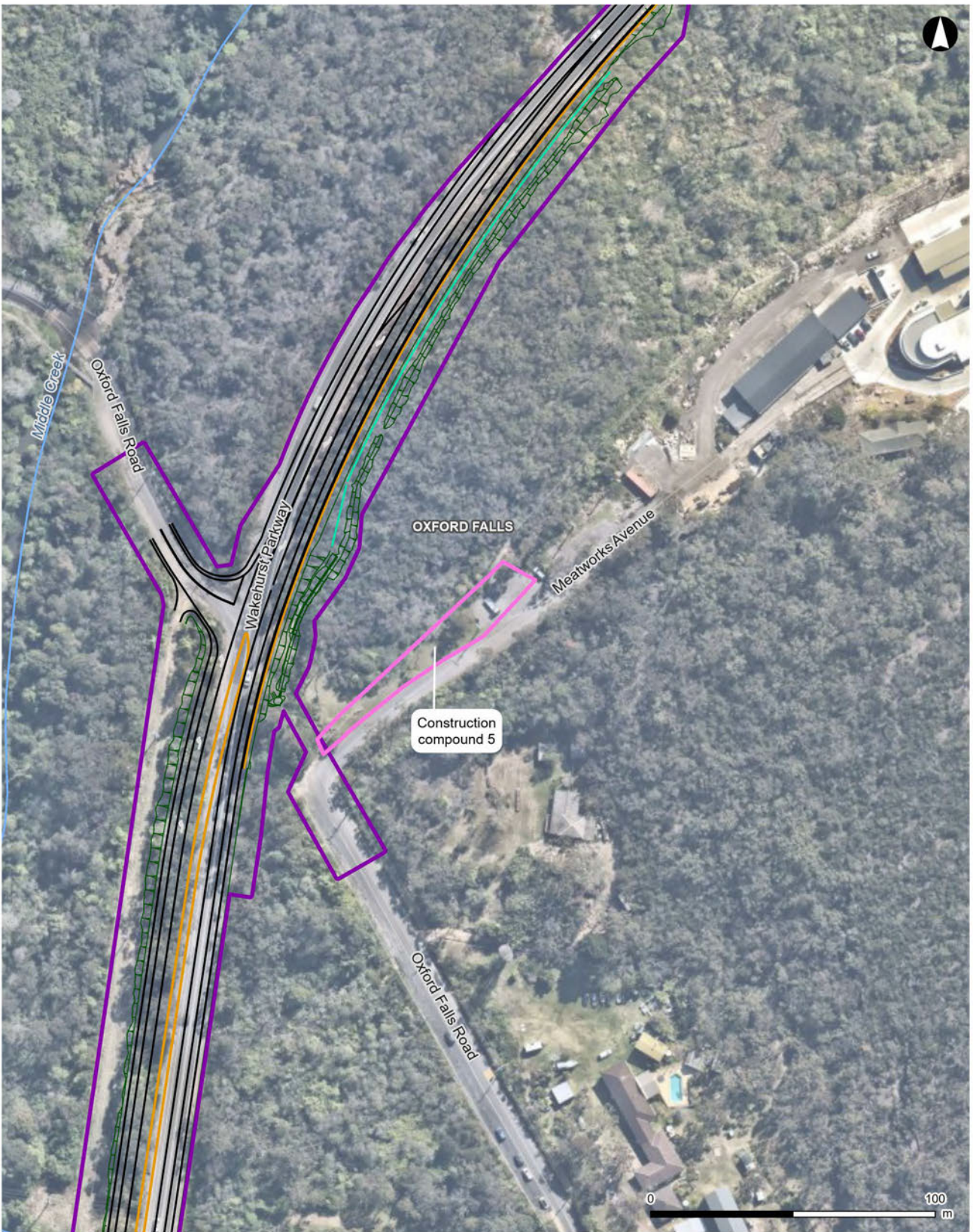
- |  |   |
|--|---|
|  Proposed compound site |  Barrier     |
|  Proposal area          |  Earthworks  |
| <b>Proposal</b>  |  Kerb/Median |
|  Line marking           |  Road design |
|  Footpath               |   |



1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022

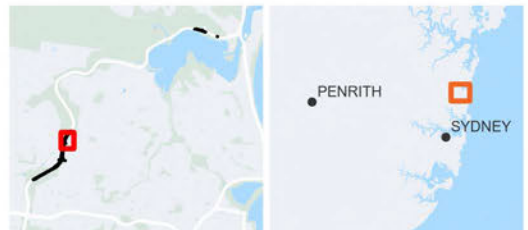


Figure 3-40, Ancillary facilities - Construction compound 2 to 4



Legend

- |                        |                |
|------------------------|----------------|
| Proposed compound site | Retaining wall |
| Proposal area          | Earthworks     |
| Proposal               | Kerb/Median    |
| Line marking           | Road design    |
| Barrier                |                |




1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022

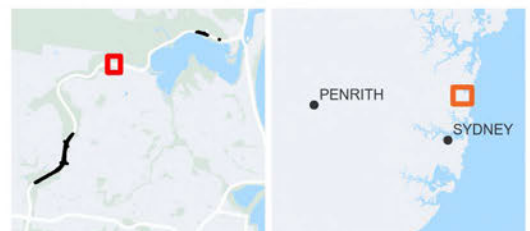


Figure 3-41, Ancillary facilities - Construction compound 5



Legend

 Proposed compound site



1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022

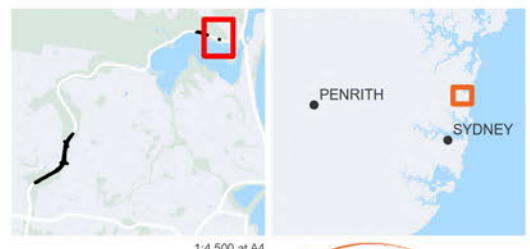


Figure 3-42, Ancillary facilities - Construction compound 6





- Legend**
- Proposed compound site
  - Proposal area
  - Proposal
  - Line Marking
  - Footpath
  - Barrier
  - Retaining wall
  - Earthworks
  - Road design



1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022

**ESC** **GDA 2020**  
 Building a Sustainable Legacy

Figure 3-43, Ancillary facilities - Construction compound 7 to 9

## 3.5 Utility adjustments

### 3.5.1 Public utility adjustment

Several public utilities would be impacted by the proposed work. Utility adjustments would be made within the proposal work area, to the extents described below:

- within and between Wakehurst Parkway from Trefoil Creek to Dreadnought Road intersection
- within and between the intersections of Wakehurst Parkway and Dreadnought Road and Wakehurst Parkway and Oxford Falls Road
- within and between the intersections of Wakehurst Parkway and Elanora Road and Wakehurst Parkway and Mirrool Street.

Impacted utilities, including the proposed actions are detailed below in Table 3-3. Impacts on existing drainage infrastructure is detailed in Section 3.2.3 and shown on Figure 3-11 to Figure 3-13.

Utility relocations have generally been proposed in accordance with guidelines from the relevant service providers.

Table 3-3: Public utility impacts

Owner	Asset	Location	Proposed Treatment
Jemena	High pressure gas pipe	Wakehurst Parkway	Protection with a concrete slab
Transport for NSW	Low voltage Intelligent Transport Systems (ITS)	Wakehurst Parkway and Dreadnought Road intersection	Relocate in alignment with the proposed Traffic Control Signal (TCS) design
Ausgrid	Low voltage cover	Wakehurst Parkway and Oxford Falls Road intersection	Relocate to the kerb on Wakehurst Parkway northbound
Ausgrid	Electrical pole	Wakehurst Parkway	Relocate to the kerb on Wakehurst Parkway northbound, south of the Oxford Falls Road intersection
Ausgrid	Electrical pole	Wakehurst Parkway	Relocate to the kerb on the new bus bay located on Wakehurst Parkway northbound
Ausgrid	Electrical pole	Wakehurst Parkway and Oxford Falls Road intersection	Relocate to kerb of on Wakehurst Parkway northbound, on the south-western corner of the intersection
Ausgrid	Electrical pole	Wakehurst Parkway and Oxford Falls Road intersection	Road to be constructed without affecting the electrical pole. Stay to be adjusted outside of the road corridor.

Owner	Asset	Location	Proposed Treatment
Transport for NSW	Low voltage electrical	Wakehurst Parkway	Relocate in alignment with the proposed TCS design
Ausgrid	High voltage overhead electrical	Wakehurst Parkway	Stay to be adjusted outside of the road corridor
Transport for NSW	Low voltage overhead electrical and traffic classifier loops	Wakehurst Parkway	Loops to be relayed in pavement as they are constructed. Pits to be shifted out of road widening.
Ausgrid	Electrical pole	Pedestrian island ramp at Wakehurst Parkway and Dreadnought Road intersection	Relocate to north-eastern corner of the intersection. Existing overhead low voltage and high voltage cable to be relocated underground.
Ausgrid	Electrical pole	Wakehurst Parkway and Dreadnought Road intersection	Replaced with stronger pole at the north-western corner of the intersection. Stay to be relocated outside of the road corridor
Transport for NSW	Low voltage electrical	Wakehurst Parkway	Relocate in alignment with the proposed TCS design
Telstra	Communication line	Wakehurst Parkway and Oxford Falls Road intersection	Asset to be relocated over a cable length of about 75 metres. Property connection to be reinstated.
Jemena	High pressure gas pipe	Wakehurst Parkway and Elanora Road intersection	Protect with a concrete slab

### 3.6 Property acquisition

To accommodate the widening of Wakehurst Parkway southbound near Oxford Falls Road, partial property acquisition of Crown land may be required. The property boundaries at this location are not formally defined. These boundaries would be verified during further design development which may result in change to the area of proposed acquisition. There is potential that no acquisition would be required, subject to the confirmation of property boundaries. An overview of the affected property including address, Lot and DP, current land use and proposed area of acquisition is provided in Table 3-4. The approximate location of the proposed property acquisition can be seen in Figure 3-44.

The owner of the affected property would be consulted with, and ongoing consultation would occur during detailed design and construction stages. The cadastral boundary of affected properties is still subject to definition, and this would inform final acquisition quantities.

All land acquisition would be carried out in accordance with the provisions of the *Land Acquisition (Just Terms) Compensation Act 1991*.

Table 3-4: Proposed property acquisition

Description	Total area (m <sup>2</sup> )	Acquisition type	Current owner	Lot and DP	Land use zone (LEP)
Partial acquisition	About 2,700	Partial	Federal Government	Lot 1043, DP 752038 Lot 1051, DP 752038 Lot 1044, DP 752038	SP2 Infrastructure



**Legend**

- Proposed construction site
- Proposal area
- Property acquisition
- Lot\*
- Watercourse

\*Cadastral boundary is subject to being defined in this area which will impact the final acquisition area



1:1,500 at A4  
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 Imagery: Nearmap 2022



Figure 3-44, Property acquisition - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

## 4. Statutory and planning framework

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

### 4.1 Environmental Planning and Assessment Act 1979

#### 4.1.1 State Environmental Planning Policies

##### **State Environmental Planning Policy (Transport and Infrastructure) 2021**

State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP (Transport and Infrastructure)) aims to facilitate the effective delivery of infrastructure across the State.

Section 2.109 of SEPP (Transport and Infrastructure) 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 the upgrade of key intersections along Wakehurst Parkway and is to be carried out by Transport, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* (NPW Act) and does not require development consent or approval under:

- State Environmental Planning Policy (Planning Systems) 2021
- State Environmental Planning Policy (Precincts – Central River City)
- State Environmental Planning Policy (Precincts – Eastern Harbour City)
- State Environmental Planning Policy (Precincts – Regional) 2021
- State Environmental Planning Policy (Precincts – Western Parkland City) 2021.

Section 2.10 to 2.15 of SEPP (Transport and Infrastructure) 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 SEPP (Transport and Infrastructure) (where applicable), is discussed in chapter 5 of this REF.

##### **State Environmental Planning Policy (Resilience and Hazards) 2021**

The SEPP (Resilience and Hazards) aims to promote an integrated and coordinated approach to land use planning in the coastal zone that is consistent with the objects of the Coastal Management Act 2016. The SEPP (Resilience and Hazards) provides conditions surrounding the development or environmental impact on land considered coastal wetland or littoral rainforest as identified in Division 1 of the SEPP (Resilience and Hazards).

The northern section of the proposal (at Elanora Road and Mirrool Street) is located on land in proximity to coastal wetlands as defined by the SEPP (Resilience and Hazards). Therefore development consent is required under section 2.8 of the SEPP and the consent authority must be satisfied that the proposal would not significantly impact on:

- (a) *the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest,*  
or
- (b) *the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.*

The proposal would not impact on coastal wetlands or on littoral rainforest as defined in the SEPP (Resilience and Hazards), and as a result an environmental impact statement is not required.

Chapter 6 of the REF includes an assessment of the proposal's impacts on biodiversity (Section 6.1), hydrology and flooding (Section 6.2), surface water (Section 6.3) and groundwater (Section 6.4).

#### 4.1.2 Local Environmental Plans

As outlined in Section 4.1.1, development consent is not required in line with the Transport and Infrastructure SEPP.

The proposal site is located on land identified in the Pittwater Local Environmental Plan 2014 (Pittwater LEP) and the Warringah Local Environmental Plan 2011 (Warringah LEP) as:

- road reserves
- Elanora Road and Mirrool Street intersections:
  - Lot 12 of DP749900 (Warringah LEP)
  - Lot 9 of DP749900 (Warringah LEP)
  - Lot 15 of DP1014199 (Warringah LEP)
  - Lot 14 of DP1014199 (Warringah LEP)
  - Lot 13 of DP1014199 (Warringah LEP)
- Oxford Falls Road intersection:
  - Lot 1051 of DP752038 (Pittwater LEP)
  - Lot 1044 of DP752038 (Pittwater LEP)
- construction compounds:
  - Option 1:
    - Lot 11 of DP1092595 (Warringah LEP)
    - Lot 12 of DP1092595 (Warringah LEP)
  - Option 5:
    - Lot 1053 of DP752038 (Warringah LEP)
    - Lot 2591 of DP752038 (Warringah LEP)
  - Option 6:
    - Lot 888 of DP752038 (Pittwater LEP)
    - Lot 7060 of DP1058878 (Pittwater LEP)
  - Option 8:
    - Lot 11 of DP749900 (Warringah LEP)
  - Option 9:
    - Lot 1 of DP348226 (Warringah LEP)

The land zoning applicable to the proposal includes SP2 (Infrastructure), SP4 (Enterprise), RE1 (Public Recreation), and DM (Deferred Matter) (refer to Figure 4-1 to Figure 4-4).

***Pittwater Local Environmental Plan (2014)***

The western part of the proposal is subject to the Pittwater LEP. A small portion of the work are proposed on land that is not zoned (deferred matter).

The objectives of each zone and the proposal’s consistency with these objectives are summarised in Table 4-1.

Table 4-1: Proposal consistency with relevant land use zone objectives

Zone type	Objectives of zone	Proposal consistency with objectives
RE1 Public recreation	<ul style="list-style-type: none"> <li>• to enable land to be used for public open space or recreational purposes</li> <li>• to provide a range of recreational settings and activities and compatible land uses</li> <li>• to protect and enhance the natural environment for recreational purposes</li> </ul>	<p>The proposal would not involve use of substantial portions of land zoned RE1.</p> <p>The proposal would improve traffic congestion and in effect improve the accessibility of public open space resources.</p> <p>This proposal is consistent with the objectives of the RE1 zone.</p>

Zone type	Objectives of zone	Proposal consistency with objectives
	<ul style="list-style-type: none"> <li>to allow development that does not substantially diminish public use of, or access to, public open space resources</li> <li>to provide passive and active public open space resources, and ancillary development, to meet the needs of the community.</li> </ul>	
SP2 Infrastructure	<ul style="list-style-type: none"> <li>to provide for infrastructure and related uses</li> <li>to prevent development that is not compatible with or that may detract from the provision of infrastructure.</li> </ul>	The proposal involves intersection upgrades that would improve performance and safety and reduce congestion. This proposal is consistent with the objectives of the SP2 zone.

**Warringah Local Environmental Plan (2011)**

The eastern part of the proposal is subject to the Warringah LEP.

The objectives of each zone and the proposal's consistency with these objectives are summarised in Table 4-2.

Table 4-2: Proposal consistency with relevant land use zone objectives

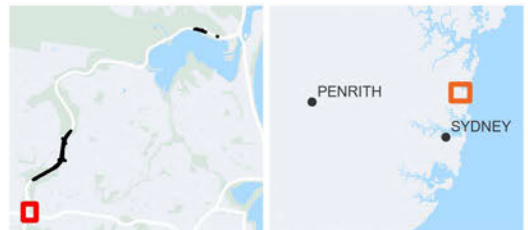
Zone type	Objectives of zone	Proposal consistency with objectives
RE1 Public Recreation	<ul style="list-style-type: none"> <li>to enable land to be used for public open space or recreational purposes</li> <li>to provide a range of recreational settings and activities and compatible land uses</li> <li>to protect and enhance the natural environment for recreational purposes</li> <li>to protect, manage and restore public land that is of ecological, scientific, cultural or aesthetic value</li> <li>to prevent development that could destroy, damage or otherwise have an adverse effect on those values</li> </ul>	The proposal would not involve use of substantial portions of land zoned RE1. The proposal would improve traffic congestion and in effect improve the accessibility of public open space resources. This proposal is consistent with the objectives of the RE1 zone.
SP2 Infrastructure	<ul style="list-style-type: none"> <li>to provide for infrastructure and related uses</li> <li>to prevent development that is not compatible with or that may detract from the provision of infrastructure</li> </ul>	The proposal involves intersection upgrades that would improve performance and safety and reduce congestion. This proposal is consistent with the objectives of the SP2 zone.
SP4 Enterprise	<ul style="list-style-type: none"> <li>to provide for development and land uses that support enterprise and productivity</li> </ul>	The proposal is marginally located in land zoned SP4 (see Figure 4-1). The proposal would result in additional employment and improvement of Wakehurst Parkway, supporting the objective of Enterprise zoned land.





Legend

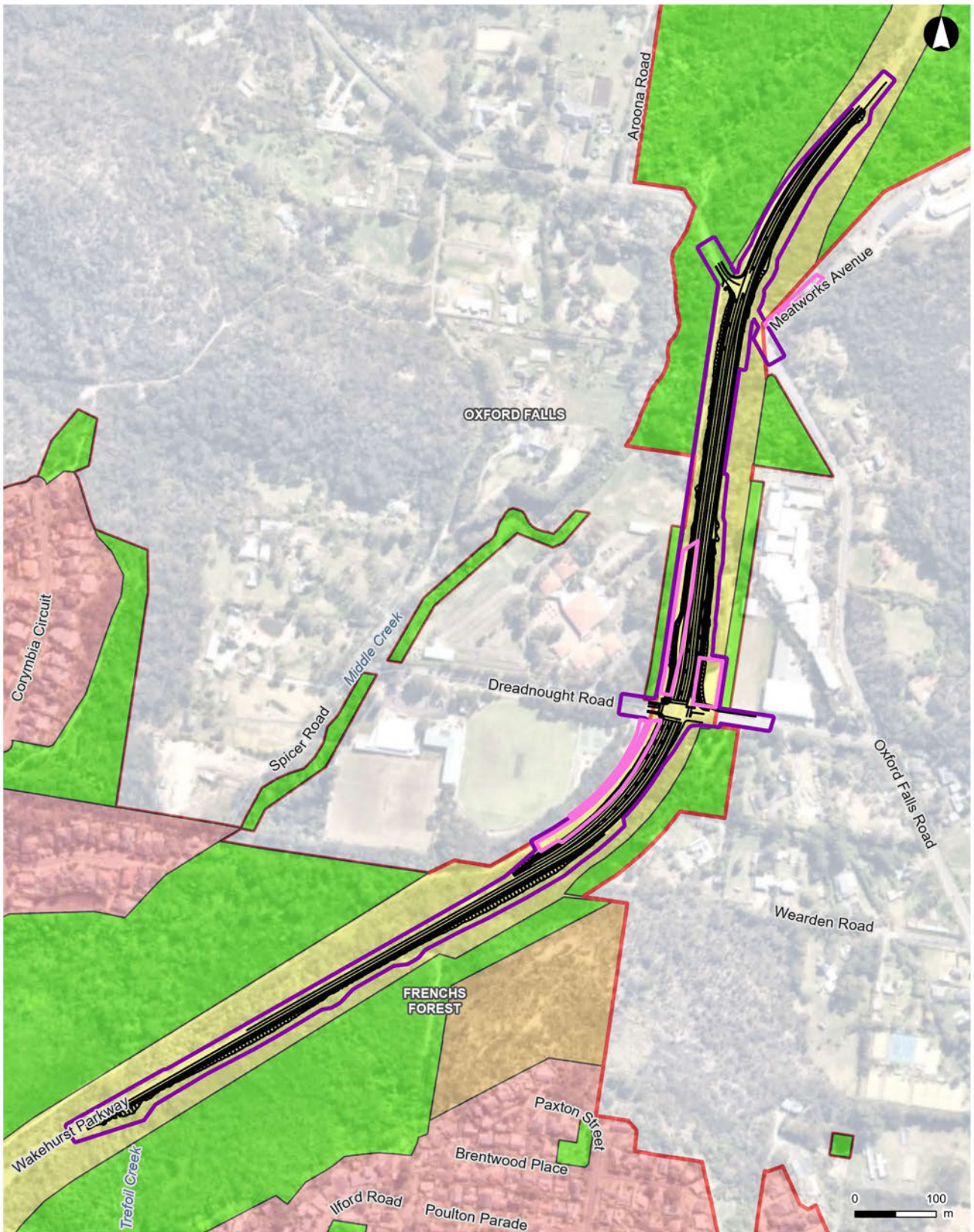
- Proposed compound site
- Land Zoning
- R2 - Low Density Residential
- R3 - Medium Density Residential
- RE1 - Public Recreation
- SP2 - Infrastructure
- SP4 - Enterprise



1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 20, 2023  
 Imagery: Nearmap 2022

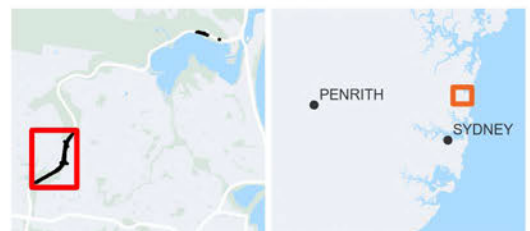


Figure 4-1, Land zoning - Construction compound 1



Legend

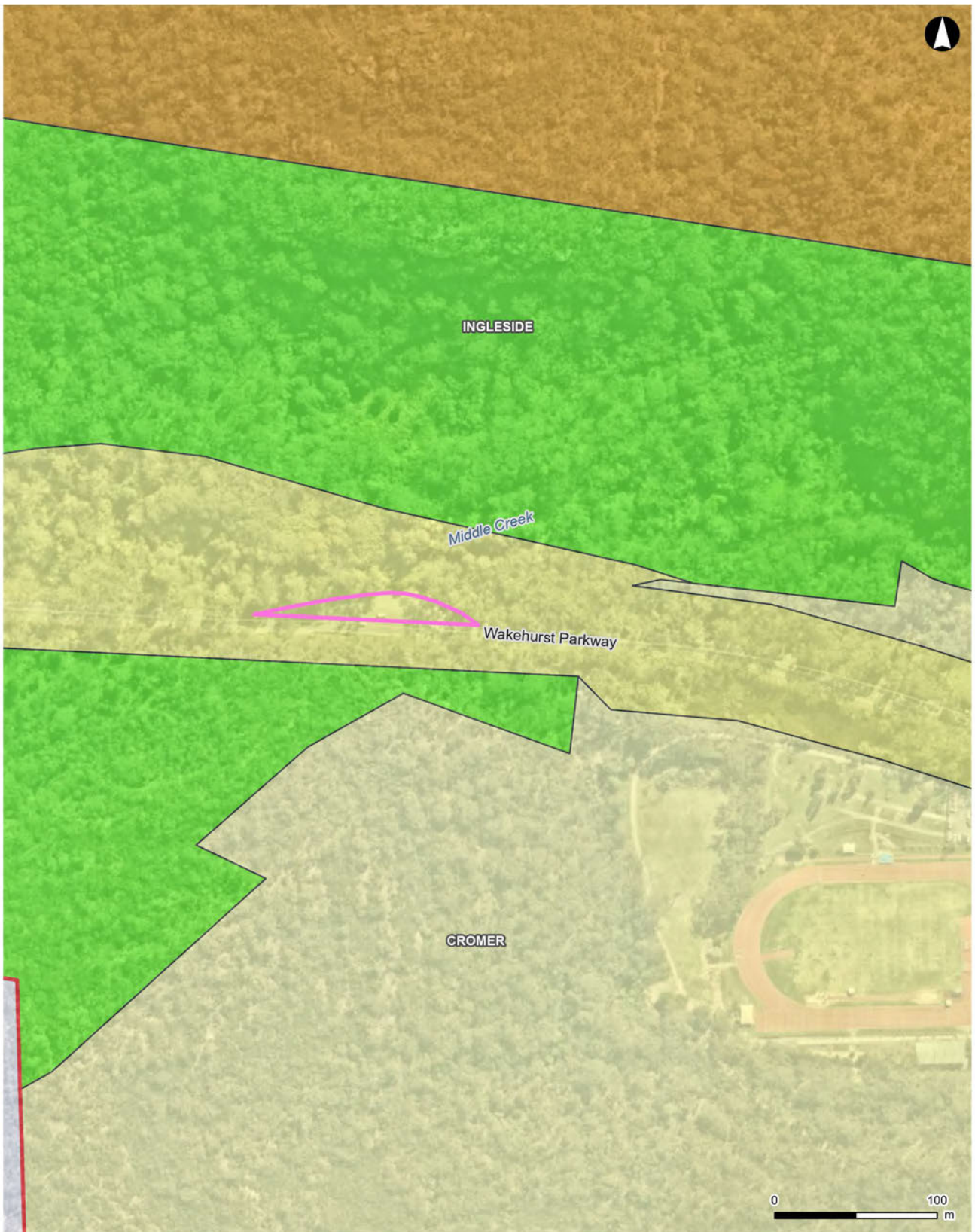
- |                               |                              |
|-------------------------------|------------------------------|
| Proposed compound site        | R2 - Low Density Residential |
| Proposal area                 | RE1 - Public Recreation      |
| Proposal                      | SP2 - Infrastructure         |
| <b>Land Zoning</b>            | DM - Deferred Matter         |
| C3 - Environmental Management |                              |



1:7,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 20, 2023  
 Imagery: Nearmap 2022



Figure 4-2, Land zoning - Wakehurst Parkway from Trefoil Creek and Oxford Falls Road



Legend

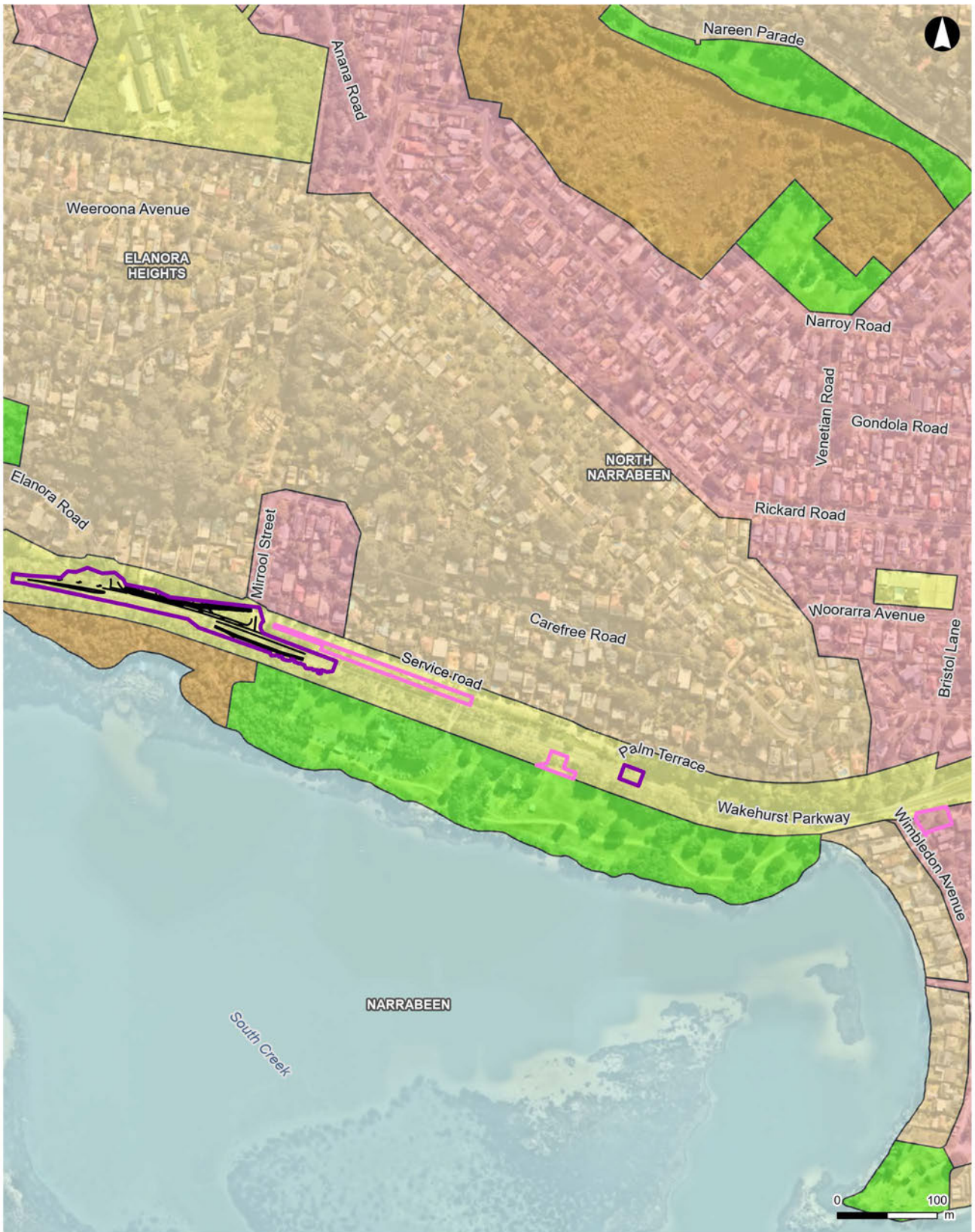
- Proposed compound site
- Land Zoning
- C1 - National Parks and Nature Reserves
- RE1 - Public Recreation
- SP1 - Special Activities
- SP2 - Infrastructure
- DM - Deferred Matter












1:3,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
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Figure 4-3, Land zoning - Construction compound 6



Legend

- |  |  |
|--|--|
|  Proposed compound site   |  C4 - Environmental Living    |
|  Proposal area  |  R2 - Low Density Residential |
|  Proposal   |  RE1 - Public Recreation      |
| <b>Land Zoning</b>   |  SP2 - Infrastructure         |
|  C2 - Environmental Conservation;<br>C2, Environmental Management |  W1 - Natural Waterways       |



1:5,700 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 20, 2023  
 Imagery: Nearmap 2022



Figure 4-4, Land zoning - Wakehurst Parkway from Elanora Road to Mirrool Street

## 4.2 Other relevant NSW legislation

### 4.2.1 Roads Act 1993

Under this Act, state authorities such as Transport are given the ability to carry out activities such as construction and upgrades on roads in NSW. These are permitted under a road occupancy licence obtained by the construction contractor prior to work beginning. This may include temporary closures of roads and regulation of traffic to ensure construction can be completed. As well, this Act permits Transport to acquire land for the purposes of road work, in line with the *Land Acquisition (Just Terms Compensation) Act 1991*.

A road occupancy licence would need to be obtained by the construction contractor before beginning any work that requires road possession and closures.

### 4.2.2 Biodiversity Conservation Act 2016

The BC Act regulates impacts on the natural environment and provides a framework for the avoidance and minimisation of impacts to biodiversity. It establishes the Biodiversity Offsets Scheme which attempts to offset impacts to biodiversity where impacts from development are unavoidable. Offsets are not required for development assessed under Division 5.1 of the EP&A Act unless an action is deemed to have a 'significant impact' on a threatened species, population, or community, as determined by an assessment of significance in line with section 7.3 of the BC Act.

As described in Section 6.1, there would be an anticipated significant impact on the endangered Angus's Onion Orchid (*Microtis angusii*) due to the proximity of identified colonies to the intersection of Wakehurst Parkway and Oxford Falls Road. A BDAR has been prepared to assess the potential biodiversity impacts of this proposal which is available in Appendix D.

Biodiversity offsets for this proposal are described in the BDAR and in Section 6.1.

### 4.2.3 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* (Biosecurity Act) requires any person who deals with any biosecurity matter, including who knows (or ought to know) of any biosecurity risk, to ensure the risk is prevented, eliminated, or minimised, so far as is reasonably practicable. Biosecurity matters include weeds and pathogens. Weeds are managed in accordance with control regions. Within each of the regions are listed Priority Weeds. These Priority Weeds are allocated different measures based on their threat level.

The proposal area for the proposal is located entirely within the Greater Sydney region. Lists of potentially occurring Priority Weeds for the Greater Sydney region, and Commonwealth listed Weeds of National Significance (WoNS), were reviewed before the commencement of targeted vegetation surveys across the proposal area and have been reported upon in the Section 6.1 and the BDAR which is available in Appendix D.

### 4.2.4 Coastal Management Act 2016

The Coastal Management Act replaces the repealed Coastal Protection Act 1979, establishing a strategic framework and objectives for managing coastal issues in NSW. The Coastal Management Act promotes strategic and integrated management, use and development of the coast for the social, cultural and economic wellbeing of the people of NSW.

The REF proposal is subject to the provisions of the Coastal Management Act as it partially located within proximity to coastal wetlands. The Coastal Management Act has the following management objectives for coastal environment and coastal use areas.

- to protect and enhance the coastal environmental values and natural processes of coastal waters, estuaries, coastal lakes and coastal lagoons, and enhance natural character, scenic value, biological diversity and ecosystem integrity
- to reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change
- to maintain and improve water quality and estuary health
- to support the social and cultural values of coastal waters, estuaries, coastal lakes and coastal lagoons

- to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place
- to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms.

Assessment of potential impacts to biodiversity, surface and groundwater and socio-economic from the REF proposal are assessed in Chapter 6.

#### 4.2.5 Crown Lands Management Act 2016

The Crown Land Management Act 2016 (Crown Land Management Act) provides a streamlined framework from Crown land administration and management in NSW. The objectives of the Crown Land Management Act include:

- providing for the ownership, use and management of the Crown land
- requirements that environmental, social, cultural heritage and economic considerations be taken into account in decision-making about Crown land
- facilitating the use of Crown land by the Aboriginal people of NSW
- providing for the management of Crown land whilst having regard to the principles of 'Crown land management'.

Under Clause 2.18 (1), the Minister for Primary Industries can:

*'Despite any other provision of this Act, the Minister may grant a lease, licence, permit, easement or right of way over dedicated or reserved Crown land for any of the following purposes (a relevant interest)—*

- (a) *Any facility or infrastructure,*
- (b) *Any other purpose the Minister thinks fit.'*

As detailed within Section 3.6, the REF proposal would require the occupation of parcels of Crown land. The need and extent of acquisition and any relevant permit/lease of Crown land for the REF proposal would be discussed with DPE (Crown land) and in accordance with the requirements of the Crown Land Management Act.

Once the REF has been determined and funding approved, Transport would acquire the Crown land through Treasury Direction.

#### 4.2.6 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates land, air, noise and water pollution in NSW. It also aims to provide opportunity for increased public involvement and access to information regarding environmental protection.

The POEO Act regulates licencing for certain activities that create environmental impacts such as waste, air, and water pollution. Those provided with a licence must comply with its conditions when carrying out these activities. Activities requiring licences are defined in Part 3.2, Schedule 1.

In line with Schedule 1, clause 35, road construction is listed as an activity that may require licencing. Under the POEO Act, road construction includes road widening work and related earthworks and cuttings. Clause 35(3) states that a licence is required should the road construction involve extraction or processing of more than 150,000 tonnes of material or involves a metropolitan road of four or more traffic lanes for three or more kilometres in length. An environmental protection licence is not required as the proposal does not require construction involving large volumes of earthworks or construction of three or more kilometres of road.

#### 4.2.7 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the conservation of buildings, work, relics and places that are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the state. Matters protected under the Heritage Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council LEPs, and the heritage and conservation registers established under Section 170 of the Heritage Act by NSW state government agencies (Section 170 Registers). The Heritage Act also provides for the protection of archaeological 'relics', being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance.

The Heritage Act concerned with all aspects of heritage conservation ranging from basic protection against indiscriminate damage and demolition of buildings and sites, through to restoration and enhancement. Heritage database searches indicate that there is one non-Aboriginal heritage item within the proposal area and one item near the proposal area. Further assessment of potential non-Aboriginal heritage impacts is provided in Section 6.8 of this REF.

## 4.3 Commonwealth legislation

### 4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the 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 the BDAR available in Appendix D and the environmental assessment in Chapter 6.1 of the REF.

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

Within the proposal footprint, several observations of the Angus's Onion Orchid (*Microtis angusii*) have been made during ecological surveys. In accordance with the strategic assessment approval, a BDAR has been prepared to assess the existing populations of Angus's Onion Orchid and biodiversity offsets have been calculated (available in Section 6.1.3).

#### **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. Accordingly, the proposal has not been referred to the Australian Government Department of Climate Change, Energy, the Environment and Water under the EPBC Act.

#### **Findings - nationally-listed biodiversity matters (where the strategic assessment applies)**

The assessment of the proposal's impact on nationally-listed threatened species, endangered ecological communities and migratory species found that there is likely to be a significant impact on relevant matters of national environmental significance. Section 6.1 of the REF describes the safeguards and management measures to be applied to minimise or mitigate impacts. Section 6.1 also details the Biodiversity Offset Strategy to be implemented to address residual significant impacts on nationally-listed biodiversity matters.

## 4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under section 2.109 of SEPP (Transport and Infrastructure) 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'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.

### 5.1 Consultation strategy

Consultation activities for the proposal to date comprise of engagement with authorities and other stakeholders through consultation under the requirements of SEPP (Transport and Infrastructure) consultation.

Consultation with the community would occur through display of this REF with the opportunity for individuals and businesses to respond via formal submissions. A Submissions Report would then be prepared to provide responses to key community concerns and questions, and provide further information or clarification if required.

A summary of consultation undertaken to date is provided in Section 5.2 to Section 5.3. Transport would continue to consult with the community and relevant stakeholders during construction of the proposal.

### 5.2 SEPP (Transport and Infrastructure) consultation

The Northern Beaches Council was consulted about the proposal on 5 June 2023 and 16 August 2023 as per the requirements of section 2.10 of SEPP (Transport and Infrastructure). Appendix B contains a SEPP (Transport and Infrastructure) consultation checklist that documents how SEPP (Transport and Infrastructure) consultation requirements have been considered.

Issues raised from this consultation are outlined in Table 5-1 below.

Table 5-1: Issues raised through SEPP (Transport and Infrastructure) consultation

Group	Issue raised	Response / where addressed in REF
Northern Beaches Council	<b>Collaboration and coordination</b>	
	Concern regarding collaboration and coordination of flood management work	Transport understands Council are in the process of progressing design submissions through the appropriate Transport processes. The project team have reviewed the preliminary information received in June 2023 from Council.  Matters regarding the proposed Council flood improvement project, need to be raised with the Transport funding manager contact.
	<b>Design</b>	
	Request for the proposal's design drawings	Concept design drawings have been provided to Council.
<b>Review of Environmental Factors (REF) and Community Consultation</b>		
	REF and community consultation coordination	The potential cumulative impacts of Council's flood improvement project is assessed in Section 6.14.2.  Transport is strongly committed to working closely with key stakeholders, including Northern Beaches Council.  Various methods will be used to inform and engage with the variety of stakeholders of the proposal. These may include briefings,



Group	Issue raised	Response / where addressed in REF
		<p>community notifications via letterbox drops or email, stakeholder emails, website updates, media releases and pop-up displays during the public display of the REF.</p> <p>Council will be informed of the community consultation to be undertaken as part of the REF display.</p>
	<p><b>Upgrade to the Dreadnought Road traffic signals, including safety, capacity, and connectivity improvements for both road users and pedestrians.</b></p>	
	<p>Support of the Dreadnought Road traffic signal upgrade</p>	<p>Noted</p>
	<p>Recommended incorporation of new standard shared user signals at Dreadnought Road</p>	<p>The proposal includes new pedestrian crossings on all four legs of Dreadnought Road intersection with suitable widths for shared use for both pedestrians and cyclists. At this stage it is not envisaged the signals would be configured for cyclists.</p> <p>The key features of the proposal are outlined in Section 3.2.3.</p>
	<p>Recommended extension of shared user path to provide future connection from Oxford Falls to Frenchs Forest</p>	<p>The proposed intersection upgrade would support a possible future extension of shared user path at the south-east corner to provide a connection between Oxford Falls and Frenchs Forest.</p> <p>The key features of the proposal are outlined in Section 3.2.3.</p>
	<p><b>An additional lane in both directions between Dreadnought Road and Oxford Falls Road</b></p>	
	<p>Concern regarding potential conflict point where the northbound lane merges near Oxford Falls Road west intersection</p>	<p>Signage would be installed to give motorists advanced warning of a lane merge north of the Dreadnought Road traffic sign.</p> <p>The key features of the proposal are outlined in Section 3.2.3.</p>
	<p><b>Providing a new southbound left turn slip lane into Dreadnought Road</b></p>	
	<p>Council does not support the southbound left turn slip lane without an on-demand signalised crossing</p>	<p>An on-demand signalised crossing is proposed at the new southbound left turn slip lane into Dreadnought Road.</p> <p>The key features of the proposal are outlined in Section 3.2.3.</p>
	<p><b>Providing a new southbound right turn bay into Oxford Falls Road</b></p>	
	<p>Recommended consideration of either an acceleration lane or seagull intersection at right turn into Oxford Falls Road</p>	<p>Installation of a seagull intersection would increase the project's impact within the surrounding environmentally sensitive area, amongst several other considerations.</p> <p>Options considered for this proposal are detailed in Chapter 2.4, including an assessment of each option's merits against the proposal objectives and design objectives.</p>
	<p><b>Proposed new Bus Stop locations along the 155 route</b></p>	

Group	Issue raised	Response / where addressed in REF
	Support of the new bus stop locations	Noted
	<b>Southbound Duplication from Dreadnought Road to Trefoil Creek</b>	
	Support of the extra southbound lane from Dreadnought Road to Trefoil Creek noting that upgraded shoulder and drainage must be provided	Appropriate shoulder and drainage provisions in this area have been integrated. The key features of the proposal are outlined in Section 3.2.3.
	<b>Elanora Road and Mirrool Street Improvements</b>	
	Support of hold line adjustment and concrete median installation at Elanora Road	Noted
	Recommended upgrade of Elanora Road to a seagull intersection	Options considered for this proposal are detailed in Chapter 2.4, including an assessment of each option's merits against the proposal objectives and design objectives.  Installation of a seagull intersection would increase the project's impact at this environmentally sensitive site, in particular concerns of the project's proximity to coastal wetlands and the Narrabeen Lagoon, amongst several other considerations
	Suggestion to consider further measures to reduce large vehicle use of prohibited section of Elanora Road	Transport welcomes any specific suggestions that would help Council manage incidences of large vehicles entering Elanora Road from Wakehurst Parkway. Transport will investigate options to integrate these suggestions into the design wherever possible
	<b>Providing localised widening at the Mirrool Street intersection</b>	
	Support of localised widening at Mirrool Street intersection	Noted
	Recommended implementation of a left-in-left-out treatment at Mirrool Street	Transport has requested clarification confirming if Council refers to installing a left-in and left-out solution at the other end of the Service Road, near Palm Terrace (which is as per the current proposal).
	<b>Consultation under State Environmental Planning Policy (Transport and Infrastructure) 2021</b>	
	Request for further information regarding proposal's construction and operational stormwater management and water quality management measures	The environmental safeguards proposed for this project are provided in full in Section 7.2, which include measures for flood risk, erosion and sedimentation, and waste management throughout both construction and operation of the proposal.
NSW State Emergency Service	The NSW State Emergency Service (SES) has reviewed the proposed upgrade and the flood risk information (e.g. Local Flood Plan, Narrabeen Lagoon Flood Study 2013) available to the NSW SES and have identified that some of the proposed works will occur in areas likely to be impacted in a 50% Annual Exceedance Probability (AEP) flood extent.	Noted.  Information regarding the impact of the proposal on flooding and hydrology through construction and operation is available in Section 6.2.

Group	Issue raised	Response / where addressed in REF
	<p>The NSW SES also notes that parts of the site and surrounding area is at risk of flooding in a Probable Maximum Flood (PMF).</p> <p>The proposed work appears to have minimal impact to the NSW SES response operations, however any improvements that Transport for NSW can make to reduce any flood risk will benefit the current and future community. Based on this review, the NSW SES provides the following advice:</p> <ul style="list-style-type: none"> <li>• consider the impact of flooding on the site up to and including the PMF</li> <li>• pursue, if relevant, site design and stormwater management that minimises any risk to the community.</li> </ul> <p>Ensure workers and people using the site during and after the upgrades are aware of the flood risk, for example by using signage.</p>	
	<p>In addition, if the construction phase of the upgrades causes disruption to the operation of local roads, this may impact the ability for emergency vehicles to use these routes. The NSW SES requests that notification be provided where there are likely to be significant delays in the operation of the roads affected by the upgrades.</p>	<p>Noted.</p> <p>Details of construction related traffic impacts are available in Section 3.3 and Section 6.6.</p> <p>Transport will continue to consult with authorities and the public on traffic impacts relating to construction of the proposal, as detailed in Section 5</p>

### 5.3 Ongoing or future consultation

This REF will be on display to give members of the public the opportunity to respond to the proposal. Exhibition would occur for a minimum of four weeks and would consist of publishing the REF and supporting assessments online. All submissions to the proposal would be formally considered and responses provided in a submissions report, which would be made available to the public.

Consultation with property owners affected by the proposed upgrades would be undertaken, and Transport would continue to inform surrounding residents and stakeholders of the ongoing development of the proposal and before construction occurs. This would be carried out using methods such as the distribution of community updates, emails to the stakeholder database, updates on the Transport project website and variable message signs advising motorists of the changed traffic conditions. Transport would also continue to consult with Northern Beaches Council, SES, and other stakeholders as the proposal develops.

## 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 Guideline for Division 5.1 assessments (DPE 2022) and as required under section 171 of the EP&A Regulation and the Roads and Related Facilities EIS Guideline (DUAP, 1996). The factors specified in section 171 of the EP&A Regulation are also considered in Appendix A.
- site-specific safeguards and management measures are provided to mitigate the identified potential impacts

### 6.1 Biodiversity

#### 6.1.1 Methodology

A Biodiversity Development Assessment Report (BDAR) (Sustain JV, September 2023) and an Arboricultural Assessment Report (AAR) (Sustain JV, September 2023) has been prepared for the proposal and is available in Appendix D and Appendix E, respectively.

The BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM) (2020), as required by the BC Act.

#### Assessment areas

The key assessment areas and boundaries that are used in the BDAR are listed in Table 6-1 and included in Figure 6-1 to Figure 6-3. Of these, the assessment areas 'subject land' and 'study area' are used most frequently throughout the BDAR. For consistency with the other sections of the REF, 'subject land' will be referred to as the 'proposal area' throughout this section.

Several compound sites have been included in the proposal and have been situated on already cleared or developed lands. With the exception of Construction Compound 4 (CC4), these proposed compound sites (refer to Section 3.4) would not directly impact native vegetation or other biodiversity values during construction or and have subsequently not been included in the proposal area. CC4 would require clearing of limited areas of vegetation, and this impact has been assessed in the BDAR. Since there would be no impacts on native vegetation in the other compound option locations, the compound sites have not been included within the proposal area for the BDAR. The locations of the proposed compound sites in relation to the proposal are shown in Figure 3-38 to Figure 3-43.

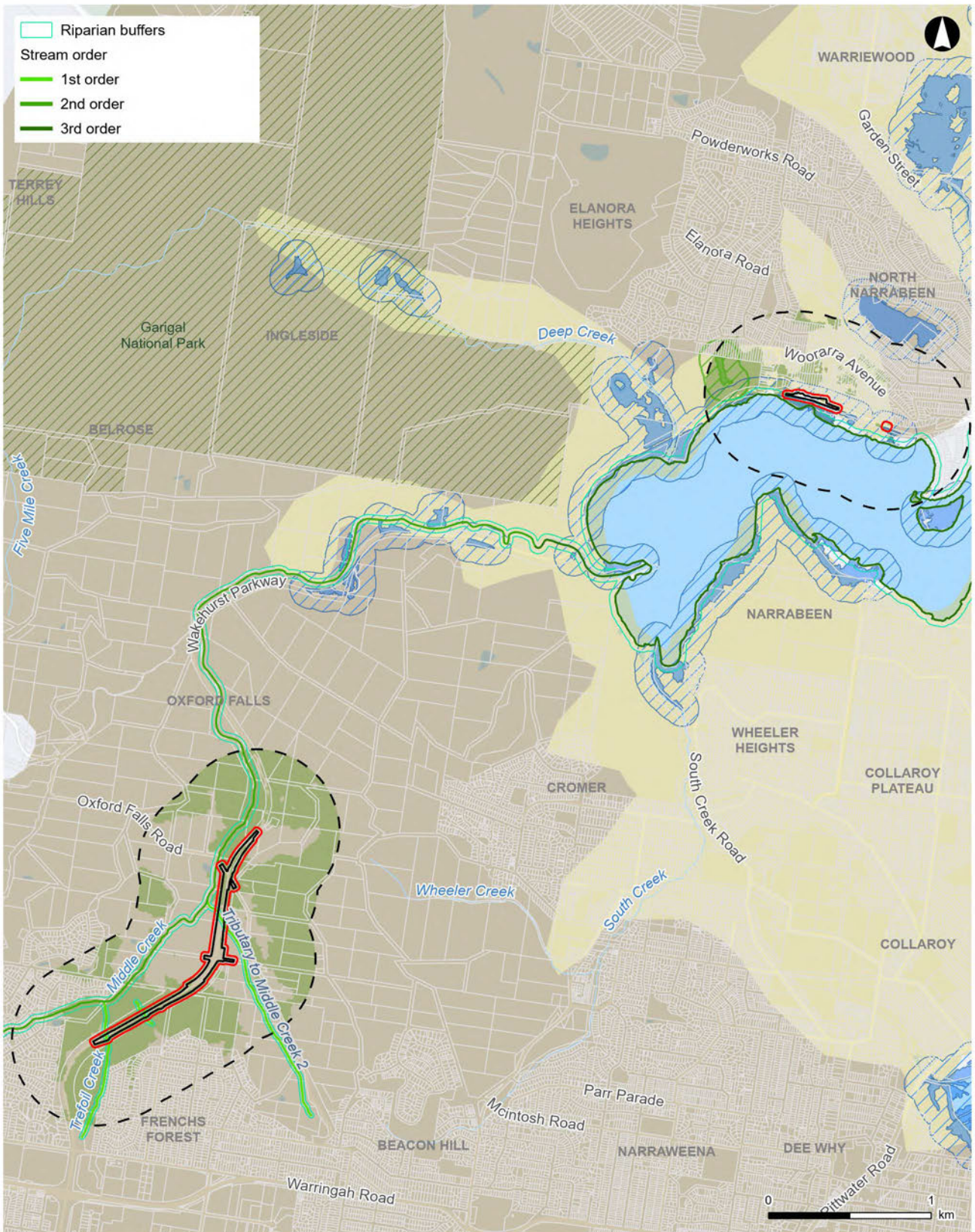
The terminology of 'proposal area' and 'study area' remain in usage only in this section (Section 6.1) of the REF.

Table 6-1: Key assessment areas and boundaries

Key assessment areas/ project boundaries	Area to which it applies	Purpose
Proposal area	Encompasses the operational and construction footprint of the proposal where direct impacts would occur. Does not include the proposed compound sites, with the exception of Construction Compound 4 (CC4) where there is vegetation clearing proposed.	The boundary used to calculate direct impacts. Referred to as 'proposal area' in the BDAR as defined by the BAM (DPIE EES, 2020a).
Study area	Encompasses the proposal area and the area of land within a 20-metre buffer zone surrounding the proposal area.	The boundary used to qualitatively assess indirect impacts.

Transport  
for NSW

Key assessment areas/ project boundaries	Area to which it applies	Purpose
Landscape assessment area	The proposal area and the area of land within a 500-metre buffer zone surrounding the proposal area	The boundary that would be used to calculate the percentage of native vegetation cover surrounding the proposal



**Legend**

- Study area
- Subject land
- Landscape assessment area
- Native vegetation
- Cadastre
- Garigal National Park
- Watercourse
- Resilience and Hazards SEPP 2021
- Coastal Wetlands
- Proximity Area for Coastal Wetlands
- Littoral Rainforest
- Proximity Area for Littoral Rainforest
- NSW (Mitchell) Landscapes
- Belrose Coastal Slopes
- Sydney - Newcastle Barriers and Beaches

The study area is within  
 IBRA Bioregion: Sydney Basin  
 IBRA Subregion: Pittwater

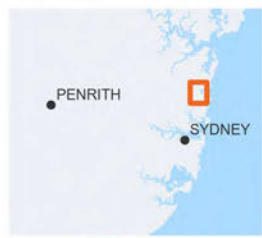
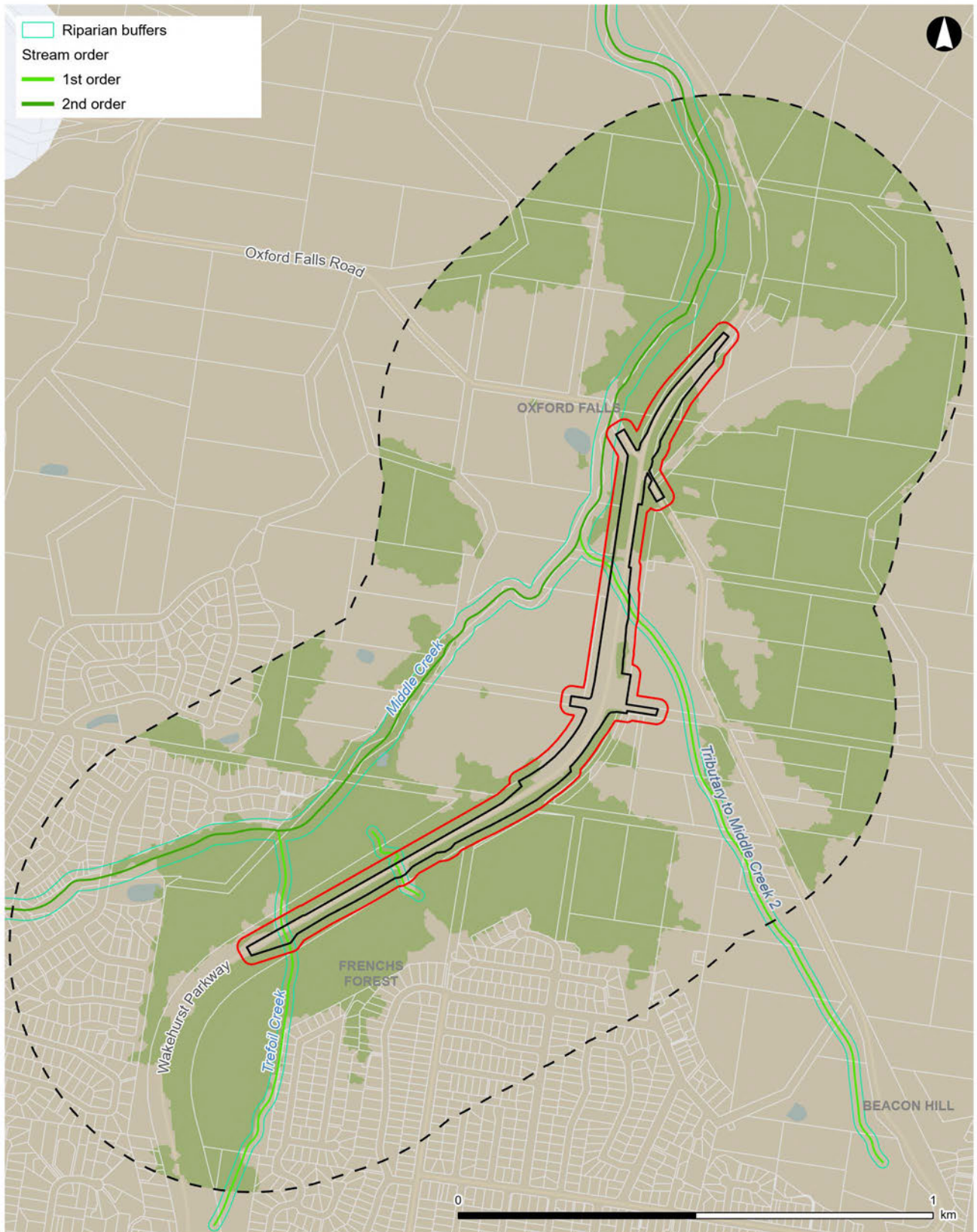


Figure 6-1, Biodiversity assessment areas - overview

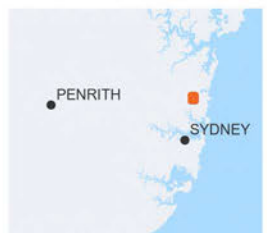
1:35,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 12, 2023





**Legend**

- Study area
- Subject land
- Landscape assessment area
- Native vegetation
- Cadastre
- ~ Watercourse
- NSW (Mitchell) Landscapes
- Belrose Coastal Slopes



*The study area is within  
IBRA Bioregion: Sydney Basin  
IBRA Subregion: Pittwater*

Figure 6-2, Biodiversity assessment areas - southern package

1:12,000 at A4  
Coordinate System: GDA2020 MGA Zone 56  
Date issued: September 12, 2023







**Legend**

- Study area
- Subject land
- Landscape assessment area
- Native vegetation
- Cadastre
- Watercourse

- Resilience and Hazards SEPP 2021**
- Coastal Wetlands
  - Proximity Area for Coastal Wetlands
  - Littoral Rainforest
  - Proximity Area for Littoral Rainforest

- NSW (Mitchell) Landscapes**
- Belrose Coastal Slopes
  - Sydney - Newcastle Barriers and Beaches
- The study area is within  
IBRA Bioregion: Sydney Basin  
IBRA Subregion: Pittwater*



Figure 6-3, Biodiversity assessment areas - northern package

1:10,000 at A4  
Coordinate System: GDA2020 MGA Zone 56  
Date issued: September 12, 2023



### Desktop review

A desktop assessment was undertaken from the end of 2022 to mid-2023 which included a review of the following relevant databases and previously undertaken assessments:

- Threatened Ecological Communities of Greater Sydney (DPE, 2021a)
- NSW State Vegetation Type Mapping (DPE, 2022a)
- Biodiversity Values Map and Threshold Tool (DPE, 2023b)
- NSW BioNet – Vegetation Classification Database (DPE EHG, 2023)
- NSW Bionet – Species sighting search (DPE, 2023a)
- NSW Fisheries Spatial Data Portal (NSW DPI, 2023)
- Biodiversity Assessment Method Calculator (BAM calculator) (DPIE EES, 2023c)
- Coastal management areas identified by the Resilience and Hazards SEPP 2021 (NSW State Environmental Planning Policy (Resilience and Hazards) 2022 – maps) (DPE, 2021b)
- Protected Matters Search Tool (Department of Climate Change, Energy, Environment and Water (DCCEEW)) (DoE, 2023)
- Commonwealth Atlas of Groundwater Dependent Ecosystems (GDE): GDE Atlas Map: Water Information: Bureau of Meteorology (bom.gov.au). (BoM, 2023a)
- NSW Koala Habitat Suitability Models v1.0 (NSW Koala Habitat Suitability Model 5m v1.1, 2023)
- Important Area Maps (NSW Koala Habitat Suitability Model 5m v1.1, 2023)
- National Flying-fox monitoring viewer (DCCEW, 2023)
- NSW BioNet Threatened Biodiversity Data Collection (DPE, 2023b)
- Current provisional determinations to list species and ecological (DPE, 2023)
- Finalised Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act (DCCEEW, 2023)
- Northern Beaches Council Biodiversity Planning Review (SMEC, 2021)
- Preliminary biodiversity investigations. Easing Sydney's Congestion Wakehurst Parkway Improvements – Frenchs Forest to Narrabeen (Transport for New South Wales (Arcadis, 2023)
- Survey of the Duffys Forest Vegetation Community (report to NSW National Parks and Wildlife Service and Warringah Council) (Smith, 2000)
- Policy and guidelines for fish habitat conservation and management (Update 2013) (nsw.gov.au).
- Why do fish need to cross the road? Fish passage requirements for waterway crossings (nsw.gov.au) (Fairfull & Witheridge, 2003)
- The Aquatic Ecology in Environmental Impact Assessment – EIA Guideline (Lincoln Smith, 2003)
- Fisheries Spatial Data Portal
- Protected Matters Search Tool
- SEED – NSW Wetlands mapping
- SEPP (Resilience and Hazards) 2022 – Coastal management area Interactive map viewer
- Australian Wetlands Database
- Australian Standard Protection of trees on development sites, AS 4970 – 2009 (Standards Australia, 2009)
- Transport for NSW Biodiversity Policy, No.CP22004, (NSW Government, 2022)
- Transport for NSW Arboricultural assessment considerations – Version 1.0 (TfNSW, 2021)
- Significant Tree Register (National Trust, 2022)

- Soils Landscapes Reports and mapping (DPE, 2023) eSpade online database – accessed 1 August 2023
- Warringah vegetation mapping (Smith and Smith 2005)
- Pittwater vegetation mapping (Bangalay 2012)
- Draft Northern Beaches Council Biodiversity Planning Review (SMEC 2021).

### **Habitat suitability assessment**

In order to identify species for targeted field surveys, a list of candidate species identified by the BAM Calculator known or considered likely to occur was refined based on the known geographic distribution and the suitability of habitat features present, including associated plant community types and soil and geological preferences. A habitat assessment was then undertaken to determine the likelihood for each of the listed candidate species to occur and, as such, required targeted field surveys and assessment of potential impacts of the proposal.

### **Arboricultural field surveys**

The Arboricultural Assessment Report includes findings from field surveys carried out on the 14, 19, 20, 21 and 22 June, and 18 and 19 July 2023. The field survey was carried out by a botanist holding Arborist Australian Qualifications Framework (AQF) Level 10 qualifications and three ecologists. All trees within or immediately adjacent to the proposal footprint were inspected, however the trees assessed in the Arboricultural Assessment Report comprise native and exotic vegetation that do not trigger BAM offsets. The field assessment included the following:

- a visual tree assessment
- assessment of tree structure and health
- determination of tree protection zones

The location of each tree or tree group was recorded in the field with the use of a Trimble R12 GNSS receiver with sub-metre accuracy. Further detail on the methodology used for the above activities is available in Appendix G – Arboricultural Assessment Report.

### **Threatened species field surveys**

Field surveys for the BDAR were carried out for the study area between October 2022 and June 2023. Further detail on survey dates and personnel is provided in Table 5-5 and Table 5-8 of the BDAR (Appendix D). The study area covered a total area of 17.51 hectares.

Targeted threatened species surveys were conducted for species returned by the database searches and the BAM Calculator. Targeted surveys were also conducted for ecosystem credit species listed under the EPBC Act which were not required under the BAM. Species targeted during survey included Spotted-tailed Quoll (*Dasyurus maculatus*), New Holland Mouse (*Pseudomys novaehollandiae*), Swift Parrot (*Lathamus discolor*), Regent Honeyeater (*Anthochaera phrygia*), White-fronted Chat (*Epthianura albifrons*), and migratory waders that were excluded from candidate species assessment due to the proposal area not containing mapped important habitat. Surveys for these species were conducted to meet the minimum survey requirements detailed in the EPBC survey guidelines for Australia's threatened birds and mammals (CoA, 2011a; CoA, 2010a).

The targeted threatened flora surveys were comprised of parallel field traverses. A total of 15 vegetation integrity plots were used to sample PCTs and divide vegetation into 11 vegetation zones on the proposal area.

The targeted threatened fauna surveys included the following:

- fauna habitat assessments
- diurnal bird surveys
- anabat deployment and collection
- diurnal bird survey
- Giant Burrowing Frog and Giant Barred Frog surveys
- Red-crowned Toadlet survey
- Broad-headed Snake survey
- spotlighting
- Bush Stone-curlew call-playback
- nest box checks
- remote cameras
- wetland bird survey
- BAM plots
- Koala Spot Assessment Technique survey
- frog habitat assessment

### Impact assessment

Potential impacts to biodiversity as a result of the proposal were identified and assessed. This included an assessment of direct and indirect construction and operational impacts. Mitigation measures for avoiding, managing or reducing impacts on biodiversity values during pre-construction, construction and operation were identified. Offsetting requirements for any residual impacts that cannot be avoided, minimised or mitigated were outlined and discussed.

### Sample analysis

A sample of the Magenta Lilly Pilly (*Syzygium paniculatum*) on the proposal area was submitted to the Royal Botanical Gardens, Mount Annan to confirm species identification and provide an opinion on whether the individual is naturally occurring or has been planted.

## 6.1.2 Existing environment

### Landscape features

The biodiversity landscape features of the construction footprint are summarised in Table 6-2 and shown in Figure 6-1 to Figure 6-3.

Table 6-2: Landscape features

Landscape feature	Landscape assessment area
Interim Biogeographic Regionalisation for Australia (IBRA) bioregions and subregions	The proposal area lies within the Pittwater subregion of the Sydney Basin IBRA bioregion.
NSW (Mitchell) landscapes	<p>The proposal area lies within two Mitchell landscapes; Belrose Coastal Slopes and Sydney-Newcastle Barriers and Beaches.</p> <p>Belrose Coastal Slopes is mapped for the southern portion of the proposal area comprising the Dreadnought and Oxford Falls packages. The Belrose Coastal Slope landscapes comprise benched hill slopes and deep valleys on horizontal Triassic quartz sandstone, lithic sandstone, and shales.</p> <p>The Sydney – Newcastle Barriers and Beaches landscape occurs in the northern part of the proposal area comprising the Mirrool package. The Sydney – Newcastle Barriers and Beaches landscape is roughly associated with streams, drainage lines, and lower lying coastal areas in this locality. It comprises quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands backed by dunes and intermittently closed and open lagoons.</p> <p>The majority of the proposal area is within the Belrose Coastal Slopes landscape therefore this value was entered into the BAM Calculator.</p>
Cleared areas	Of the 7.53 hectares comprising the proposal area, 5.15 hectares are cleared. Cleared land has been taken to include lands that have been developed or identified as not supporting native vegetation constituting a Plant Community Type.
Rivers, streams and estuaries	The proposal area transects the following mapped waterways:

Landscape feature	Landscape assessment area
	<ul style="list-style-type: none"> <li>• Trefoil Creek – First-order stream</li> <li>• Middle Creek – Third-order stream</li> <li>• unnamed tributary of Middle Creek south of Oxford Falls Road – First-order stream</li> <li>• unnamed tributary of Middle Creek south of Dreadnought Road – First-order stream</li> </ul>
Groundwater Dependent Ecosystems	Groundwater Dependent Ecosystems (GDEs) are ecosystems that rely on access to groundwater to meet their water requirements to maintain their ecological processes (DES, 2014). A search of the National Atlas of Groundwater Dependent Ecosystems (BoM, 2023) identified several GDEs with potential reliance on subsurface groundwater in the proposal area (discussed further in this section below). Areas of vegetation along Oxford Falls and Middle Creek are identified as having potential for groundwater interaction, as well as the wetland areas southwest of Narrabeen Lagoon.
Wetlands	No Wetlands of International Importance (Ramsar wetlands) nor Nationally Important Wetlands were identified as occurring within 10 kilometres of the proposal area during PMST database searches. Several mapped coastal wetlands and proximity areas for coastal wetlands are mapped within the proposal area under the SEPP (Resilience and Hazards). These predominantly occur around Narrabeen Lagoon in the north of the proposal area.
Connectivity features	There are no mapped Biodiversity Corridors of Regional Significance in the proposal area. However, the proposal area is adjacent to Garigal National Park, with expansive areas of contiguous habitat occurring north of the Oxford Falls package through to the Mirrool package in the north of the proposal area. There is an isolated patch of remnant vegetation located in the south of the proposal area at the Dreadnought Road assessment area.  SMEC utilised Plant Community Type (PCT) mapping and other criteria to identify core and corridor habitat within the Northern Beaches region, with their mapping included in The Northern Beaches Council Biodiversity Planning Review (SMEC, 2021). Both core and corridor habitat is identified in the SMEC mapping within the subject area.
Areas of geological significance and soil hazard features	The proposal area does not contain any karst, caves, or cliffs. Submerged and exposed sandstone rock and crevices are present on the proposal area and in adjacent areas. No other features of geological significance are present.  Soils within the proposal area are comprised of Warriewood, Deep Creek, Hawkesbury, Lambert, Oxford Falls, Watagan and Lucas Heights soil landscape types, with some areas of Disturbed Terrain (DPE, 2023a).  High-risk areas for erosion include areas mapped as the Hawkesbury soil landscape in the southern Dreadnought package and a small section just north of Oxford Falls Road intersection.
Areas of outstanding biodiversity value	Areas of Outstanding Biodiversity Value (AOBVs), as defined under the BC Act, are currently limited to areas previously declared as critical habitat under the Threatened Species Conservation Act 1995 (TSC Act). No AOBVs occur within or surrounding the proposal area. The closest area is the Little Penguin population in Sydney's North Harbour, located approximately 11 kilometres southeast of the proposal area.

## Flora

### Vegetation types

The proposal area contains 3.80 hectares of vegetation, of which 2.38 is native vegetation comprised of seven Plant Community Types (PCTs). Of these, six had been previously mapped in the NSW State Vegetation Type Mapping (DPE, 2022a), one was not previously mapped, and four PCTs previously mapped were not found to be present.

The total list of PCTs confirmed to be present in the proposal area following ground-truthing are listed in Table 6-3 with their associated Threatened Ecological Communities (TECs) identified, where applicable. Vegetation has been assessed against criteria and/or condition thresholds for their corresponding TEC under both the BC Act and EPBC Act.

PCT distribution across the study area is presented in Figure 6-4 to Figure 6-6, and their extent and description listed in Table 6-3.

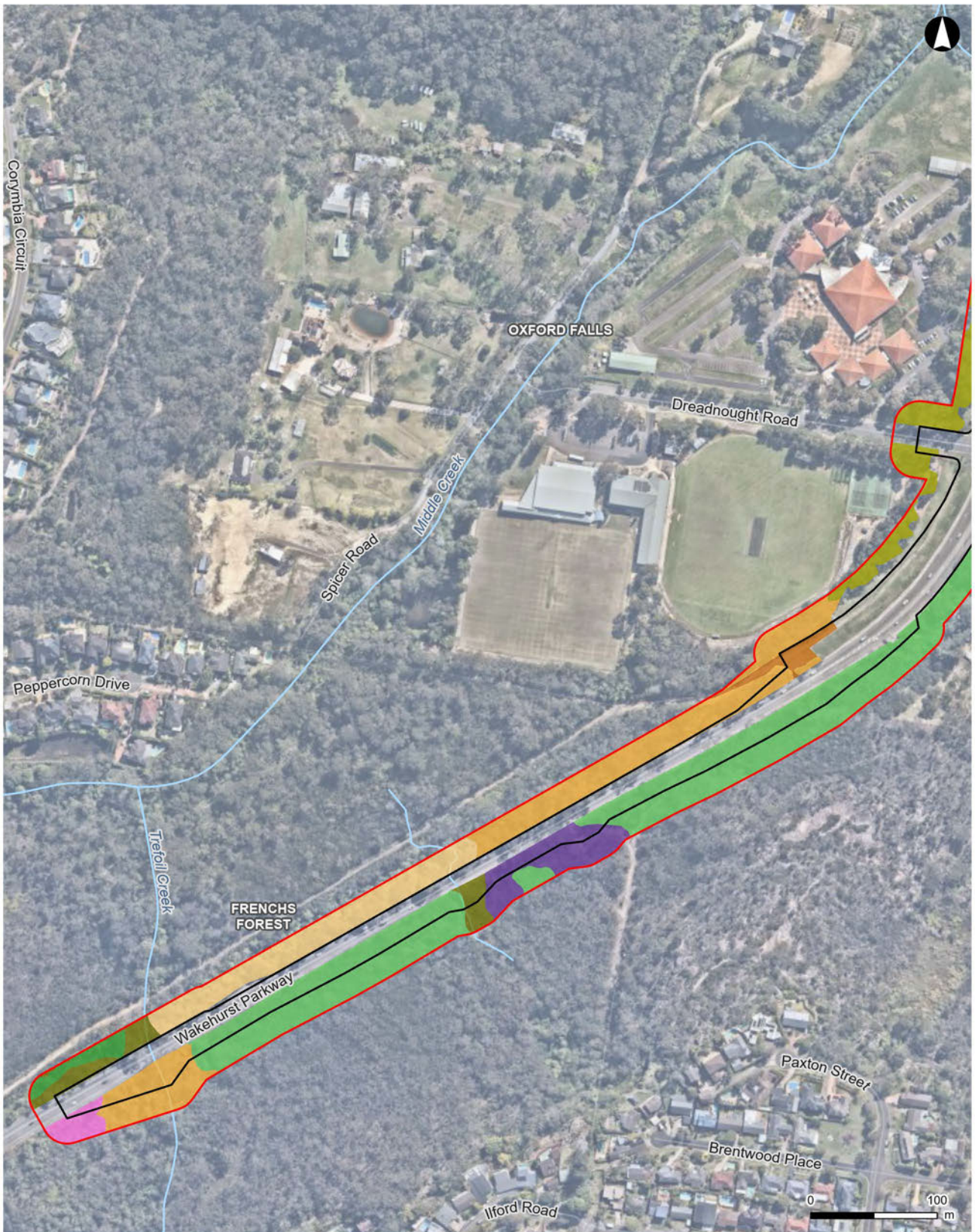
In addition to the seven PCTs recorded within the proposal area, an additional two vegetation zones were assigned to vegetation that did not conform to a locally occurring PCT, these include:

- urban - exotic/native
- weeds and exotics.

A description of non-PCT vegetation recorded within the proposal area is provided under the 'Weeds' subheading below.

Table 6-3: PCTs identified within the proposal area

Plant community type	Vegetation zone	Threatened ecological community	Area in proposal area (ha)
3586: Northern Sydney Scribbly Gum Woodland	3586 (exotic) 3586 (low)	Does not have an associated TEC	0.79
3592: Sydney Coastal Enriched Sandstone Forest	3592 (low-moderate) 3592 (moderate)	Does not have an associated TEC	0.13
3593: Sydney Coastal Sandstone Bloodwood Shrub Forest	3593 (moderate)	Associated with Duffys Forest Ecological Community in the Sydney Basin Bioregion (BC Act: Endangered)	0.48
3595: Sydney Coastal Sandstone Gully Forest	3595 (exotic) 3595 (low) 3595 (moderate)	Does not have an associated TEC	0.92
3924: Sydney Coastal Upland Swamp Heath	3924 (exotic)	Associated with: <ul style="list-style-type: none"> <li>• Coastal Upland Swamp in the Sydney Basin Bioregion (BC Act: Endangered)</li> <li>• Coastal Upland Swamps in the Sydney Basin Bioregion (EPBC Act: Endangered)</li> </ul>	0.02
4019: Coastal Alluvial Bangalay Forest	4019 (moderate)	Associated with: <ul style="list-style-type: none"> <li>• Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: Endangered)</li> <li>• River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (EPBC Act: Critically Endangered)</li> </ul>	0.02
4028: Estuarine Swamp Oak Twig-rush Forest	4028 (low)	Associated with: <ul style="list-style-type: none"> <li>• Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: Endangered)</li> <li>• Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community (EPBC Act: Endangered)</li> </ul>	0.02



**Legend**

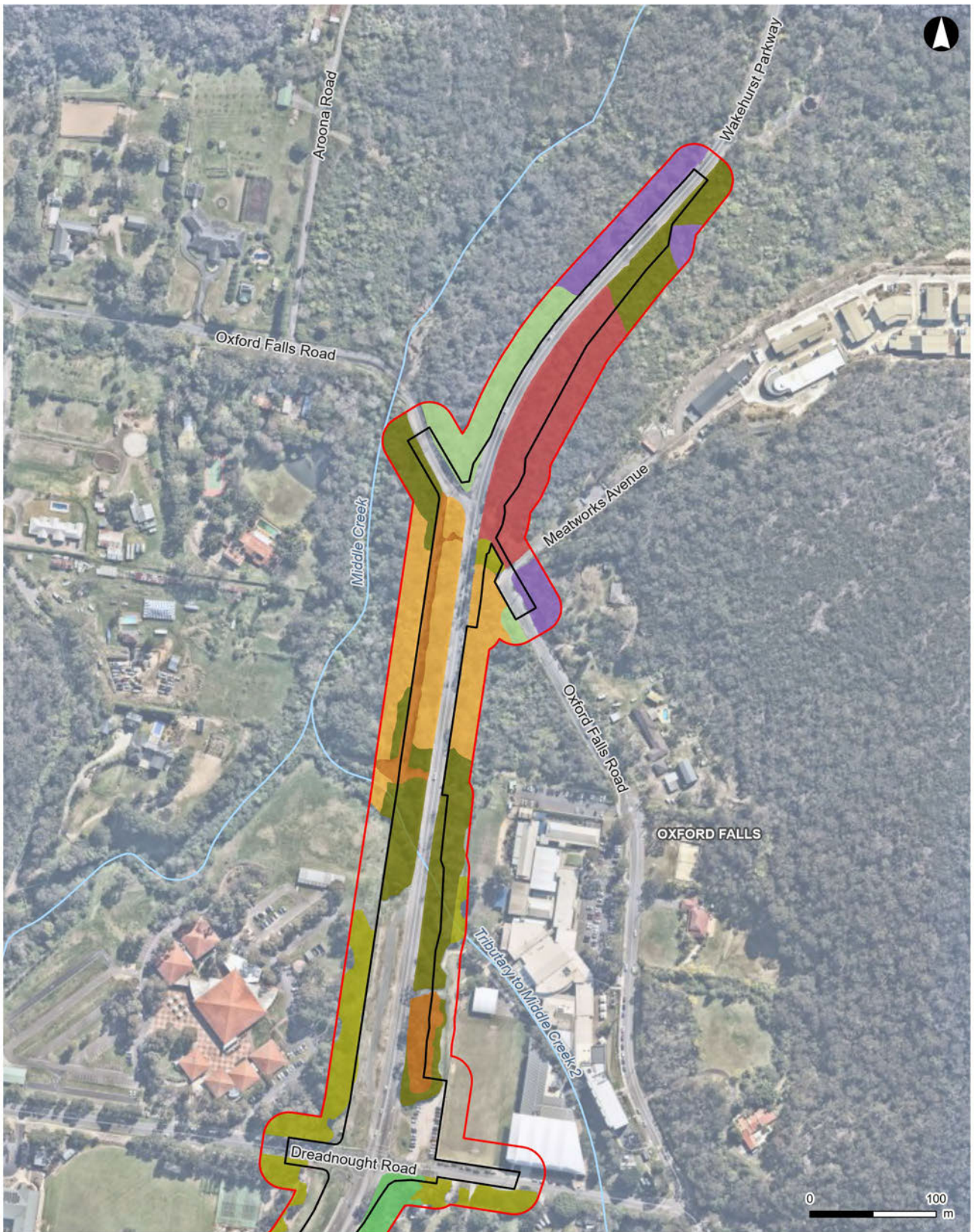
- Study area
- Subject land
- ~ Watercourse
- Vegetation zone**
- PCT 3586 (Exotic)
- PCT 3592 (Moderate condition)
- PCT 3595 (Exotic)
- PCT 3595 (Moderate condition)
- PCT 3595 (Low condition)
- PCT 3924 (Moderate condition)
- Urban - exotic/native
- Weeds and exotics



Figure 6-4, Plant community types and vegetation zones - Wakehurst Parkway from Trefoil Creek to Dreadnought Road

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Nearnmap





**Legend**

- Study area
- Subject land
- Watercourse
- PCT 3586 (Low condition)
- PCT 3592 (Low-Moderate condition)
- PCT 3595 (Moderate condition)
- Urban - exotic/native
- Weeds and exotics
- PCT 3586 (Moderate condition)
- PCT 3593 (Moderate condition)
- PCT 3595 (Exotic)



Figure 6-5, Plant community types and vegetation zones - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Neimap







**Legend**

- Study area
- Subject land
- Watercourse
- PCT 4019 (Low condition)
- PCT 4028 (Low-Moderate condition)
- PCT 4028 (Low condition)
- PCT 4019 (Moderate condition)
- Urban - exotic/native



Figure 6-6, Plant community types and vegetation zones - Wakehurst Parkway from Elanora Road to Mirrool Street

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Nearnmap



## Threatened flora species

Database searches and BAM candidate species development identified 58 threatened flora species in the proposal area. Of these, 37 threatened flora species were identified as having potential to occur within the proposal area and were targeted during field surveys. Two threatened flora species were identified under the EPBC Act and BC Act were recorded during surveys carried out for the proposal. These include:

- Angus's Onion Orchid (*Microtis angusii*), listed as Endangered under the BC and EPBC Acts
- Magenta Lilly Pilly (*Syzygium paniculatum*), listed as Endangered under the BC Act and Vulnerable under the EPBC Act.

The location of threatened flora species is shown in Figure 6-7 to Figure 6-9. In these figures, species polygons are an area of land identified as containing habitat for or is occupied by a threatened species (DPIE 2020a). Potential impacts to threatened flora species are detailed in Section 6.1.3.

### Angus's Onion Orchid

A total of 62 individuals of Angus's Onion Orchid were recorded during targeted surveys at four locations within the study area, of which 52 occur within the proposal area (refer to Figure 6-7 and Figure 6-8). All individuals were recorded in disturbed roadside vegetation adjacent to PCTs which are associated with this endangered orchid species (DPE, 2023c). Three areas of occupied habitat are present on the proposal area, situated on all sides of the road at Wakehurst Parkway and Oxford Falls Road intersection (refer to Figure 6-8).

One sub-population is present in the broader study area outside the proposal area, located on the edge of the electricity easement which runs parallel to Wakehurst Parkway from Dreadnought Road to Oxford Falls Road. This sub-population comprises of 10 individuals.

Individuals which are assumed to be Angus's Onion Orchid could not be confirmed through morphological investigation using a microscope or through currently available genetic analysis techniques. With no way of definitively ruling out the orchids as Angus's Onion Orchid, all individuals have been precautionarily assumed to be the endangered Angus's Onion Orchid as listed under the BC Act and EPBC Act.

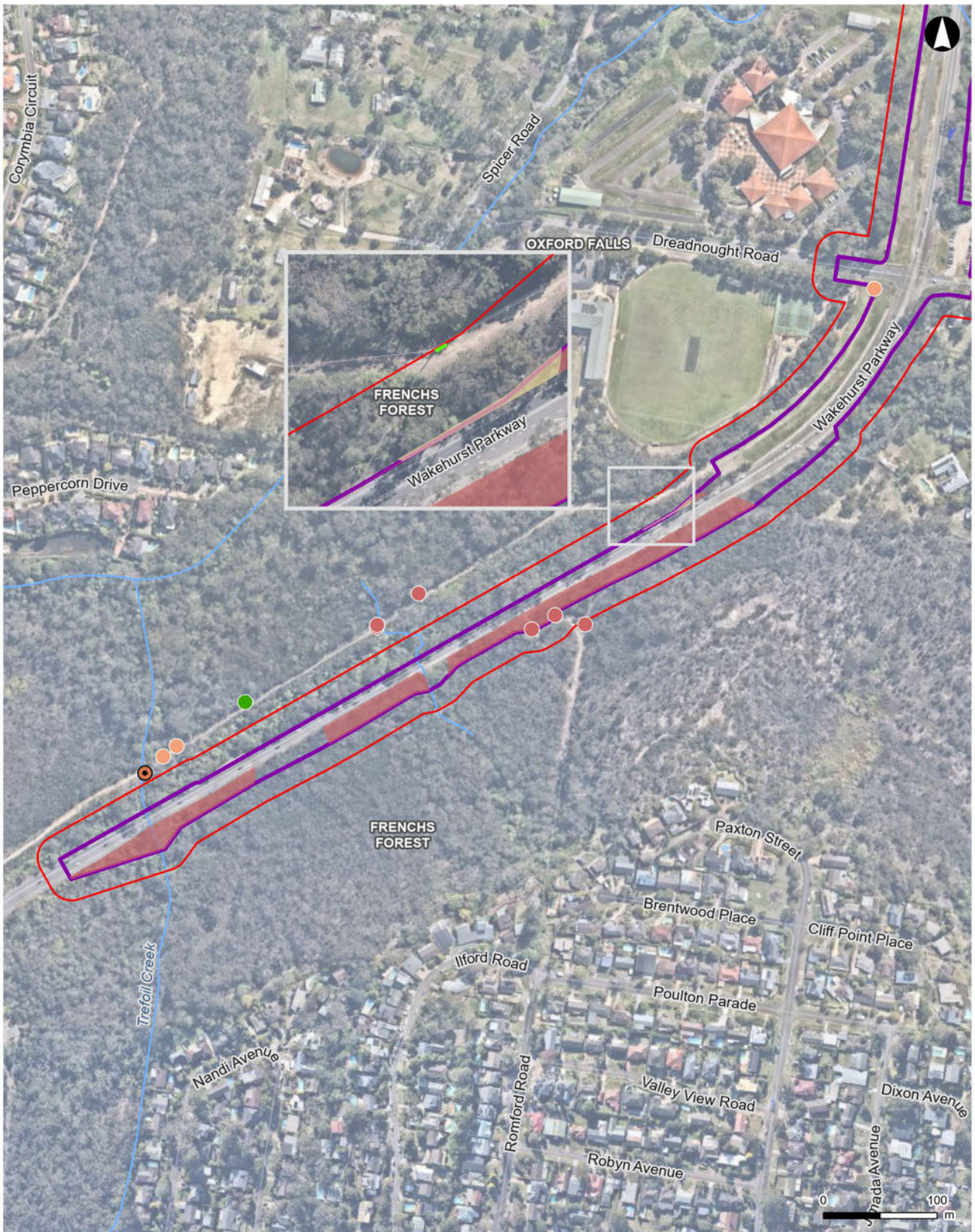
A review of observations and records for this species found that the 52 individuals of Angus's Onion Orchid within the proposal area represent approximately one per cent of the total NSW population.

### Magenta Lilly Pilly

Two individuals of Magenta Lilly Pilly were identified in the study area, one of which occurs on the proposal area (refer to Figure 6-9). The individual in the broader study area had been previously recorded in 2012, with an observation record lodged on the BioNet atlas, tagged as 'Valid and accepted without modification' (DPIE EES, 2023a).

The individual on the proposal area has not been previously recorded. The individual is approximately five meters tall with an estimated diameter at breast height of 300 millimetres. It is growing in a highly modified environment on the residential side of Wakehurst Parkway between Elanora Road and Mirrool Street (refer to Figure 6-9).

Based on the response received from Royal Botanical Gardens the individual of Magenta Lilly Pilly on the proposal area is considered to be planted and subsequently does not hold the same conservation significance as a naturally occurring individual. Impacts to this tree would therefore be considered in impacts to the patch of PCT 4028 where it occurs rather than through generation of species credits.



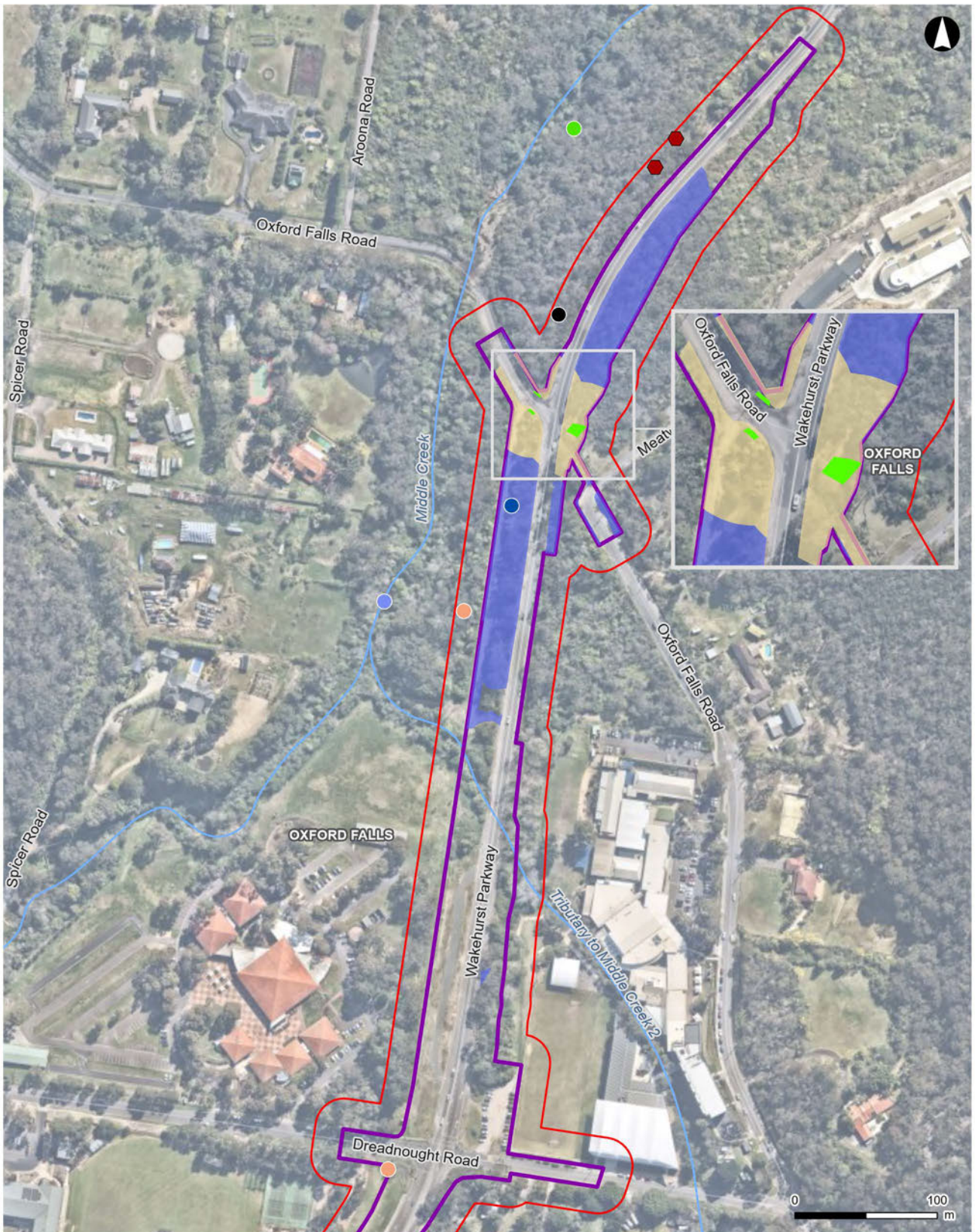
- Legend**
- Study area
  - Proposal area
  - Watercourse
  - Angus's Onion Orchid occupied habitat
  - Species polygon
  - Red-crowned Toadlet
  - Southern Myotis
  - Red-crowned Toadlet (Heard call)
  - Little Bent-winged Bat (Ultrasonic recorder)
  - Grey-headed Flying-fox (Observed)
  - Powerful Owl (Heard call)



Figure 6-7. Distribution of threatened species recorded – Wakehurst Parkway from Trefoil Creek to Dreadnought Road

1:5,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023





- Legend**
- Study area
  - Proposal area
  - ~ Watercourse
  - Angus's Onion Orchid occupied habitat
  - Species polygon
  - Angus's Onion Orchid
  - Southern Myotis
  - Species observations**
  - Glossy Black-cockatoo (Chewed cones)
  - Grey-headed Flying-fox (Observed)
  - Powerful Owl (Observed)
  - Southern Myotis (Observed)
  - White-bellied Sea-eagle (Observed)
  - Rocky feature



Figure 6-8. Distribution of threatened species recorded – Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

1:4,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023





**Legend**

- Study area
- Proposal area
- ~ Watercourse

- Species observations**
- Eastern Osprey (Observed)
  - White-bellied Sea-eagle (Observed)

- Flora**
- ⬠ Magenta Lilly Pilly (planted)



1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 27, 2023



Figure 6-9. Distribution of threatened species recorded – Wakehurst Parkway from Elanora Road to Mirrool Street

#### Groundwater dependent ecosystems

The study area contains high, moderate and low potential terrestrial GDEs and this mapping broadly aligns with the mapping of PCTs 3586, 3592, 3593, 4019 (refer to Figure 6-10). The total area of mapped terrestrial GDEs for vegetation in the proposal area is 0.79 hectares as summarised in Table 6-4. No aquatic GDEs are mapped in the proposal area.

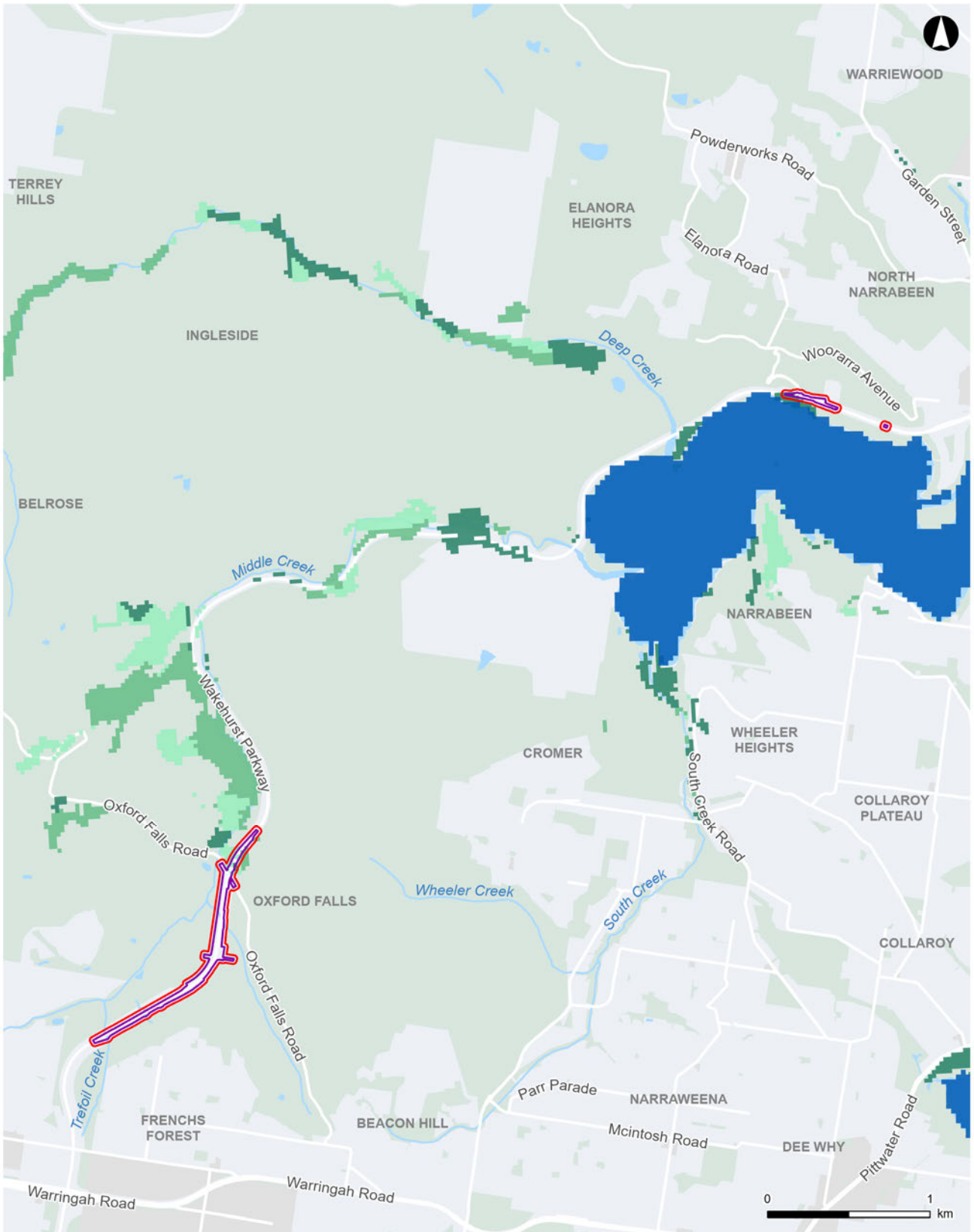
A review of the landscape position and occurring PCTs where terrestrial GDEs have been mapped has indicated that the presence of GDEs in some locations is unlikely. GDEs are unlikely to be present in the study area around Wakehurst Parkway and Oxford Falls Road intersection, where PCTs 3586, 3592 and 3593 occur. The landscape in this location comprises an elevated sandstone ridge which supports vegetation types which are not considered likely to rely on groundwater.

The mapping of GDEs in the northern extent of the subject land in the Mirrool/Elanora footprint is considered to be accurate. PCTs in this location which include Coastal Alluvial Bangalay Forest and Estuarine Swamp Oak Twig-rush Forest are associated with persistent and permanent groundwater presence. The floristic composition of these communities which commonly include reeds, sedges and rushes rely on the presence of semi-permanent/permanent water to persist.

Areas of vegetation along Deep Creek, Oxford Creek and Middle Creek are identified as having potential for groundwater interaction, as well as the wetland areas southwest of Narrabeen Lagoon (refer to Figure 6-10).

Table 6-4: Groundwater dependent ecosystems type and potential

GDE Type	GDE potential	Vegetation zone	Area in the proposal area
Terrestrial	High potential	3593 (moderate condition)	0.24 ha
		4019 (moderate condition)	
Terrestrial	Moderate potential	3592 (low-moderate condition)	0.27 ha
		3593 (moderate condition)	
		Weeds and exotics	
Terrestrial	Low potential	3586 (low condition)	0.28 ha
		3593 (moderate condition)	
<b>Total area</b>			<b>0.79 ha</b>



Proposal area	Groundwater Dependent Ecosystems
Study area	Aquatic
Watercourse	High
	Terrestrial
	High
	Moderate
	Low

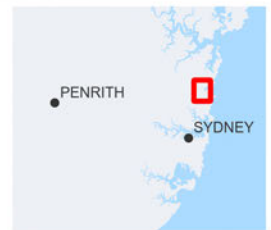


Figure 6-10, Groundwater dependent ecosystems

1:35,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 9, 2023  
 Imagery: Neamap 2022



### Coastal wetlands

Coastal wetlands and proximity areas for coastal wetlands are mapped within the study area under the *State Environmental Planning Policy (Resilience and Hazards) 2021* (SEPP (Resilience and Hazards)). As shown in Figure 6-1, these predominantly occur around Narrabeen Lagoon in the north of the study area and mapping aligns with PCTs 4019 and 4028. These PCTs overlap with mapping of high potential terrestrial GDEs in the study area.

No vegetation mapped as coastal wetlands fall within the proposal area, however a substantial area near the northern package is mapped as Coastal Wetlands Proximity Area.

### Weeds

The study area supports about 0.72 hectares of planted native and exotic vegetation and weeds that are not consistent with any formally recognised PCT. 24 exotic species recorded within the study area are considered to be high threat exotic species. Of these, six are listed as Priority Weeds for the Greater Sydney Land Services region under the Biosecurity Act including:

- Asparagus Fern (*Asparagus aethiopicus*)
- Asparagus Fern (*Asparagus virgatus*)
- Lantana (*Lantana camara*)
- Ludwigia (*Ludwigia peruviana*)
- African Olive (*Olea europaea* subsp. *Cuspidate*)
- Blackberry complex (*Rubus fruticosus* species aggregate)

Asparagus Fern (*Asparagus aethiopicus*), Lantana and Blackberry complex are also included on the Commonwealth list of Weeds of National Significance.

### Fauna

#### Threatened fauna species

Database searches and BAM candidate species development identified 125 threatened fauna species with potential to occur in the locality. Of these, 15 threatened fauna species were identified as having potential to occur within the proposal area and were targeted during field surveys. Twelve threatened fauna species listed under the EPBC Act and/or BC Act were recorded during surveys carried out in the study area. These include:

- Red-crowned Toadlet (*Pseudophryne australis*) (Vulnerable under the BC Act)
- Southern Myotis (*Myotis macropus*) (Vulnerable under the BC Act)
- Glossy Black-cockatoo (*Calyptorhynchus lathami*) (Vulnerable under the EPBC Act and BC Act)
- Powerful Owl (*Ninox strenua*) (Vulnerable under the BC Act)
- Grey-headed Flying-fox (*Pteropus poliocephalus*) (Vulnerable under the EPBC Act and BC Act)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) (Vulnerable under the BC Act)
- Eastern Osprey (*Pandion cristatus*) (Vulnerable under the BC Act)
- Little Bent-winged Bat (*Miniopterus australis*) (Vulnerable under the BC Act)
- Large Bent-winged bat (*Miniopterus orianae oceanensis*) (Vulnerable under the BC Act)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (Vulnerable under the BC Act)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) (Vulnerable under the BC Act)
- Yellow-bellied Sheath-tail-Bat (*Saccolaimus flaviventris*) (Vulnerable under the BC Act)

Of these, the Red-crowned Toadlet and the Southern Myotis are credit species that require offsetting through the preparation of the species polygon. Potential impacts to threatened fauna species are detailed in Section 6.1.3.

The location of threatened fauna species is shown in Figure 6-7 to Figure 6-9.



### Red-crowned Toadlet

Red-crowned Toadlet is a species credit species confined to the Sydney Basin and occurs in open forests on Hawkesbury sandstones. Individuals are commonly found below sandstone ridges, and breeding habitat for the species comprises periodically wet drainage lines with eggs laid amongst dense leaf litter and debris alongside ephemeral watercourses. The species can be found in native vegetation up to 100 metres from breeding habitat.

Red-crowned Toadlet was recorded in several locations to the south of Dreadnought Road during targeted surveys. The species was heard calling along the powerline easements on both sides of Wakehurst Parkway. Locations of Red-crowned Toadlet records are shown in Figure 6-7.

A species polygon has been prepared for Red-crowned Toadlet, with a 100-metre buffer applied to all areas found to be occupied by the species as well as adjacent breeding habitat. The species polygons for Red-crowned Toadlet are shown in Figure 6-7.

### Southern Myotis

Southern Myotis is a species credit species due to its foraging habitat requirements. Potential habitat includes associated PCTs within 200 metres of a waterbody with pools or stretches over 3 metres wide (DPE, 2023c). The species roosts in areas of suitable vegetation, in tree hollows, caves, bridges or other artificial structures within 200 metres of riparian zones.

Southern Myotis was also observed foraging on Middle Creek upstream of Oxford Falls Road (refer to Figure 6-8). While Middle Creek at Oxford Falls is not within the proposal area, native vegetation within the proposal area is considered habitat for the species as it is situated less than 200 metres from Middle Creek.

A species polygon has been prepared for Southern Myotis. PCTs 3586, 3592, 3593, 3595 in the proposal area that fall within 200 metres of the riparian edge along Middle Creek near Oxford Falls Road where the species was recorded have been included in the species polygon, as shown in Figure 6-8.

### Aquatic habitat and species

The proposal traverses Trefoil Creek and several unnamed and unmapped watercourses including two tributaries of Middle Creek, one south of Dreadnought Road and the other south of Oxford Falls Road, and ephemeral drainage lines formed along power line easements in the southern extent of the proposal area.

Narrabeen Lagoon and Middle Creek from the lagoon to Oxford Creek are mapped as Key Fish Habitat and the freshwater fish community status is mapped as fair. The proposal runs parallel to the edge of Narrabeen Lagoon in the northern extent of the proposal area but does not transect the lagoon as it is buffered by native vegetation and Bilarong Reserve.

The Key Fish Habitat mapped in Narrabeen Lagoon and Middle Creek can be classified as Type 1 'highly sensitive aquatic habitat' and waters are assessed as Class 1 'major key fish habitat' as per the *Policy and guidelines for fish habitat conservation and management (2013 update)* (DPI, 2013). This section of Middle Creek mapped as key fish habitat is a 3rd order stream according to the Strahler (1952) classification system, with the 2nd-order upstream sections of the watercourse not identified Key Fish Habitat.

No threatened fish habitat is mapped in the proposal area on the Fisheries NSW Spatial Data Portal and no threatened fish listed under the FM Act or the EPBC Act are considered likely to occur. Furthermore, Middle Creek between Oxford Falls Road and just south of Dreadnought Road is mapped as 'biodiverse riparian land' on the Biodiversity Values Map, however, the proposal area does not transect this area.

Narrabeen Lagoon is known to provide foraging habitat for threatened and/or migratory bird species, with records for several species including Black Bittern (*Ixobrychus flavicollis*), Bar-tailed Godwit and Crested Tern (*Thalasseus bergii*). The proposal area, however, does not contain preferred habitat or mapped important habitat for these species. The aquatic habitat in the southern extent of the proposal area was found to support one threatened species – Red crowned Toadlet, listed as Vulnerable under the BC Act. This species has been discussed above.

### Wildlife connectivity

The proposal is an upgrade of an existing road corridor. The proposal would not fragment any patches of intact, continuous vegetation that are not already fragmented by the existing road. Altered fauna movements and the flow of genetic plant material between areas of habitat would be minimised by reducing the width of the road upgrade.

Roadkill observations were taken from the Northern Beaches Roadkill Prevention Committee dataset (2017 to February 2023) and BioNet records from 2010 to February 2023. Given the roadkill observations were recorded primarily over a 5-year period, the actual roadkill occurrence for 2010-2023 is expected to be higher than the numbers provided in Table 8-11

of the BDAR (Appendix D). Native fauna roadkill records are dispersed across the proposal area and not concentrated in any particular area. Mammal species accounted for the majority of roadkill records. Fauna protection fencing and habitat connectivity features were implemented, immediately to the south of the proposal location at its southern extent, along Wakehurst Parkway as part of the Northern Beaches Hospital project. At a high level of review, the establishment of this protection fencing paired with fauna connectivity features has resulted in fewer roadkill records than in sections of road without fauna protection fencing adjoining to the south.

### 6.1.3 Potential impacts

#### Avoidance and minimisation of impacts

Chapter 2.4 describes the corridor options in detail that were considered and explains how the preferred option was selected to form the proposal. Biodiversity values were considered throughout the options assessment and the design refinement process. The proposal has been designed and positioned to:

- avoid direct impacts:
  - to mapped coastal wetlands and littoral rainforest (Resilience and Hazards SEPP)
  - to higher condition areas of the Endangered Ecological Community Swamp Oak Floodplain Forests (BC Act and EPBC Act)
  - by positioning proposed compound sites in areas which do not require the removal of native vegetation or other biodiversity values
- minimise impacts:
  - to the threatened ecological communities Coastal Upland Swamp (BC Act and EPBC Act), Swamp Oak Floodplain Forest (BC Act and EPBC Act), Swamp Sclerophyll Forest (BC Act) and River-flat Eucalypt Forest (EPBC Act).
- preferentially impacting:
  - previously disturbed vegetation in the Oxford Falls package, where excavation of sandstone and vegetation clearing has occurred
  - developed areas including existing roadways, informal carparks, pedestrian footpaths and residential driveways
  - areas supporting non-native vegetation or vegetation that is not consistent with any formally recognised PCT.

#### Construction

##### Direct impacts to native vegetation and threatened ecological communities

Construction of the proposal would require the removal of 3.80 hectares of vegetation that occurs in the proposal area, of which 2.38 hectares is native vegetation. The 2.38 hectares of native vegetation to be removed from within the proposal area is comprised of seven different PCTs. The areas of vegetation zones to be cleared are listed in Table 6-5 and shown in Figure 6-11 to Figure 6-13.

The area of native vegetation to be cleared includes 0.06 hectares of vegetation that meet the criteria for TECs listed under the BC Act and EPBC Act (refer to Figure 6-4 to Figure 6-6), comprising:

- 0.02 hectares of PCT 3924 which qualifies for listing as the Endangered Ecological Community Coastal Upland Swamp (BC Act and EPBC Act), and
- 0.02 hectares of PCT 4019 which qualify for listing as the EEC Swamp Sclerophyll Forest (BC Act) and critically endangered ecological community River-flat Eucalypt Forest (EPBC Act)
- 0.02 hectares of PCT 4028 which qualifies for listing as the EEC Swamp Oak Floodplain Forest (BC Act) and EEC Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland (EPBC Act).

The small areas of impact from the proposal on the aforementioned TECs are considered unlikely to place the TECs at risk of extinction in the locality or across their total extent.

A total of 18 hollow-bearing trees were identified in the study area but not within the proposal area. The proposal is not expected to impact these hollow-bearing trees.

Table 6-5: Summary of impacts to native vegetation

Vegetation zone	PCT	TEC	Area to be impacted in the proposal area (ha)
3586 (low condition)	Northern Sydney Scribbly Gum Woodland	Not a TEC	0.03
3586 (moderate condition)	Northern Sydney Scribbly Gum Woodland	Not a TEC	0.76
3592 (low – Moderate condition)	Sydney Coastal Enriched Sandstone Forest	Not a TEC	0.02
3592 (moderate condition)	Sydney Coastal Enriched Sandstone Forest	Not a TEC	0.11
3593 (moderate condition)	Sydney Coastal Sandstone Bloodwood Shrub Forest	Not a TEC	0.48
3595 (exotic)	Sydney Coastal Sandstone Gully Forest	Not a TEC	0.35
3595 (low condition)	Sydney Coastal Sandstone Gully Forest	Not a TEC	0.01
3595 (moderate condition)	Sydney Coastal Sandstone Gully Forest	Not a TEC	0.56
3924 (moderate condition)	Sydney Coastal Upland Swamp Heath	Listed as: <ul style="list-style-type: none"> <li>Coastal Upland Swamp in the Sydney Basin Bioregion (BC Act: Endangered)</li> <li>Coastal Upland Swamps in the Sydney Basin Bioregion (EPBC Act: Endangered)</li> </ul>	0.02

Vegetation zone	PCT	TEC	Area to be impacted in the proposal area (ha)
4019 (moderate condition)	Coastal Alluvial Bangalay Forest	<p>Listed as:</p> <ul style="list-style-type: none"> <li>Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: Endangered)</li> <li>River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (EPBC Act: Critically Endangered)</li> </ul>	0.02
4028 (low condition)	Estuarine Swamp Oak Twig-rush Forest	<p>Listed as:</p> <ul style="list-style-type: none"> <li>Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: Endangered)</li> <li>Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community (EPBC Act: Endangered)</li> </ul>	0.02



- Legend**
- Subject land
  - Native vegetation
  - Non-native vegetation
  - ~ Watercourse

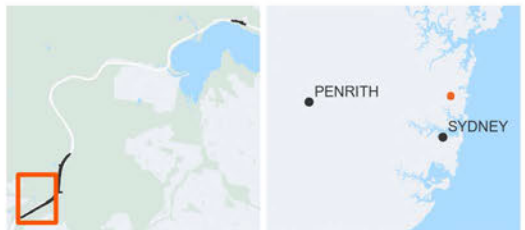
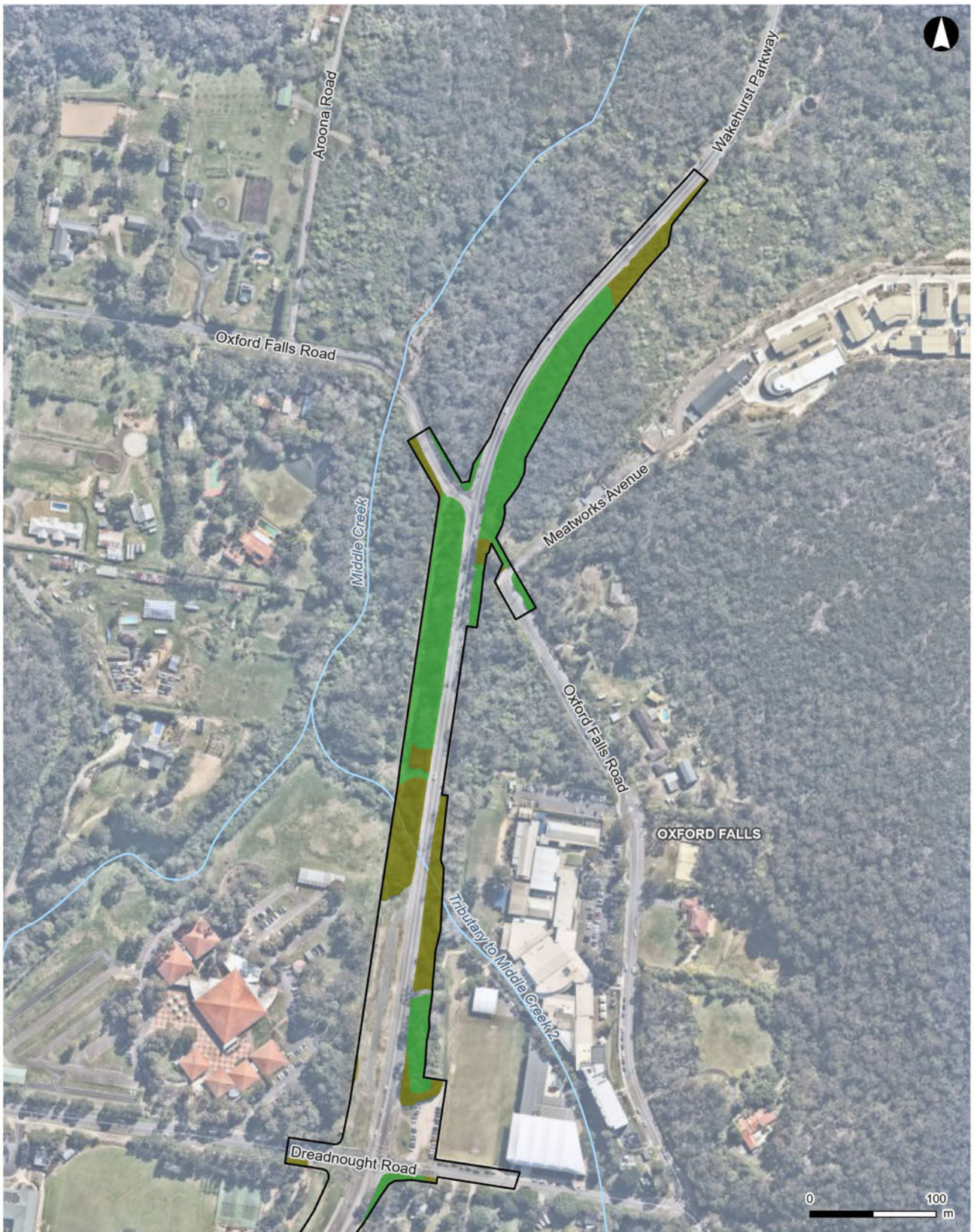


Figure 6-11, Areas of vegetation clearing - Wakehurst Parkway from Trefoil Creek to Dreadnought Road

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Neamap

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Legend

- Subject land
- Native vegetation
- Non-native vegetation
- ~ Watercourse

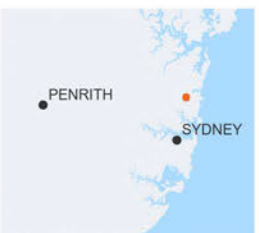


Figure 6-12, Areas of vegetation clearing - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Neamap





- Legend**
- Subject land
  - Native vegetation
  - Non-native vegetation
  - Watercourse



Figure 6-13, Areas of vegetation clearing - Wakehurst Parkway from Elanora Road to Mirrool Street

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Neamap



### Direct impacts to threatened species

Ecosystem credits are required to offset impacts to the threatened ecosystem credit fauna species known, or likely to occur. Three species credit species were recorded on the proposal area during targeted seasonal surveys, two fauna species and one flora species, including Angus's Onion Orchid, Red-crowned Toadlet, and Southern Myotis. Impacts to these species are assessed by "area" based on a species polygon. Associated PCTs and impact areas for each of the credit species are detailed in Table 6-6 which have been used to calculate biodiversity offsets (refer to Section 6.1.5).

#### Angus's Onion Orchid

The proposal would remove 52 individuals of Angus's Onion Orchid from 3 sub-populations. The three sub-populations would be completely removed. The species polygon prepared for the Angus' Onion Orchid has a total area of 0.21 hectares, comprising 0.01 hectares of occupied habitat and 0.2 hectares of high potential habitat based on the ecology and known habitat preferences of the species (refer to Figure 6-7 and Figure 6-8).

The Angus's Onion Orchid has been identified as being at risk of Serious and Irreversible Impacts (SAIL). To make an assessment as to whether the proposal is likely to have serious and irreversible impacts on Angus's Onion Orchid additional information has been provided for the Principles which apply to Angus's Onion Orchid as identified in the Threatened Biodiversity Data Collection. The assessment concluded that the proposal is likely to constitute a significant impact to Angus's Onion Orchid.

Further detail on the additional impact assessment provisions is provided in Section 8.3 of the BDAR. No other threatened entities identified on the proposal area or likely to be impacted by the proposal are listed as at risk of SAIL.

#### Southern Myotis

The species polygon for Southern Myotis includes 1.07 hectares of native vegetation in the proposal area. No hollow-bearing trees have been identified within the proposal area, so impacts on Southern Myotis by the proposal would primarily be the removal of aerial foraging habitat that runs parallel to Middle Creek near Oxford Falls Road (refer to Figure 6-8).

#### Red-crowned Toadlet

The Red-crowned Toadlet species polygon encompasses 0.83 hectares of native vegetation in the proposal area considered habitat for the species. The area of habitat to be removed by the proposal consists primarily of dispersal and foraging habitat, however, includes a small patch of breeding habitat where modified sandstone drainage lines along the power line alignment to the east of Wakehurst Parkway meet the road (refer to Figure 6-7).

Red-crowned Toadlet is sensitive to changes in hydrology including alterations in flows and degradation of water quality (NSW National Parks and Wildlife Service, 2001). Surface water in areas of occupied habitat is a result of seepage and surface flow from bushland and sandstone escarpments to the east and southeast and from rainfall; rather than Trefoil Creek. Habitat along drainage lines like Trefoil Creek is deemed less suitable for the species due to degraded water quality. The proposal is located downslope of occupied habitat of this species and subsequently is unlikely to impact seepage and surface water flow important to the persistence and quality of habitat. Similarly, occupied habitat for the species on the other side of Wakehurst Parkway, outside of the subject land is influenced by surface water and seepage from upslope bushland and escarpments. An increase in surface flow from the road surface is also unlikely to impact the habitat of this species. Surface water from the road surface would be captured by table drains and directed to the existing watercourses in Trefoil Creek. As such any impact to Trefoil Creek through increased water flow is unlikely to impact the habitat of the species or the present population.

#### Other fauna species

Seven additional dual credit fauna species were recorded during surveys (Powerful Owl, Glossy Black-cockatoo, White-bellied Sea-eagle, Eastern Osprey, Little Bent-winged Bat, Grey-headed Flying-fox), however, the species credit components (i.e., breeding habitat) were not detected.



Table 6-6: Summary of direct impacts on threatened species credit species

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	Serious and Irreversible impacts?	Associated vegetation Zone	The area within the proposal area (ha)	Total habitat or individuals to be impacted (ha)
<b>Flora</b>								
<i>Mirotis angusii</i>	Angus's Onion Orchid	E	E	Moderate	Yes	3586 (low)	0.02	0.21
						3593 (moderate)	0.10	
						3595 (exotic)	0.03	
						3595 (moderate)	0.06	
<b>Fauna</b>								
<i>Myotis macropus</i>	Southern Myotis	Not listed	V	High	No	3586 (low)	0.02	1.07
						3592 (low-moderate)	0.02	
						3593 (moderate)	0.48	
						3595 (exotic)	0.18	
						3595 (moderate)	0.37	
<i>Pseudophryne australis</i>	Red-crowned Toadlet	Not listed	V	Moderate	No	3586 (moderate)	0.55	0.83
						3592 (moderate)	0.11	
						3595 (moderate)	0.15	
						3924 (moderate)	0.02	

\*E = Endangered, V = Vulnerable

#### Trampling of threatened flora species

Angus's Onion Orchid is a small cryptic orchid that occurs in cleared, edge-effected grassy areas within the study area. During the construction of the proposal, it is possible that the risk of trampling of individuals outside of the proposal area would increase due to the increase in human activity. The risk to Angus's Onion Orchid outside the proposal area would be mitigated by the implementing the safeguards in this REF.

#### Areas of geological significance

Geological landforms and features in the local landscape provide habitat for a suite of common and threatened fauna species including Rosenberg's Goanna and Red-crowned Toadlet. Exposed and embedded sandstone rock occurs within the southern extent of the proposal area. The threatened species Rosenberg's Goanna and Red-crowned Toadlet are associated with the habitat where exposed sandstone rock is present, however, neither of these species relies exclusively on these geological features to complete their lifecycle. No threatened species are considered to inhabit buried or embedded

sandstone. During construction, the proposal would permanently remove buried sandstone rock and areas of exposed sandstone. Impacts would be restricted to sandstone rocks and boulders, ranging from large (two cubic metres) to gravel.

### Non-native vegetation

Non-native vegetation in the proposal area includes assemblages of weeds, planted native and non-native vegetation that is not consistent with any formally recognised PCT and expanses of exotic grassland. Non-native vegetation covers 1.42 hectares of the proposal area, a large proportion of which is exotic grassland. Non-native vegetation comprising trees and shrubs that offer limited potential foraging, nesting and sheltering habitat for the Grey-headed Flying-fox.

Non-native vegetation is not considered to be an important component of habitat for any other threatened species within the proposal area or surrounds.

### Noise, dust and light spill

Construction activities would result in localised and temporary noise, vibration, and dust impacts that would result in disturbance to local fauna populations in bush that is adjacent to the proposal area. Additionally, night work would occur as a component of the proposal resulting in light spill to habitat in the area surrounding the work. Indirect noise, vibration, dust and lighting impacts from the construction phase of the project would be temporary and therefore would not result in a permanent reduction in the viability of nearby habitat.

Threatened microbat species have been detected in the proposal area, with Southern Myotis potentially roosting in tree hollows around Middle Creek at Oxford Falls Road adjacent to the proposal area. Little Bent-winged Bat was also detected near Trefoil Creek; however, no roosting habitat was identified in, or near the proposal area in this area. Indirect impacts to these threatened microbats could occur during construction through increased noise, vibration and light spill. With appropriate mitigation it is not expected this disturbance would cause a substantial reduction in the viability of adjacent habitat such that it becomes unsuitable for use by threatened microbats and other fauna.

It is not anticipated that the proposal would substantially increase the amount of noise, vibration, dust or light spill disturbance to the surrounding area in its operational phase. Areas where permanent lighting has been proposed are restricted to those where surrounding land is already developed, and existing street lighting is present. Widening of the Wakehurst Parkway would increase the penetration of vehicular disturbance to the connected habitat, however, this increase in disturbance is expected to be negligible and would not reduce the viability of adjacent habitat.

### Invasion and spread of weeds and pathogens

An increase in the movement of people, vehicles, machinery, vegetation waste and soil during and following the construction of the proposal may facilitate the introduction or spread of exotic flora species that occur within the proposal area. Management measures would be required to minimise the introduction and spread of weeds.

Though no pathogens were observed with the proposal area, the proposal has the potential to increase the spread of pathogens that threaten native biodiversity in the proposal area, including Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Austropuccinia psidii*) and Amphibian chytrid fungus disease (*Batrachochytrium dendrobatidis*). Phytophthora and Myrtle Rust are introduced plant pathogens, while amphibian chytrid fungus is a pathogen that causes the disease chytridiomycosis impacting native frog species. All three pathogens have spread associated with human activity and can be mitigated through the implementation of proper hygiene practices during the construction phase of the proposal.

### Aquatic habitat impacts

Middle Creek and Narrabeen Lagoon occur outside the proposal area, and both watercourses are mapped Key Fish Habitat. No mapped Key Fish Habitat transects the proposal area. These watercourses have the potential to be indirectly impacted through changes to water quality and hydrological characteristics. During construction, sedimentation and chemical pollutants have the potential to flow into these watercourses, particularly during periods of high rainfall. The proposal area has several locations susceptible to flooding, which may increase the potential for sediment to enter watercourses downstream during the construction period. Mitigation measures would be implemented to reduce the risk of downstream impacts to all watercourses, including Key Fish Habitat as a result of the proposal.

The construction phase of the proposal presents a risk to downstream surface water quality through the disturbance of the existing ground surface required for road construction. Water quality impacts associated with the construction phase include increased turbidity from sedimentation which can reduce the visual amenity and increased nutrient levels in water resulting in eutrophication and a reduction in the quality of aquatic habitat. The mitigation measures identified in this REF are expected to reduce the risk of these impacts.

During construction, there is a potential for waterways to be temporarily blocked or diverted. Blocking or diversion of drainage lines would block fish passage, though it is unlikely to affect any threatened species and would be temporary in nature. Watercourses transecting the proposal and subject to direct impacts are all first order ephemeral streams already in

a modified condition due to the existing road. Within the Northern Zone (Sustain JV 2023) excavation during construction and construction staging has been designed to reduce the risk of impacts to adjoining sensitive aquatic habitats. Existing culverts would remain operational while proposed culvert extensions and the new embankment are constructed to manage any potential flooding.

Permanent changes to flow and water quality by the proposal are anticipated to be minor, therefore downstream impacts are not anticipated as a result of the proposal.

### Impacts to coastal wetlands

Coastal wetlands (refer to Figure 6-1), are susceptible to hydrological changes, which have been considered in the proposal's design to ensure changes to water quality and flow in the northern extent of the proposal area are negligible. The area of coastal wetland proximal to the proposal supports native vegetation mapped as PCT 4028 on the foreshore of Narrabeen Lagoon. The patch of coastal wetland subject to potential indirect impacts by the proposal is approximately 2.7 hectares, with the entire area of coastal wetlands on the northern side of Narrabeen Lagoon totalling approximately 6.18 hectares.

A small amount of vegetation removal is required for the localised widening of the southbound carriageway at Mirrool Street, adjacent to, but not within the Coastal Wetland. The proposal would not remove any vegetation within the mapped Coastal Wetland extent of located between Narrabeen Lagoon and Wakehurst Parkway, therefore no direct or indirect impacts are anticipated to occur to the vegetation mapped as coastal wetland. The proposal would not include deep earthworks near Narrabeen Lagoon and therefore impacts to groundwater would be minor. Existing drainage infrastructure in this area the Northern Zone (Sustain JV 2023) is being retained, with one new drain being installed to direct water away from the lagoon, into the existing roadside swale. During construction, this vegetated swale would be excavated and replanted, which would result in a brief period where high rainfall may result in a temporary reduction of water quality due to sedimentation.

Minor changes to water quality may also occur throughout the construction of the proposal, as a result of sediment-laden runoff, however, mitigation measures would be in place to minimise the sediment load of runoff. Opportunities for installing additional water quality treatment elements such as vegetated swales and GPTs exist within the Northern zone and it is anticipated that these would be investigated further during detailed design development. Permanent increases in surface flows from an increase in the road surface are expected to be minor and would be captured in existing stormwater drainage.

The proposal is not expected to substantially impact, groundwater, surface water flow or quality in this area, with minor impacts anticipated in the proposal's construction and operation. Small amounts of vegetation removal would occur adjacent to but not within Coastal Wetland at the intersection of Mirrool Street. During construction, there is potential for a minor reduction in water quality through increased sedimentation and runoff. No impacts to groundwater are anticipated as excavation would not intersect ground water. It is also unlikely that the proposal would result in substantial impacts to the mapped coastal wetlands within the vicinity of the proposal area given the modified state and existing disturbances to wetlands caused by the current Wakehurst Parkway and adjacent Bilarong Reserve.

### Groundwater dependent ecosystems

A total of 0.79 hectares of mapped areas of potential GDEs would be impacted by the proposal, most of which are classified as having a low to moderate groundwater interaction (refer to Figure 6-10).

In the northern section of the proposal, there is anticipated to be minor impacts to GDEs. PCT 4019 and PCT 4028 in this location are groundwater dependent vegetation communities. A total of 0.02 hectares of PCT 4019 and 0.02 hectares of 4028 would be removed by the proposal. Indirect impacts to adjacent areas of these communities as a result of impacts to groundwater would be negligible. Limited earthworks and excavations are proposed in this location that could intersect the water table. An existing vegetated swale on the northern side of the road mapped as terrestrial GDE would be excavated and deepened slightly, however, depth would not extend past existing culvert depth. Further, the increase in hard stand in this location would have a negligible impact in surface water flows that interact with these GDEs.

GDEs would not be impacted in the location around Wakehurst Parkway and Oxford Falls Road intersection.

## Operation

### Wildlife connectivity and habitat fragmentation

The proposed road widening and installation of targeted fauna protection fencing would reduce connectivity and act as a barrier to wildlife movement across the landscape. However, it should be noted that fauna protection fencing already exists immediately to the south of the proposal location at its southern extent, along Wakehurst Parkway installed as part of the Northern Beaches Hospital project. Most species, besides flying foxes and larger birds, would have increased difficulty crossing the landscape. Existing drainage culverts may facilitate limited movement for some species, and other crossing structures along Wakehurst Parkway, beyond the proposal area, may also offer connectivity to fauna in the locality.

The potential impact on habitat connectivity to threatened fauna species and species which form part of a TEC present in the proposal area are summarised in Table 8-9 of the BDAR (Appendix D).

### Edge effects on adjacent native vegetation and habitat

The proposal would indirectly impact native vegetation adjacent to the proposal area by fragmenting vegetation and creating new edges which may result in edge effects. The proposal would encroach on already disturbed and edge-affected vegetation, likely degrading the quality of native vegetation and habitat in widened areas. New edges created by the proposal would be subject to degradation by potential weed establishment and spread and alterations to hydrological regimes from revised pavement drainage.

However, measures to mitigate the potential indirect impacts from edge effects, including weed management and the provision of drainage infrastructure that would appropriately manage surface water flows are provided in Section 6.1.4. Areas of the design where the road features a cut edge are also less likely to be subject to a reduction in habitat quality from changed hydrology, such as erosion, weed spread, or nutrient-rich runoff, due to the location of the vegetation upslope. Most of the proposal's encroachment on native vegetation are in areas of cut, which minimises the negative impact of edge effects on habitat by the proposal.

### Fauna injury and mortality

Several sections of Wakehurst Parkway would be widened by the proposal, increasing the distance required for fauna to travel when crossing the road. The increase in the number of traffic lanes also increases the risk of vehicle strike in these sections by increasing the capacity for vehicles on the road. However, the risk of fauna strike to motorists is not expected to increase as the proposal would not result in changes to speed conditions on the road and is expected to improve the line of sight where the road is being widened on a curve. As such, the occurrence of vehicle strike to fauna in the proposal area is not anticipated to increase substantially because of the proposal but rather is expected to decrease with the inclusion of mitigation measures (fauna protection fencing) in the southern extent of the proposal area (refer to Section 6.1.4).

### Aquatic impacts

Instream impacts would occur with installation of drainage structures including culvert extensions at Trefoil Creek and two tributaries of Middle Creek, between Trefoil Creek and Oxford Falls Road. The extension of the culverts in the proposal area would result in the permanent removal of small areas of aquatic vegetation, rock, and snags over a small area. Flow of these creeks would also be altered through the extension of culverts.

All culverts in the proposal area are in a modified condition due to the existing highway and surrounding land use practices. There would be an increase in runoff into these watercourses in the proposal area due to the increase in road surface and redirection of flow from drainage, however drainage infrastructure would be largely retained with the existing specifications to ensure minimal changes to existing performance, to prevent substantial changes to surface water flow in the area. As such, flow alteration impacts are expected to be minor. Notwithstanding this, there is opportunity to provide additional water quality treatment in this location, such as the use of a vegetated swale at the outlet of the new longitudinal pavement drainage to separate clean and dirty water. Gross pollutant traps could be fitted to headwall structures to further improve water quality discharging towards areas of sensitive aquatic receiving environments. Similar opportunities are present in both the Central and Southern Zones and these would be investigated further during Detailed Design.

Riparian vegetation would be permanently removed at each waterway. Impacts would be limited to small areas around each culvert and drainage structure, and disturbed areas would be revegetated following construction. Riparian vegetation near the existing road is degraded with a high cover of exotic plant species. Revegetation in these areas would likely result in an improvement of condition for remaining adjacent riparian vegetation.

Permanent changes to flow and water quality by the proposal are anticipated to be minimal, therefore downstream impacts are not anticipated as a result of the proposal.

### Noise, dust and light spill

It is not anticipated that the proposal would substantially increase the amount of noise, vibration, dust or light spill disturbance to the surrounding area in its operational phase. Areas where permanent lighting has been proposed are restricted to those where surrounding land is already developed, and existing street lighting is present. Widening of Wakehurst Parkway would increase the penetration of vehicular disturbance to the connected habitat, however, this increase in disturbance is expected to be negligible and would not reduce the viability of adjacent habitat.

### Conclusion on significance of impacts

The proposal is likely to significantly impact the threatened flora species Angus's Onion Orchid, listed as endangered under the BC Act and EPBC Act, therefore a BDAR has been prepared.

The proposal is not likely to significantly impact any other threatened species or ecological communities or their habitats, within the meaning of BC Act, EPBC Act, or FM Act.

Table 6-7: Conclusion on significance of impacts

Is there a real chance that the activity threatens the long-term survival of nationally-listed biodiversity matters?	Yes there is a real chance that the Proposal threatens the long-term survival of <i>Microtis angusii</i> (Angus' Onion Orchid)
Has the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advices and guidelines provided by the Australian Government been considered?	Yes
Can suitable offsets be secured?	Yes

As the proposal would require the removal of native vegetation and fauna habitat from the proposal area, Transport is required to offset these impacts on biodiversity. Offsets required for the proposal are outlined in Section 6.1.5.

#### 6.1.4 Safeguards and management measures

Table 6-8: Biodiversity safeguards and management measures

Impact	Mitigation measure	Responsibility	Timing
Biodiversity	<p>A Flora and Fauna Management Plan will be prepared and in accordance with Transport for NSW's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on Projects</i> (RTA, 2011) and implemented as part of the Construction Environmental Management Plan (CEMP). It will include (but not be limited to) the following:</p> <ul style="list-style-type: none"> <li>pre-clearing survey requirements and a site walk with appropriate site personnel including Transport for NSW representatives to confirm clearing boundaries and sensitive location prior to commencement of works.</li> <li>identification (marking) of the clearing boundary and identification (marking) of habitat features to be protected. Eg. – use of flagging tape.</li> <li>a map/ plans showing vegetation clearing boundaries, areas to be protected including sensitive areas/no go zones, protected habitat features and revegetation areas.</li> <li>incorporation of management measures identified as a result of the pre-clearing survey report, completed by an ecologist, (G40, section 2.4) and nomination of actions to respond to the recommendations made. This should include details of measures to be implemented to protect clearing limits and no go areas</li> <li>a detailed clearing process in accordance with Transport for NSW Biodiversity Guidelines (2011) including requirements of Guide 1,2, 4 &amp; 9.</li> <li>identify in toolbox talks where biodiversity will be included such as vegetation clearing or works in or adjacent to sensitive locations</li> </ul>	Transport for NSW and Contractor	Pre-construction and Construction

Impact	Mitigation measure	Responsibility	Timing
	<ul style="list-style-type: none"> <li>identify control/mitigations measures to prevent impacts on sensitive locations or no go zones</li> <li>procedures for unexpected threatened species finds and fauna handling</li> <li>procedures addressing relevant matters specified in the <i>Policy and Guidelines for Fish Habitat Conservation and Management (2013)</i></li> <li>protocols to manage weeds and pathogens.</li> </ul>		
Removal of native vegetation	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	Contractor	Pre-construction
Removal of native vegetation	Vegetation removal will be undertaken by a qualified arborist and in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	Contractor	Construction
Removal of native vegetation	Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	Contractor	Post-construction
Removal of native vegetation	Vegetation to be retained is to be protected in accordance with AS 4970-2009 – <i>Protection of trees on development sites</i> , and may require exclusion fencing of the Tree Protection Zones.	Contractor	Pre construction and construction
Direct impacts to threatened species	Fauna will be managed in accordance with Guide 9: Fauna handling of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	Contractor	Construction
Direct impacts to threatened species	Habitat will be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> .	Contractor	Construction
Direct impacts to threatened species	The unexpected species find procedure is to be followed under Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)</i> if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	Contractor	Construction
Direct impacts to threatened species	Retained individuals of Angus's Onion Orchid outside of the subject land are to be addressed in the CEMP. Individuals or areas of known occurrence outside the construction footprint will have exclusion zones established around them to prevent trampling or other accidental impacts. Where practical and feasible, surveys should be undertaken prior to construction during the flowering period of this species to maximise detection of the individuals to be protected within exclusion zones. The listed survey month for this species as identified on the Threatened Species Data Collection is in October, however this species is known to have above ground	Contractor	Construction

Impact	Mitigation measure	Responsibility	Timing
Aquatic impacts	features between May and October (DECCW, 2010), which may be identifiable by an ecologist experienced with surveying for this species.		
	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i> (DPI (Fisheries NSW) 2013).	Contractor	Construction
Fragmentation of identified habitat corridors and impacts to connectivity and movement	A Wildlife Connectivity Strategy will be prepared as part of final design in accordance with the requirements of the Transport for NSW <i>Biodiversity Policy</i> . The strategy would be prepared and implemented in accordance with the <i>Draft Wildlife Connectivity Guidelines for Road Projects</i> (RTA 2011) or equivalent updated NSW Guidelines.	Transport for NSW and Contractor	Detailed design, during Construction and Post-construction
Fragmentation of identified habitat corridors and impacts to connectivity and movement	Connectivity measures, if proposed, will be developed and designed in consultation with the project ecologist.	Contractor	Construction
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with Guide 2: Exclusion zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
Invasion and spread of weeds	Weed species will be managed in accordance with Guide 6: Weed management of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
Invasion and spread of pests	Pest species will be opportunistically monitored during construction of the project. A process on how incidental sightings will be recorded will be set out in the Construction Flora and Fauna Management Sub-plan. If it is deemed that the proposal is exacerbating the impact of pest species on the biodiversity in the proposal location management actions may be investigated and implemented.	Contractor	Construction
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with Guide 7: Pathogen management of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
Light spill and shading impacts	Construction lighting impacts will be minimised as follows: <ul style="list-style-type: none"> <li>lighting would only be used as necessary to conduct construction activities at night. Lights would be turned off when not needed</li> </ul>	Contractor	Construction

Impact	Mitigation measure	Responsibility	Timing
	<ul style="list-style-type: none"> <li>• adaptive light controls to manage light timing, intensity and colour would be installed where possible</li> <li>• only the object or area intended would be lit where reasonable and practical</li> <li>• lights would be kept close to the ground and directed to avoid light spill. Lighting would be shielded where possible</li> <li>• the lowest intensity lighting appropriate for the task would be used</li> <li>• use non-reflective, dark-coloured surfaces where possible</li> <li>• use lights with reduced or filtered blue, violet, and ultra-violet wavelengths where possible.</li> </ul>		
Impacts to areas of geological significance	Impacts to sandstone rock will be minimised through salvage and relocation to avoided or remediated natural areas	Contractor	Construction
Vehicle strike	<p>Fauna protection fencing will be installed at targeted locations along the proposal area. Fauna protection fencing will be designed to minimise impacts to threatened fauna species and species subject to vehicle strike. Locations selected will consider connectivity requirements of fauna, utilise existing crossing structures and potential fauna crossing infrastructure (i.e. canopy bridges and underpasses) to maintain connectivity.</p> <p>A monitoring strategy will be developed to detect efficacy of fauna protection fencing and maintenance requirements would be detailed as part of the Wildlife Connectivity Strategy.</p>	Transport for NSW and Contractor	Pre-construction and Construction
Removal of individuals of the threatened flora species Angus's Onion Orchid	<p>Plant salvage. A salvage management plan will be prepared in consultation with the Royal Botanical Gardens (RBG) and the NSW Threatened Species Officer for Angus's Onion Orchid, with the ultimate objective of salvaging individuals within the proposal area prior to construction and replanting in suitable habitat beyond the limit of works</p> <p>The salvage management plan will likely include the following tasks:</p> <ol style="list-style-type: none"> <li>1. Salvage of individuals and replanting at translocation site</li> </ol> <ul style="list-style-type: none"> <li>• methodology to undertake salvage of orchid tubers from construction area</li> <li>• timeframes and project program to undertake salvage, store tubers and translocate to a suitable recipient site.</li> <li>• process for storage, care of individuals and preparation for replanting at RBG</li> <li>• planting design for translocation site (s) to minimise inbreeding and maximise genetic diversity, fitness and resilience of translocated populations.</li> </ul>	Transport for NSW and Contractor	Pre-construction or construction



Impact	Mitigation measure	Responsibility	Timing
Residual impacts to native vegetation and habitat	<p>2. Ongoing monitoring</p> <ul style="list-style-type: none"> <li>development of a monitoring program to measure the success of the plant salvage and translocation</li> </ul> <p>This mitigation measure will be undertaken either as early works or, if during the main contract, will have an exclusion hold point in the area around the Oxford Falls Road and Wakehurst Parkway intersection to prevent any other works occurring prior to salvage</p>		
	<p>A Biodiversity Offset Strategy and Tree and Hollow Replacement Strategy (TfNSW 2022) will be prepared which sets out how offsets will be delivered for impacts to biodiversity and other natural values.</p>	Contractor	Pre-construction and construction

Other safeguards and management measures to address biodiversity impacts are identified in Section 6.3.4.

### 6.1.5 Biodiversity offsets

Biodiversity offsets are based on the BAM Calculator and the Transport for NSW Biodiversity Policy (TfNSW, 2022). Transport follows the principles of ‘no net loss’ of biodiversity, as described in the Biodiversity Policy, and in doing so institutes a tree and hollow replacement (Tree and Hollow Replacement Program: An implementation plan for payments to and from the Transport for NSW Conservation Fund, 2022).

As the proposal would require the removal of native vegetation and fauna habitat from the proposal area, Transport is required to offset these impacts on biodiversity. The offsets required for the proposal were calculated using the BAM Calculator. A total of 42 ecosystem credits (refer to Table 6-9) and 48 species credits (refer to Table 6-10) are required to offset the direct impacts of the proposal. No offsets are required for aquatic habitats as no impacts would occur to mapped areas of Key Fish Habitat. Areas requiring offset are shown in Figure 6-14 to Figure 6-16.

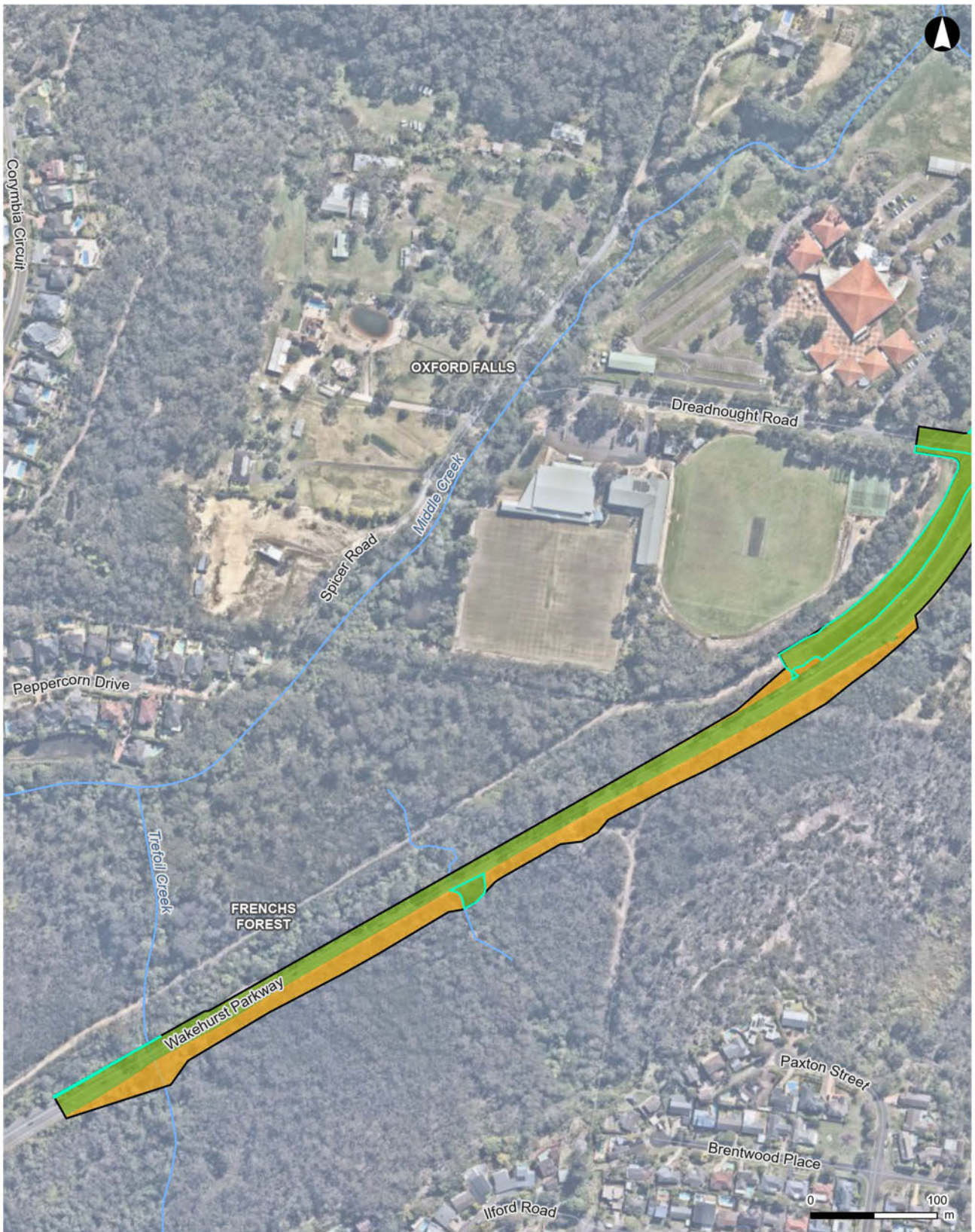
Table 6-9: Ecosystem credits required to offset direct impacts from the proposal

Plant Community Type	Threatened Ecological Community	Impact area	Ecosystem credits required
PCT 3586: Northern Sydney Scribbly Gum Woodland	Not a TEC	0.79 hectares (ha)	15
PCT 3592: Sydney Coastal Enriched Sandstone Forest	Not a TEC	0.13 ha	3
PCT 3593: Sydney Coastal Sandstone Bloodwood Shrub Forest	Not a TEC	0.48 ha	8
PCT 3595: Sydney Coastal Sandstone Gully Forest	Not a TEC	0.92 ha	13
PCT 3924: Sydney Coastal Upland Swamp Heath	<p>Is listed as:</p> <ul style="list-style-type: none"> <li>Coastal Upland Swamp in the Sydney Basin Bioregion (BC Act: Endangered)</li> </ul>	0.02 ha	1

Plant Community Type	Threatened Ecological Community	Impact area	Ecosystem credits required
PCT 4019: Coastal Alluvial Bangalay Forest	<ul style="list-style-type: none"> <li>Coastal Upland Swamps in the Sydney Basin Bioregion (EPBC Act: Endangered)</li> </ul>	0.02 ha	1
	Is listed as: <ul style="list-style-type: none"> <li>Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: Endangered)</li> <li>River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (EPBC Act: Critically Endangered)</li> </ul>		
PCT 4028: Estuarine Swamp Oak Twig-rush Forest	Is listed as: <ul style="list-style-type: none"> <li>Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: Endangered)</li> <li>Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community (EPBC Act: Endangered)</li> </ul>	0.02 ha	1
<b>Total</b>		<b>2.38 ha</b>	<b>42</b>

Table 6-10: Species credits required to offset direct impacts from the proposal

Threatened species	Status	Loss of habitat	Species credits required
Southern Myotis ( <i>Myotis macropus</i> )	Vulnerable (BC Act)	1.07 ha	24
Red-crowned Toadlet ( <i>Pseudophryne australis</i> )	Vulnerable (BC Act)	0.83 ha	16



**Legend**

- Subject land
- Tree and hollow replacement area
- ~ Watercourse
- Impacts requiring offsets under BAM
- Impacts not requiring offsets under BAM

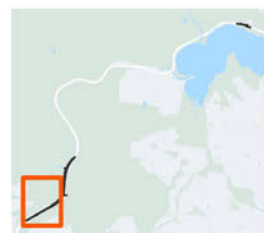
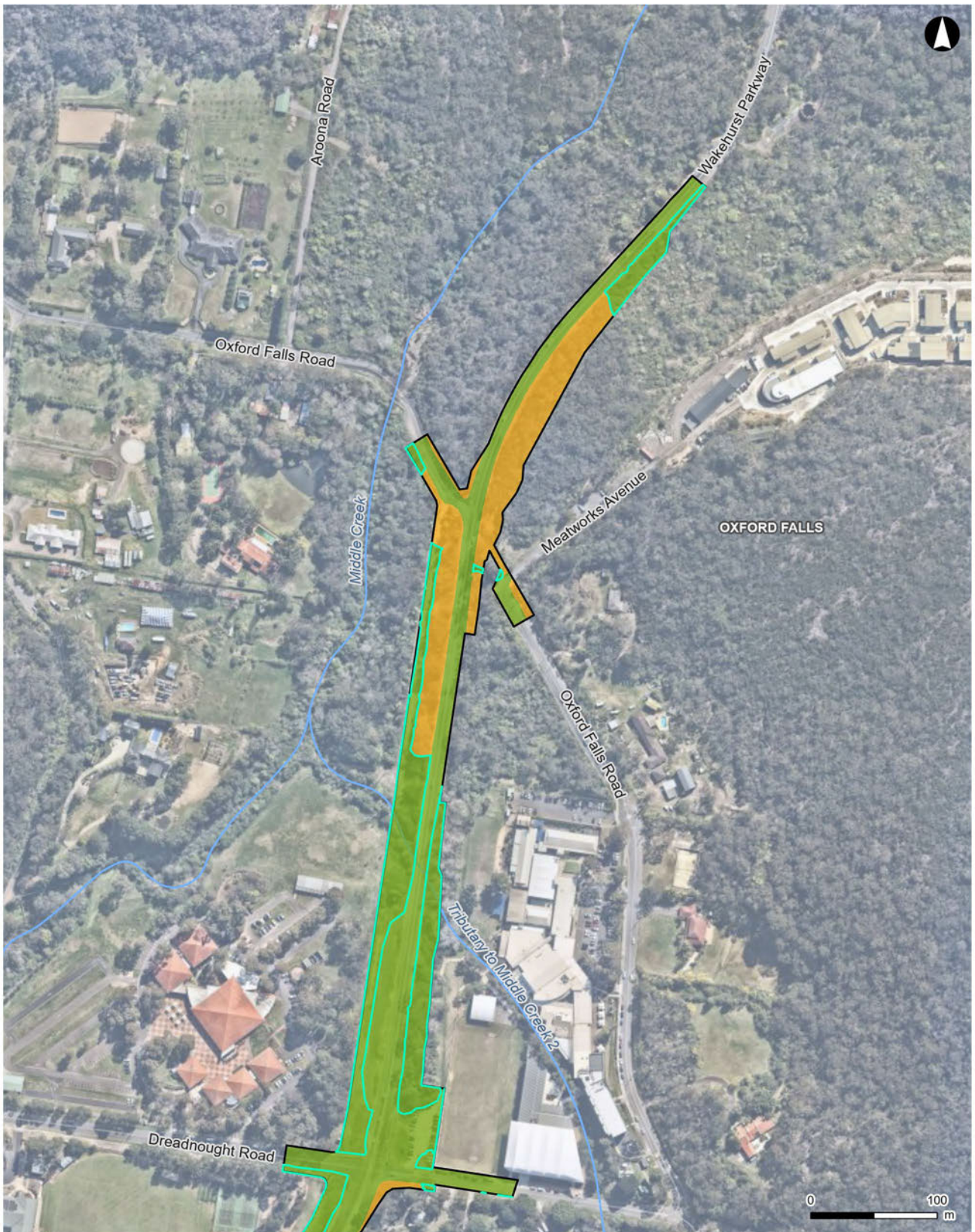


Figure 6-14, Areas requiring offsets - Wakehurst Parkway from Trefoil Creek to Dreadnought Road

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Neamap





**Legend**

- Subject land
- Tree and hollow replacement area
- ~ Watercourse
- Impacts requiring offsets under BAM
- Impacts not requiring offsets under BAM

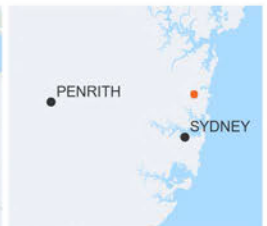


Figure 6-15, Areas requiring offsets - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Neamap





**Legend**

- Subject land
- Tree and hollow replacement area
- Watercourse
- Impacts requiring offsets under BAM
- Impacts not requiring offsets under BAM



Figure 6-16, Areas requiring offsets - Wakehurst Parkway from Elanora Road to Mirrool Street

1:4,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Neamap



## Transport for NSW

The trees assessed in the Arboricultural Assessment Report comprise native and exotic vegetation and do not trigger BAM offsets. This vegetation was considered under the BDAR but the Vegetation Integrity score for patches of vegetation was below the offsetting threshold set by the BAM, therefore under that system, no compensation would have been provided. Compensation for the loss of trees in these areas is therefore required in order to remain consistent with Transport's *Biodiversity Policy* (2022).

Of the 731 trees likely to require removal, 115 trees are native and are to be offset under the *Tree and hollow replacement guidelines* (2022), as shown in Table 6-11. The remaining 616 trees are exotic and are not considered high amenity trees, as such, these trees do not require offsetting under the *Tree and hollow replacement guidelines*.

Table 6-11: Transport for NSW (2022) tree and hollow replacement requirements

Tree size (DBH) (m)	Native trees requiring removal under TfNSW (2022)	Tree and hollow replacement guideline requirements	Replacement planting requirements
Very large tree (DBH greater than 100cm)	2	Plant a minimum 16 trees and provide 3 artificial hollows for every occupied hollow removed (assuming a 20% occupancy rate) OR \$2500 per tree and \$500 for each hollow required	32 trees
Large tree (DBH between 50cm and 100cm)	4	Plant minimum 8 trees and provide 3 artificial hollows for every occupied hollow removed (assuming a 20% occupancy rate) OR \$1000 per tree and \$500 for each hollow required	32 trees
Medium tree (DBH greater than 20 cm, but less than 50cm)	83	Plant minimum 4 trees and provide 3 artificial hollow for every occupied hollow removed (assuming a 20% occupancy rate) OR \$500 per tree and \$500 for each hollow required	332 trees
Small tree (DBH greater than 5cm, but less than 20cm)	26	Plant a minimum 2 trees OR \$125 per tree	52 trees

Based on the requirements of Transport (2022), 448 new trees would need to be planted within the proposal footprint or in neighbouring properties to offset the impact of the proposal. If this cannot be achieved, the proposal must make a payment to Transport's Conservation Fund. The proposal would aim to meet the replacement requirements through landscaping and revegetation. Any remaining balance would be met via contribution into the Transport Conservation Fund.

The offsetting requirements would likely change if the construction footprint or construction methodology changes, or during the detailed design phase of the project which would vary the nature and scale of impacts to existing trees.

## 6.2 Hydrology and flooding

### 6.2.1 Methodology

The assessment of water quality and hydrology is based on the analysis of the surrounding catchment area, existing waterbodies, database searches and historical records. The following databases and plans were reviewed on 26 May 2023:

- Northern Beaches Council Flood Mapping (Northern Beaches Council, 2023)
- Narrabeen Lagoon Floodplain Risk Management Study (Cardno, 2019)
- Flood mitigation feasibility study (Northern Beaches Council, 2022)

The flood risk categories used in the following sections are broken into three categories:

- low flood risk – applies to areas that would be affected only by the probable maximum flood event
- medium flood risk – applies to areas would be impacted by a 1 in 100-year flood event, however, are not subject to hydraulic hazards (the potential damage that overland flows can do, such as dangerous water speeds or damage to buildings) and have minimal difficulties facing an evacuation
- high flood risk – applies to areas that are below the 1 in 100-year flood zone extent, face hydraulic hazards and would have difficulties facing evacuations.

Flood risk is expressed in the following:

- Exceedances per Year (EY): the number of times an event is likely to occur or be exceeded within any given year.
- Annual Exceedance Probability (AEP): the probability or likelihood of an event occurring or being exceeded within any given year, usually expressed as a percentage.
- Annual Recurrence Interval (ARI): the average or expected value of the periods between exceedances of a given rainfall total accumulated over a given duration.
- Probable Maximum Flood (PMF): the largest flood that could conceivably be expected to occur at a particular location, usually estimated from probable maximum precipitation.

#### Flooding modelling

Modelling of existing flood behaviour in the southern package has been prepared to identify the existing flooding conditions of the proposal area and assess the impacts of the proposal on flooding regimes and hydrology of the surrounding waterways and catchments. Modelling was based on previous assessments prepared for Northern Beaches Council by Royal Haskoning DHV (RHDHV). The model calculated flood levels, depths and velocities were mapped for existing and proposed conditions. Flood behaviour was simulated for 1 EY, 50%, 20%, 10% and 1% AEP events for existing and proposed conditions.

Using the calculated velocities and depths, the flood hazard was also determined in accordance with the Australian Institute for Disaster Resilience publication “Technical Flood Risk Management Guideline: Flood Hazard” (Australian Institute for Disaster Resilience, 2014). Flood hazards are categorised as shown in Table 6-12.

Table 6-12: Flood hazard categories

Hazard category	Description
H1	Generally safe for vehicles, people and buildings
H2	Unsafe for small vehicles
H3	Unsafe for vehicles, children and the elderly
H4	Unsafe for vehicles and people
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure

Acceptable flood impacts related to road design have been adopted from Austroads 2023 guidelines. The guideline notes that every project is distinct, and the potential impacts need to be considered in each case, and that these should be

confirmed through consultation with stakeholders and local residents, and property owners. The suggested maximum impacts from Austroads 2023 are as follows:

- flood levels:
  - buildings – 25 millimetre maximum impact in a one per cent Annual Exceedance Probability (AEP) (10 millimetre where flooding would cause significant damage).
  - residential yards – 50 millimetre
  - open space or forest – 400 millimetre in events up to the one per cent AEP.
- change in velocity, flow distribution and inundation times:
  - change in velocity, flow distribution and inundation times should be kept to a minimum by placing waterway structures where existing flow paths are present. Poorly placed or undersized structures can change the flow distribution, increase velocity downstream and increase inundation upstream.
  - flow distribution – No more than 10 per cent change in the volume of flow proportioned to each flow path.
  - velocity increases to keep velocities less than one metre per second (m/s), or if existing is greater than one m/s then no more than 10 per cent change.

## 6.2.2 Existing environment

The proposal is located within a low-lying floodplain. Narrabeen Lagoon is located about 40 metres from the proposal footprint at Wakehurst Parkway between Elanora Road and Mirrool Street Figure 6-1).

The flood mitigation feasibility study carried out by the Northern Beaches Council (Northern Beaches Council, 2022) shows that when the capacity of Middle Creek and some of its tributaries (or drainage infrastructure) is exceeded, water overtops the creek and begins to flow into the floodplain. Closures along the road corridor can occur up to seven times per year. Three main locations along the road corridor frequently flood, including Oxford Falls, The Bends and the Academy of Sports.

### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

Trefoil Creek crosses under Wakehurst Parkway at the southern end of the proposal footprint. The creek is not visible as it is substantially lower than the road level and screened by existing trees and vegetation. Flood immunity of Trefoil Creek is presently 1 in 50 Annual Exceedance Probability (AEP), which would reduce when the culvert is partially blocked. There is a high risk of partial blockage at this location due to its location in a bushland catchment where fallen sticks, branches and other debris can be mobilised during floods, progressively blocking the culvert inlet. The high likelihood of blockage is likely to be further compounded by lack of maintenance, enabling debris to accumulate after successive storms. Blockage can be initially triggered by branches longer than the 1.8 metre culvert diameter or from shorter floating sticks that form a debris raft when water ponds against the inlet during floods.

Flood mapping for the Northern Beaches LGA (Northern Beaches Council, 2023) indicates that Trefoil Creek just north of Wakehurst Parkway has a low flood risk, however this does not extend to Wakehurst Parkway. This indicates that Wakehurst Parkway in this location is above the Probable Maximum Flood (PMF) and is therefore flood immune. There is however a risk of localised flooding during high rainfall events.

There is one major culvert at Trefoil Creek and two minor culverts located between Trefoil Creek and Dreadnought Road and Wakehurst Parkways intersection (Figure 3-11).

### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

Wakehurst Parkway crosses over an unnamed tributary to Middle Creek approximately 200 metres north of Dreadnought intersection. Flood mapping for the Northern Beaches LGA (Northern Beaches Council, 2023) indicates that the area surrounding this creek is mapped as medium to high flood risk, as shown in Figure 6-17. This creek is prone to frequent flooding, with the road closing up to seven times per year on average due to floodwater levels. Outside of the areas mapped as medium flood risk, the rest of the proposal footprint is not located in flood prone land.

According to RHDHV (2021), Wakehurst Parkway between Dreadnought Road and Oxford Falls Road is overtopped in the four EY flood event under existing conditions. The primary source of site flooding is overbank flows from the unnamed tributary of Middle Creek. Flood waters primarily flow across Wakehurst Parkway from east to west. During a 1 EY flood, the model calculates that Wakehurst Parkway is overtopped across a width of 100 metres to a depth of 0.14 metres above the road crest. At this location water flows onto Wakehurst Parkway from the low point of the road.



The existing stormwater drainage infrastructure located within the proposal boundary is primarily composed of channels and cross culverts. The stormwater drains to the unnamed tributary to Middle Creek, which flows to Narrabeen Lagoon.

Figure 3-11 and Figure 3-12 shows the existing and proposed stormwater drainage infrastructure within and around the proposal area between Dreadnought Road and Oxford Falls Road.

### Wakehurst Parkway from Elanora Road to Mirrool Street

Wakehurst Parkway between Elanora Road and Mirrool Street is located about 40 metres from Narrabeen Lagoon. Flood mapping indicates that the proposal footprint in this area is located in medium to high flood risk precincts, as shown in Figure 6-19. High risk flood precincts are subject to 1 in 100 ARI events and are also subject to high hydraulic hazard. The existing flooding behaviour in this area is affected by both tributary flooding and flood levels in Narrabeen lagoon.

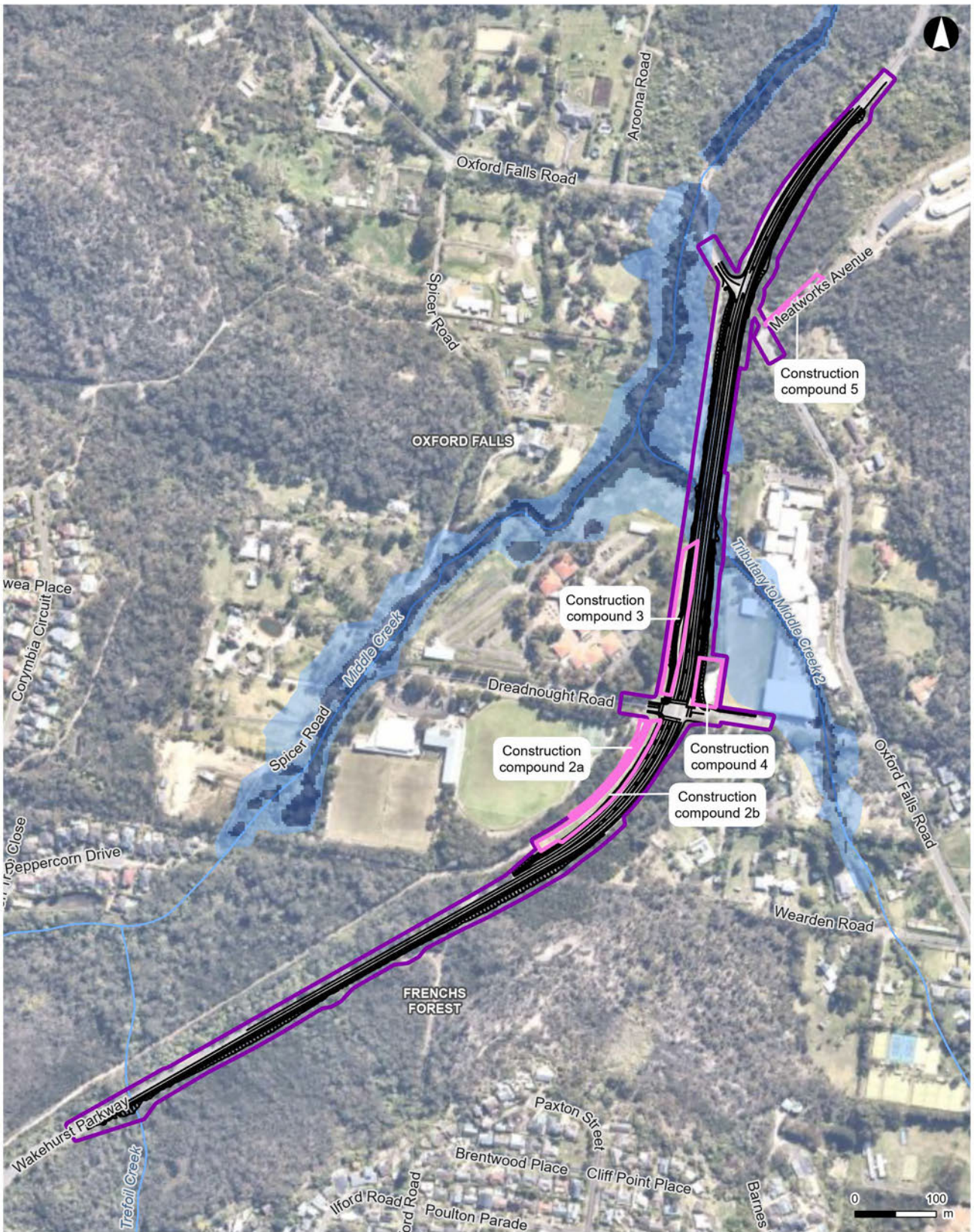
The existing stormwater drainage infrastructure located in the proposal boundary is composed of drains, culverts and channels. The stormwater in this area drains to Narrabeen Lagoon.

Figure 3-13 shows the existing and proposed stormwater drainage infrastructure within and around the proposal area at Wakehurst Parkway, Elanora Road and Mirrool Street intersections.

### Construction compounds

Construction compound 1 (CC1), 2a and 2b (CC2a and CC2b), and 5 (CC5) are not located in medium or high flood risk precincts, and therefore are not considered affected by the 1 per cent AEP flood (as shown in Figure 6-17). Option 3 (CC3) and 4 (CC4) are partially impacted by the medium flood risk precinct mapping (Figure 6-17).

Compound option 6 (CC6), 7 (CC7), 8 (CC8) and 9 (CC9) are impacted by the 1 per cent AEP flood (as shown in Figure 6-18 and Figure 6-19).



- Legend**
- Proposed compound site
  - Proposal area
  - Proposal
  - High flood risk area
  - Medium flood risk area



1:7,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022

**ESC** **GDA 2020**  
 Building a Sustainable Legacy

Figure 6-17, Flood mapping - Wakehurst Parkway from Dreadnought Road to Trefoil Creek



- Legend**
- Proposed compound site
  - High flood risk area
  - Medium flood risk area



1:3,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022

**ESC** **GDA 2020**  
 Building a Sustainable Legacy

Figure 6-18, Flood mapping - Construction compound 6



- Legend**
- Proposal area
  - Proposed compound site
  - Proposal
- Flood risks**
- High flood risk area
  - Medium flood risk area



1:5,700 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2022



Figure 6-19, Flood mapping - Wakehurst Parkway from Elanora Road to Bristol Lane

### 6.2.3 Potential impacts

#### **Construction**

Flood impacts have the potential to increase flood levels immediately upstream of Wakehurst Parkway resulting from temporary flow obstructions to existing culverts and drainage channels within the existing road corridor. Construction staging would maintain existing drainage flow paths by maintaining connectivity of piped drainage systems and overland flow paths through the proposal site throughout the construction period.

Construction of drainage utilities including new drainage pits, piping and reconnections may temporarily impact the efficiency and function of the local drainage network while construction activities are being carried out. During intense weather events such as large storms, there is the potential for areas of the work zone to be subject to flooding. There is also the potential for flooding to occur more broadly within the proposal footprint during storm events as the current drainage network is at capacity. Performance of culverts and other drainage infrastructure would be impacted temporarily during construction of new stormwater drainage lines and connections to existing stormwater network. Function of drainage infrastructure would be restored when flood events are forecast.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

During construction in this area, work would mostly remain in areas not located in flood prone land. Potential impacts during construction include erosion or sedimentation of exposed soil during flood events, pollution of floodwaters with chemicals and other construction materials, and plant equipment and construction materials being mobilised during flood events and forming part of flood debris. These impacts would be mitigated by appropriate siting of construction compounds, storage of stockpiles and materials out of flood impacted areas, and removing equipment, machinery and stockpiles from compounds and construction areas when flooding is anticipated.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

During construction in this area, there is a risk of flooding events at the first order watercourse at Oxford Falls Road and the unnamed tributary about 250 metres north of Dreadnought Road intersection. Potential impacts during construction include erosion or sedimentation of exposed soil during earthworks in flood events, pollution of floodwaters with chemicals and other construction materials, and plant equipment and construction materials being mobilised during flood events and forming part of flood debris. These impacts would be mitigated by appropriate siting of construction compounds, storage of stockpiles and materials out of flood impacted areas, and removing equipment, machinery and stockpiles from compounds and construction areas when flooding is anticipated.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

Construction activities at Wakehurst Parkway from Elanora Road to Mirrool Street would occur within a high flood risk zone. This would be managed through construction staging to allow for the extension of existing culverts and construction of the widened road embankment, during which time the traffic would utilise the existing carriageway. The existing culverts would remain operational during this time and full culvert capacity would be maintained to manage flooding while culvert extension and the new embankment are being constructed.

Potential impacts during construction include erosion or sedimentation of exposed soil during earthworks in flood events, pollution of floodwaters with chemicals and other construction materials, and plant equipment and construction materials being mobilised during flood events and forming part of flood debris. These impacts would be mitigated by appropriate siting of construction compounds, storage of stockpiles and materials out of flood impacted areas, and removing equipment, machinery and stockpiles from compounds and construction areas when flooding is anticipated.

#### Construction compounds

The following site compounds are located within the extent of the Narrabeen Lagoon and tributaries flood hazard mapping (Northern Beaches Council):

- CC6 – medium risk precinct
- CC7 – low to medium risk precinct
- CC8 – medium risk precinct
- CC9 – medium to high risk precinct

CC1 to CC4 are located outside of the flood risk precincts. Potential impacts during construction include erosion or sedimentation of exposed soil during earthworks in flood events, pollution of floodwaters with chemicals and other construction materials, and plant equipment and construction materials being mobilised during flood events and forming part of flood debris.

Construction phase use and management of CC6 to CC9 would be subject to the further assessment and preparation of a CEMP and flood contingency plan. The flood contingency plan would consider flood readiness, flood warning mechanisms, safety and evacuation of personnel and plant and appropriate placement of stockpiles and site infrastructure in relation to the flood risk and the potential for environmental impacts in the event of flooding.

Mitigation of flood risk at compound sites would include siting of stockpiles, equipment and machinery, erosion and sediment controls, locating vehicles and mobile plant to avoid flood risk areas, and observation of weather forecasts for heavy rainfall events or flood warnings to predict flooding events.

### Operation

The road is designed for flood immunity not less than the existing road flood immunity, without precluding future flood immunity upgrades.

Northern Beaches Council is proposing work to improve flood risk along Wakehurst Parkway. More detail on this project and potential cumulative impact is provided in Section 6.14.2.

The total impermeable surface of this proposal would be about 13,200 square metres larger than the existing hardstand area (about 27,700 square metres). This is an increase of about 50 per cent, resulting in a moderate increase of stormwater runoff. The increase in runoff to Narrabeen Lagoon and potential flood impacts on the lagoon resulting from 13,200 square metres of additional impermeable surface would not be measurable in the context of changes in flood levels within the Lagoon which as a total catchment area of 55 square kilometres. Runoff increase would be managed within the capacity of the proposed drainage infrastructure and no impacts to Narrabeen Lagoon are anticipated.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

There are no anticipated changes to flood risk at this area of the proposal.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

Wakehurst Parkway would continue to overtop several times per year and the hazard to motorists would be controlled using a boom gate to close the road to traffic when the road is overtopped, as is the current condition.

The Oxford Falls Grammar School is located immediately upstream of the unnamed tributary north of Dreadnought Road and the proposal has the potential to cause flooding impacts within the school in the 1 per cent AEP scenario. The modelled impact at the school was found to be less than 0.025 metres and no buildings would be impacted. The flooding impacts at the school are localised, not impacting the entire school, and are already existing. There is no impact to access to the school.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

In this area, existing culverts would be extended, and existing road overtopping levels have been maintained. Therefore changes to flooding impacts due to the proposal in this area would be minimal.

Impacts to Narrabeen Lagoon are not expected.

## 6.2.4 Safeguards and management measures

Table 6-13: Hydrology safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Water quality	All refuelling and storage of fuels, chemicals and liquids are to be within an impervious bunded area within the construction compound, located a minimum of five metres away from: <ul style="list-style-type: none"> <li>rivers, creeks or any areas of concentrated water flow.</li> <li>flooded areas.</li> </ul>	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	<ul style="list-style-type: none"> <li>slopes above 10%.</li> </ul>		
Water quality	The vehicles refuelling process would include a person attending the refuelling facility / vehicle and a spill kit on the vehicle.	Contractor	Construction
Water quality	Emergency wet and dry spill kits will be kept on site at all times. Staff will be made aware of the location of the spill kit and trained in its use.	Contractor	Construction
Flooding	A Flood Contingency Plan would be prepared as part of the CEMP to manage a potential flood event during construction and would outline procedures to reduce risk including removal of all loose materials (including plant, equipment and chemicals) and stabilisation of exposed areas prior to forecast flood events.	Contractor	Pre-construction
Flooding	To reduce the instance of culvert blockage at Trefoil Creek, regular inspection and maintenance to clear accumulated debris will occur during construction for works in the area. Additional actions such as installing bollards or a screen to intercept litter will be investigated.	Contractor	Construction
Flooding	During construction works on culverts and other infrastructure, stormwater drainage function would be restored when flooding events are forecast.	Contractor	Construction
Flooding	Ensure that safe passage of flood waters across the proposal corridor is maintained at all times during construction.	Contractor	Construction

Other safeguards and management measures to address hydrology and flooding impacts are identified in Sections 6.3 and 6.4.

## 6.3 Surface water

### 6.3.1 Methodology

The assessment of surface water is based on the analysis of the surrounding catchment area, existing waterbodies, database searches and historical records. The following databases and plans were searched on 26 May 2023:

- NSW SEED spatial data portal (NSW Government, 2023) to identify the presence of waterways and waterbodies near the study area
- Northern Beaches Council Flood Mapping (Northern Beaches Council, 2023)
- Narrabeen Lagoon Floodplain Risk Management Study (Cardno, 2019)

The surface water assessment is also based on findings from the BDAR (refer to Appendix D). The visual water quality assessment was carried out by ecologists during October and November (Spring) 2022 for the BDAR and is summarised in this section.

Water quality has been categorised as good, moderate and poor based on the presence of surfactants, eutrophication, and discolouration. Table 6-14 provides a description of water quality categories.

Table 6-14: Description of water quality categories

Water quality category	Description
Good	Low turbidity, eutrophication, visible pollutants (e.g. plastics), discolouration, and/or sedimentation.
Moderate	Presence of turbid water, eutrophication, visible pollutants, discolouration, and/or sedimentation.
Poor	Presence of turbid water, eutrophication, visible pollutants, high discolouration, and/or sedimentation.

### 6.3.2 Existing environment

The proposal is within the Northern Beaches sub catchment, which forms part of the Sydney Metropolitan catchment area. Wakehurst Parkway intersects Trefoil Creek and several unnamed and unmapped watercourses including two tributaries of Middle Creek, one south of Dreadnought Road and the other south of Oxford Falls Road, and ephemeral drainage lines formed along the power line within the road reserve in the southern extent of the proposal. The tributaries of Narrabeen Lagoon include Middle Creek, Deep Creek, South Creek, and Mullet Creek as shown in Figure 6-20.

The existing drainage infrastructure in the proposal area consists of pits, culverts, pipes and channels along Wakehurst Parkway, Dreadnought Road, Oxford Falls Road, Elanora Road and Mirrool Street (refer to Figure 3- to Figure 3-13).

Table 6-15 provides a summary of the water quality results from the BDAR.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

In this location, the proposal intersects Trefoil Creek and one unnamed tributary of Middle Creek, south of Dreadnought Road. This tributary is shown and referred to as 'Tributary to Middle Creek 1' in Figure 6-20 and Table 6-15.

Existing drainage in this location consists of three drainage culverts crossing Wakehurst Parkway. The drainage network captures surface water from the road network and discharges it into the Tributary to Middle Creek 1, which flows to Narrabeen Lagoon.

Water quality at Trefoil Creek and the Tributary to Middle Creek 1 in this location has been assessed to be moderate.

At the drainage lines along the power line within the road reserve south of Dreadnought Road, water quality has been assessed to be good.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

In this location, the proposal intersects with an unnamed tributary of Middle Creek, north of Dreadnought Road. This tributary is shown and referred to as 'Tributary to Middle Creek 2' in Figure 6-20 and Table 6-15. Middle Creek flows parallel to Wakehurst Parkway at Oxford Falls Road as shown in Figure 6-20.

Existing drainage in this location consists of four drainage culverts and one longitudinal drainage pipe along Dreadnought Road. This drainage pipe runs from the Dreadnought Road and Wakehurst Parkway intersection and extends to a culvert outside of the proposal footprint. The drainage network in this location captures surface water from the road network and discharges it into Middle Creek, which flows to Narrabeen Lagoon.

Water quality at Tributary to Middle Creek 2 has been assessed to be good. Middle Creek at Oxford Falls Road has been identified as having poor water quality.

#### Wakehurst Parkway from Elanora Road to Mirrool Street





The proposal does not intersect with any waterways in this location. However the proposal is within the vicinity of Narrabeen Lagoon, located adjacent to Wakehurst Parkway from Middle Creek to Pittwater Road (refer to Figure 6-20).

Existing drainage in this location consists of four culverts and one longitudinal drainage pipe, located adjacent to Wakehurst Parkway west of Mirrool Street. In this location, surface water is discharged into Narrabeen Lagoon.



In accordance with the 2019-20 summer results of the NSW DPE water quality monitoring program, the overall health of Narrabeen Lagoon is graded to be good (NSW DPE, 2021). The water quality assessment indicates that the water quality at Narrabeen Lagoon is moderate to good.

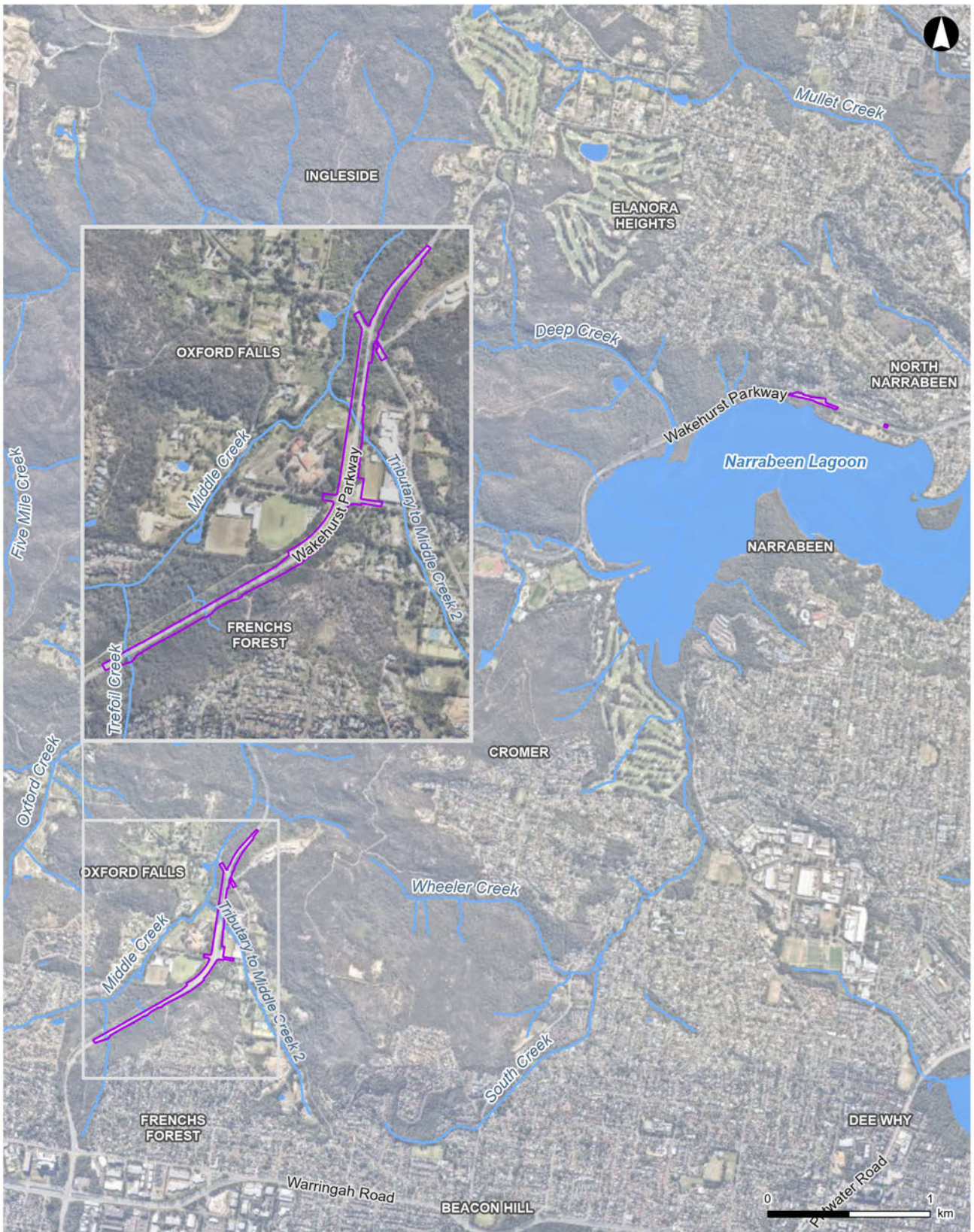


Table 6-15: Water quality assessment results

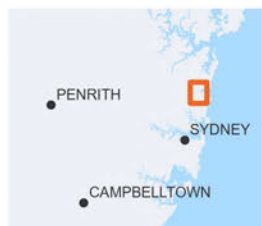
Waterway name	Stream and ecosystem type	Crossed by the alignment	Water quality characteristics	Photographs
Trefoil Creek	Permanent freshwater creek	Yes	<b>Moderate</b> – moderate turbidity, some pollution visible	
Tributary to Middle Creek 1	Ephemeral freshwater creek	Yes	<b>Moderate</b> – pollution visible, algae present, moderate turbidity	
Drainage lines along the power line within the road reserve, south of Dreadnought Road	Intermittent drainage line	Yes	<b>Good</b> – minimal pollution and low turbidity	
Tributary to Middle Creek 2	Ephemeral freshwater creek	Yes	<b>Good</b> – Minimal pollution	

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Waterway name	Stream and ecosystem type	Crossed by the alignment	Water quality characteristics	Photographs
Middle Creek at Oxford Falls Road	Permanent freshwater creek	No	<b>Poor</b> – high turbidity, eutrophication evident with stagnant pools demonstrating high algae growth	
Narrabeen Lagoon	Estuary	No	<b>Moderate-good</b> quality brackish water. Moderately turbid but low visible pollution and minimal evidence of eutrophication	



- Legend
- Proposal area
  - ~ Watercourse



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 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 21, 2023  
 Imagery: Nearmap 2023



Figure 6-20, Watercourses in proximity to the proposal area

### 6.3.3 Potential impacts

#### Construction

Construction activities have the potential to affect the quality of local surface water as a result of:

- upgrade of culverts and headwalls within waterways
- excavation to relocate utilities and stormwater services
- bulk earthworks activities, including:
  - excavation of new batters, rock cuttings and retaining walls
  - excavation of new road pavements, medians and road verges
- sediment runoff from the installation of stormwater drainage upgrades entering stormwater drainage system
- sediment runoff from site and the proposed site compound and stockpile during rainfall events due to increased soil exposure
- pollutants from site and site compound reaching nearby stormwater drains and waterways. Potential pollutants include spills and leaks of linemarking paint, fuel, chemicals, concrete washout water or sediment laden water from excavations and stockpiles.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

Earthworks required for road widening on the southbound carriageway, including the construction of road batters alongside the carriageway, have the potential to cause erosion and sediment runoff. There is a higher risk in proximity to Trefoil Creek and Tributary to Middle Creek 1 where sedimentation can reduce surface water quality of the waterways. Given that Trefoil Creek and Tributary to Middle Creek 1 are tributaries of Middle Creek, there is also potential for subsequent water quality impacts to Middle Creek.

Work within creeks associated with the extension of existing culverts and construction of culvert headwalls pose a high risk to water quality due to sediment runoff and potential for spills or other contaminants entering the waterway if not managed properly. As stated above, these waterways tributaries of Middle Creek, so any impacts could also have flow on impacts to Middle Creek.

The implementation of erosion and sedimentation controls, such as detailed erosion and sedimentation plans, during construction would reduce the risk of impacting surface water quality at Trefoil Creek and Tributary to Middle Creek 1 to a minor level. Section 6.3.4 describes the relevant safeguards to manage erosion and sedimentation impacts.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

Road widening of the northbound carriageway and the construction of road batters alongside the southbound carriageway poses minor erosion and sediment risks. Bulk earthworks associated with stormwater culverts and installation of new stormwater drainage pits along Wakehurst Parkway between Dreadnought Road and beyond Oxford Falls Road also propose a moderate risk of erosion and sediment.

As outlined above, work within creeks associated with the extension of existing culverts and construction of culvert headwalls pose of a high risk to water quality. There is a higher risk of erosion and sediment runoff that may result in surface water impacts to Tributary to Middle Creek 2 and subsequently, Middle Creek.

The implementation of erosion and sediment controls, described in Section 6.3.4, during construction would reduce the risk of impacting surface water quality at Tributary to Middle Creek 2 to a minor level.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

There would be no direct drainage work proposed at Narrabeen Lagoon though localised widening of Wakehurst Parkway at the Mirrool Street intersection may result in erosion and sedimentation, potentially introducing runoff into Narrabeen Lagoon. The proximity to Narrabeen Lagoon presents a moderate risk of sediment runoff into the lagoon and resulting reduction of surface water quality. The implementation of erosion and sediment controls during construction would reduce this risk from moderate to minor.

Construction compounds

Construction compounds used for stockpiles of spoil and other material are at risk of sediment runoff due to rainfall events, with subsequent surface water quality impacts in receiving waterways. Spills of fuel, oils, and other potentially hazardous liquids would pose a contamination risk downstream waterways in proximity to the compound. These environmental risks would be managed through the safeguards summarised in Table 6-16.

**Operation**

All disturbed areas would be reinstated and stabilised upon completion of construction. This would minimise the risk of exposed soils creating sediment runoff and entering the stormwater drainage system.

The proposed road widening would result in a substantial increase in impermeable surfaces, however the volume of surface water runoff is not expected to increase substantially. The proposal would install drainage infrastructure to ensure the operational performance would be no worse than the existing performance.

**6.3.4 Safeguards and management measures**

Table 6-16: Surface water safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Soil and water management	<p>Erosion and sediment control measures are to be implemented and maintained to:</p> <ul style="list-style-type: none"> <li>• minimise sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets</li> <li>• reduce water velocity and capture sediment on site</li> <li>• minimise the amount of material transported from site to surrounding pavement surfaces</li> <li>• divert clean water around the site.</li> </ul> <p>(in accordance with the Landcom/Department of Housing Managing Urban Stormwater, Soils and Construction Guidelines (the Blue Book)).</p>	Contractor	Construction
Soil and water management	<p>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.</p> <p>The SWMP will be reviewed by a soil conservationist on the Transport list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address review outcomes.</p> <p>Mitigation measures to be developed to minimise impacts to mapped coastal wetland from site drainage during construction.</p>	Contractor	Pre-construction
Erosion and sedimentation control	<p>A site-specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan.</p> <p>The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.</p>	Contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
Vehicle wash down	Vehicle wash down and/or cement truck washout is to occur in a designated bunded area and least 50 metres away from water bodies and surface water drains.	Contractor	Construction
Hazardous liquid storage	Any fuel, oils or other liquids stored on site will be stored in an appropriately sized impervious bunded at least 120 per cent larger than the greatest container and in an area least 50 metres away from water bodies.	Contractor	Construction
Water quality	Water quality control measures are to be used to prevent any materials (eg. concrete, grout, sediment etc) entering drain inlets or waterways.	Contractor	Construction

Other safeguards and management measures to address surface water quality impacts are identified in Section 6.2.4.

## 6.4 Groundwater

### 6.4.1 Methodology

A desktop review of the following sources was carried out on 22 June 2023 to assess potential impacts of the proposal on groundwater:

- NSW SEED spatial data portal (NSW Government, 2023)
- Australian Groundwater Explorer (BOM, 2022a) and Groundwater Dependent Ecosystem Atlas (BOM, 2022b)
- Geotechnical Factual Report (Transport, April 2023)
- Geotechnical Interpretive Report (SJV, June 2023)

As part of geotechnical work carried out for the Geotechnical Factual Report (prepared in April 2023), three boreholes and 16 shallow boreholes were drilled to depths of between 0.8 metres and 15 metres Below existing Ground Levels (BGL). Borehole tests consisted of Large Diameter Borehole (LDBH), Test Pit (TP), and Pavement Core (PC).

The purpose of the boreholes was to investigate the composition and condition of the subsurface profile, to characterise the underlying bedrock. Moisture levels and water seepage were recorded in six excavations.

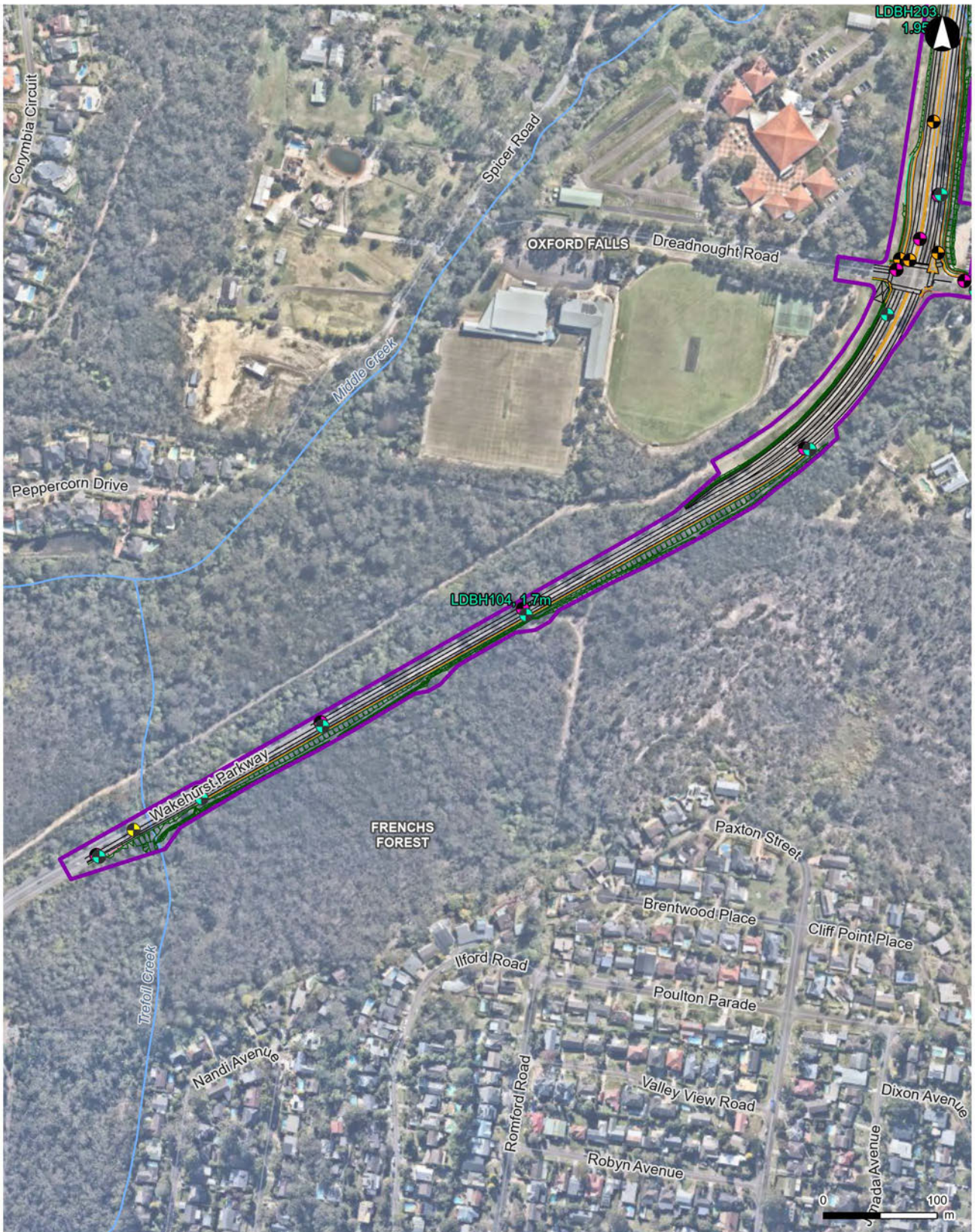
The locations of the boreholes and test pits within the proposal area are identified in Table 6-17 and shown in Figure 6-21 to Figure 6-23.

Table 6-17: Location of boreholes

Proposal area	ID	Termination Depth (m)	Depth groundwater encountered
Wakehurst Parkway from Trefoil Creek to Dreadnought Road	LDBH102	1.7	-
	LDBH103	0.64	-
	LDBH104	1.7	1.7 m BGL
	LDBH105	1.4	-
	PC101	2	-
	PC102	2	-
	PC103	0.8	-
	PC104	2	-
	PC105	1	-
	LDBH102	1.7	-
	LDBH103	0.64	-
Wakehurst Parkway from Dreadnought Road to Oxford Falls Road	LDBH201	1.7	-
	LDBH202	2	-
	LDBH203	2	1.95 m BGL
	LDBH204	2	-
	LDBH205	0.8	-

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Proposal area	ID	Termination Depth (m)	Depth groundwater encountered
	LDBH206	2	-
	PC201	2	-
	PC202	2	-
	PC203	2	-
	PC204	2	-
	PC205	2	-
	PC206	2	1.4 m BGL
	PC207	0.6	-
	TP201	2.1	-
	TP201-A	0.5	-
	TP202	2	-
	TP203	2	-
	TP204	2	1.6 m BGL
	TP205	1.8	-
	TP206	0.9	0.25 m BGL
	LDBH201	1.7	-
	LDBH202	2	-
	LDBH203	2	-
Wakehurst Parkway from Elanora Road to Mirrool Street	LDBH401	1.4	-
	LDBH402	2	-
	LDBH403	2	-
	LDBH404	2	-
	LDBH405	0.8	0.6 m BGL
	PC401	1.5	-
	PC402	0.9	-
PC403	1.35	-	



Legend

- |                         |                |             |
|-------------------------|----------------|-------------|
| Proposal area           | Proposal       | Road design |
| Geotech investigations  | Line marking   | Watercourse |
| Groundwater depth (m)   | Footpath       |             |
| Large diameter borehole | Safety barrier |             |
| Pavement core           | Retaining wall |             |
| Test pit                | Earthworks     |             |
| Borehole                | Kerb/Median    |             |

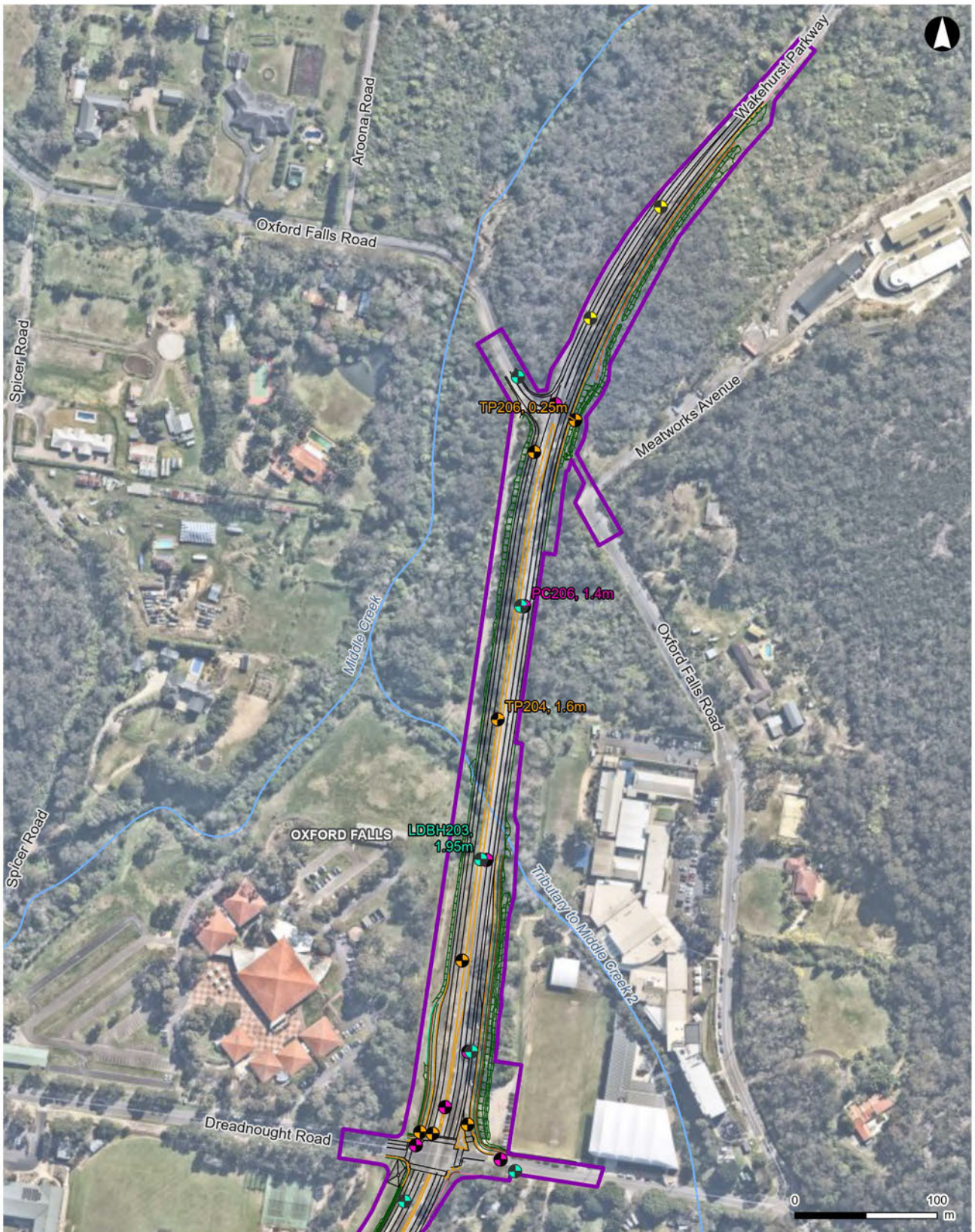


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 Coordinate System: GDA2020 MGA Zone 56  
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 Imagery: Nearmap 2022



Figure 6-21, Borehole testing locations - Wakehurst Parkway from Trefoil Creek to Dreadnought Road





Legend

- |                         |                |                |
|-------------------------|----------------|----------------|
| Proposal area           | Proposal       | Kerb/Median    |
| Geotech investigations  | Line marking   | Road design    |
| Groundwater depth (m)   | Footpath       | Watercourse    |
| Large diameter borehole | Safety barrier | Retaining wall |
| Pavement core           | Rock cutting   | Earthworks     |
| Test pit                |                |                |
| Borehole                |                |                |



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Figure 6-22, Borehole testing locations - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road



Legend

- |                         |                |
|-------------------------|----------------|
| Proposal area           | Road design    |
| Geotech investigations  | Line Marking   |
| Groundwater depth (m)   | Footpath       |
| Large diameter borehole | Safety barrier |
| Pavement core           | Retaining wall |
|                         | Earthworks     |
|                         | Kerb/Median    |



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Figure 6-23, Borehole testing locations - Wakehurst Parkway from Elanora Road to Mirrool Street

## 6.4.2 Existing environment

### Boreholes

There was no groundwater monitoring data available. Instead, groundwater levels are based on borehole and test pit investigations within the proposal boundary, that noted a number of excavations with damp material or water seepage. This is indicative of the presence of a groundwater aquifer within the proposal boundary.

A search of the Department of Primary Industries Online Database (NSW DPI, 2021) identified no existing groundwater boreholes within 100 metres on either side of the proposal footprint. The Geotechnical Interpretive Report (April 2023) noted six boreholes or test pits that had observed groundwater inflow during the investigations.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

The large diameter borehole LDBH104 excavation core log noted moist material from 0.17 metres BGL to the termination depth of 1.7 metres BGL. The noted depth to groundwater level is 1.7 metres BGL, and may be related to perched groundwater, which is an aquifer that occurs above the regional water table and is separated by an unsaturated zone of material.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

LDBH203 excavation core log noted wet and moist material between 0.53 metres BGL and 2.0 metres BGL. The noted depth to groundwater level is 1.95 metres BGL.

Test pit TP204 (0.4 metres BGL to 2.0 metres BGL) and test pit TP206 (0.0 metres BGL to 0.9 metres BGL) encountered moist or wet material associated with groundwater inflow. The noted depth to groundwater level is 1.6 metres BGL and 0.25 metres BGL respectively. TP204 is located in proximity to the unnamed tributary that feeds into Middle Creek.

Observation of pavement core PC206 noted wet and moist material between 0.8 metres BGL and 2.0 metres BGL, with a noted depth to groundwater level of 1.4 metres BGL.

The groundwater levels at these four excavations could be related to perched groundwater.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

LDBH405 excavation core log noted wet and moist material between 0.0 metres BGL and 0.8 metres BGL. The noted depth to groundwater level is 0.6 metres BGL. The groundwater in this location is likely to discharge to Narrabeen Lagoon, and groundwater levels are likely affected by the tidal-influenced lagoon water levels. Groundwater levels could also vary with time due to weather conditions and tidal variation.

In this area, GDEs are mapped over an area of 6.18 hectares. Two PCTs are mapped, Coastal Alluvial Bangalay Forest (PCT4019) and Estuarine Swamp Oak Twig-rush Forest (PCT4028). Both of these PCTs are considered reliant on groundwater and susceptible to hydrological change.

#### Construction compounds

The majority of Construction compounds do not involve any proposed vegetation clearing, earthworks, or any other activity that may impact or intersect the water table. CC4 involves the removal of about 430 square metres of vegetation from the northern side of the compound site, with the closest geotechnical investigation being at pavement core 204 (PC204) and LDBH202. Neither of these investigation points were observed to encounter groundwater.

## 6.4.3 Potential impacts

### Construction

Construction of the proposal may result in potential impacts to the groundwater table and the quality of groundwater where excavations or under-boring interact with the groundwater table. The risk of impacts however is low at all locations except for Oxford Falls Road, where risks to groundwater would not require mitigation.

Water may enter excavations after large rainfall events, requiring dewatering of excavations. Relevant safeguards to manage dewatering are described in Section 6.4.4. Minor surface water quality impacts may occur, which are detailed in Section 6.3.

Wakehurst Parkway from Trefoil Creek to Dreadnought Road

Construction impacts at this location include trenching for utilities removal or installation, excavation for culvert work, and road stabilisation by creation of a batter using fill material. At the location of LDBH104, excavation beyond groundwater level (1.7 metres BGL) is not required.

Excavation would occur up to 2.8 metres from existing ground level along the southbound side of Wakehurst Parkway about 260 metres south of Dreadnought Road intersection. At this location, no groundwater was observed in the nearest investigation point (PC105).

The impact of the proposal to groundwater or risk of groundwater drawdown at this location is therefore considered low.

Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

Excavation of up to six metres' depth is proposed to allow the widening of Wakehurst Parkway on the southbound side. Test pit TP204 from the Geotechnical Factual Report encountered groundwater at 0.25 metres depth. It is likely that groundwater would be encountered during excavation at this location. There is a moderate risk of groundwater drawdown at this location, and any interception of groundwater would be managed by the construction contractor.

While Groundwater Dependent Ecosystems (GDEs) are mapped in this location, further assessment in the BDAR noted that groundwater dependent Threatened Ecological Communities are unlikely to be present and therefore the risk of impact to these plant communities is low. Further detail of impacts to GDEs is available in Section 6.1.

Wakehurst Parkway from Elanora Road to Mirrool Street

Minor excavation for footpath construction 36 metres west of Mirrool Street would occur to a depth of 0.5 metres. The nearest investigation point (LDBH404) did not encounter groundwater. Additionally, stormwater infrastructure excavation is proposed up to a maximum depth of 2.5 metres. The nearest investigation point (LDBH402) encountered moist to wet soil at a depth of two metres, therefore the risk of encountering groundwater during stormwater trenching is likely. Considering the existing groundwater drainage to Narrabeen Lagoon, subsequent groundwater drawdown is considered unlikely. The proposal along this section is not expected to impact groundwater.

Construction compounds

In CC4, about 430 square metres of vegetation clearing is proposed in the northern part of the compound site. At this location the closest borehole investigations (PC204 and LDBH202) did not observe groundwater intrusion during excavation, therefore groundwater impacts are not expected.

The other construction compounds would not involve ground intrusive work, and therefore impacts to groundwater are not expected.

**Operation**

No operational impacts to groundwater are expected.

**6.4.4 Safeguards and management measures**

Table 6-18: Groundwater safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Impact
Groundwater and dewatering	A procedure will be prepared for dewatering activities to be included as part of the SWMP. The dewatering procedure is to comply with Transport's Technical Guideline – Environmental Management of Construction Site D–watering.	Contractor	Pre - construction	Groundwater and dewatering

## 6.5 Soils

### 6.5.1 Methodology

A desktop assessment was undertaken to assess the potential impacts of the proposal on soil and contamination. A review of the following databases was carried out on 26 May 2023 to identify the existing soil characteristics and potential for contamination in and around the proposal footprint:

- Warringah LEP 2011
- Pittwater LEP 2014
- eSpade database for soil landscape reports (DPE, 2022b)
- Descriptions of NSW Mitchell landscapes (DECCW, 2008)
- NSW SEED spatial data portal (NSW Government, 2023) to identify potential acid sulfate soil and salinity risk
- NSW contaminated land register (EPA, 2022a) and 'in-progress' list of notified sites (EPA, 2022b) (11 September 2023).

#### Acid sulfate soils

Acid sulfate soils are soils and sediments containing iron sulfides that, when disturbed and exposed to oxygen, generate sulfuric acid and toxic quantities of aluminium and other heavy metals.

Acid sulfate soils are classified into 5 different classes based on the likelihood of the acid sulfate soils being present in particular areas and at certain depths.

- Class 1: Acid sulfate soils in a Class 1 area are likely to be found on and below the natural ground surface.
- Class 2: Acid sulfate soils in a Class 2 area are likely to be found below the natural ground surface.
- Class 3: Acid sulfate soils in a Class 3 area are likely to be found beyond one metre below the natural ground surface.
- Class 4: Acid sulfate soils in a Class 4 area are likely to be found beyond two metres below the natural ground surface.
- Class 5: Acid sulfate soils are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres on adjacent Class 1,2,3 or 4 land.

### 6.5.2 Existing environment

#### Soil landscapes

Four soil landscapes occur in the study area. These are identified in Table 6-19 and Figure 6-24 to Figure 6-26.

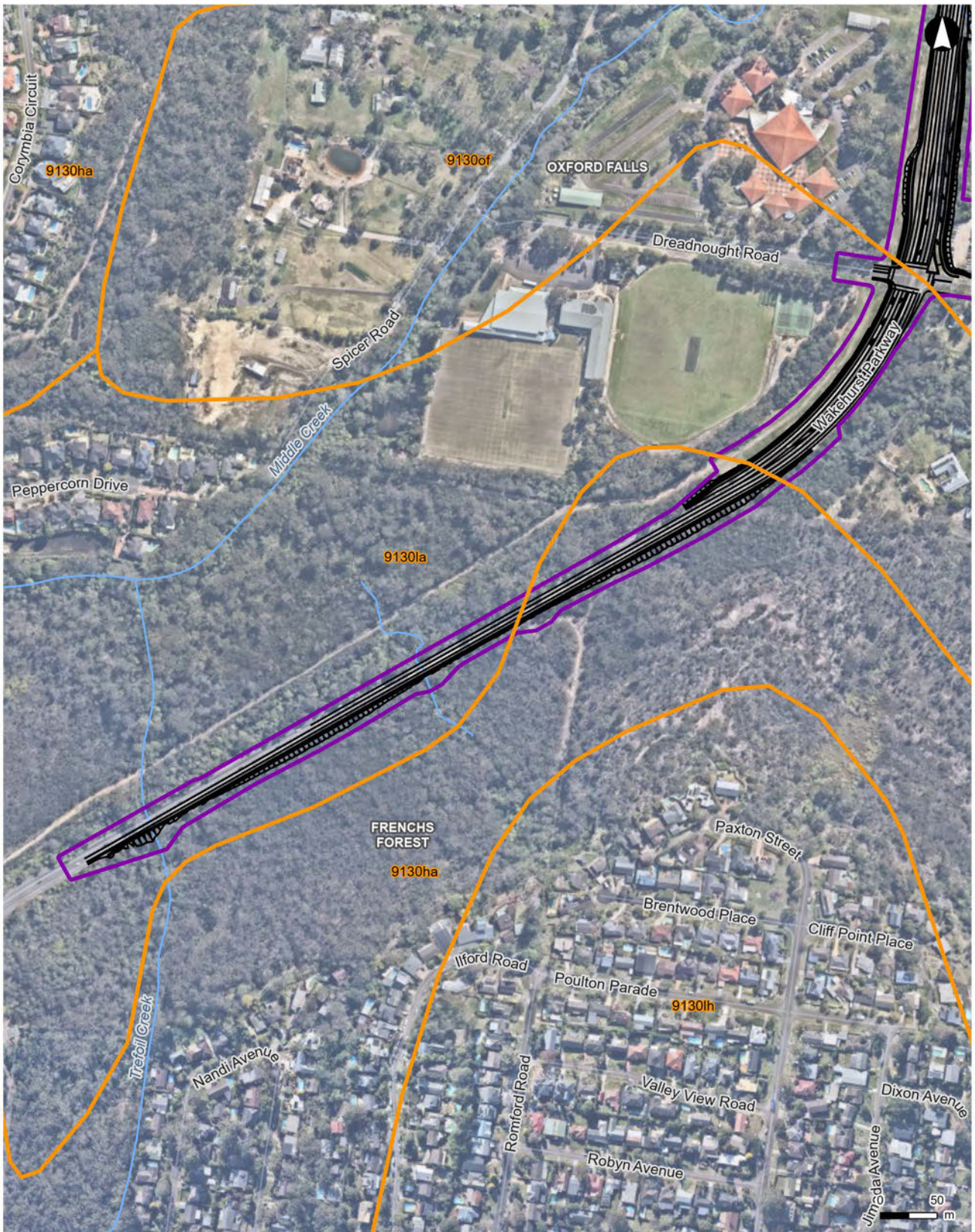
Table 6-19: Soil landscapes in proposal areas

Project area	Soil landscape ID	Soil landscape
Wakehurst Parkway from Trefoil Creek to Dreadnought Road	9130la	Lambert
	9130ha	Hawkesbury
Wakehurst Parkway from Dreadnought Road to Oxford Falls Road	9130of	Oxford Falls
	9130ha	Hawkesbury
	9130la	Lambert
Wakehurst Parkway from Elanora Road to Mirrool Street	9130dc	Deep Creek

The properties of these soil landscapes are summarised in Table 6-20.

Table 6-20: Soil landscapes within the proposal area

Soil landscape	Geology	Soils	Limitations
Lambert	Hawkesbury Sandstone, which consists of medium to coarse-grained quartz sandstone with minor shale and laminite lenses.	Shallow (<50 cm) discontinuous Earthy Sands (Uc5.11, Uc5.22) and Yellow Earths (Gn2.2) on crests and insides of benches; shallow (<20 cm) Siliceous Sands/Lithosols (Uc1.2) on leading edges; shallow to moderately deep (<150 cm) Leached Sands (Uc2.21), Grey Earths (Gn2.81) and Gleyed Podzolic Soils (Dg4.21) in poorly drained areas; localised Yellow Podzolic Soils (Dy4.1, Dy5.2) associated with shale lenses.	Very high soil erosion hazard, rock outcrop, seasonally perched watertables, shallow, highly permeable soil, very low soil fertility.
Hawkesbury	Hawkesbury Sandstone consisting of medium to coarse-grained quartz sandstone with minor shale and laminite lenses. Sandstones are either massive or cross-bedded sheet facies with vertical or subvertical joint sets. The combination of bedding planes and widely spaced joints gives sandstone outcrops a distinctive blocky appearance.	Shallow (>50 cm), discontinuous Lithosols/Siliceous Sands (Uc1.21) associated with rock outcrop; Earthy Sands (Uc5.11, Uc5.23), Yellow Earths (Gn2.24) and some Yellow Podzolic Soils (Dy4.11) on inside of benches and along joints and fractures; localised Yellow and Red Podzolic Soils (Dy4.11, Dy5.21, Dy5.11, Dr5.21) associated with shale lenses; Siliceous Sands (Uc1.2) and secondary Yellow Earths (Gn2.41) along drainage lines.	Extreme soil erosion hazard, steep slopes, rock outcrop, shallow, stony, highly permeable soil, low soil fertility.
Oxford Falls	Hawkesbury Sandstone consisting of medium to coarse-grained quartz sandstone with minor shale and laminite lenses.	Moderately deep to deep (50–>150 cm) Earthy Sands (Uc5.23), Yellow Earths (Gn2.84, Gn2.94), Siliceous Sands (Uc1.21) on slopes; deep (>200 cm) Leached Sands (Uc2.12), Podzols (Uc2.32, Uc2.36) and Grey Earths (Gn2.881) on valley floors	Very high soil erosion hazard, perched watertables and swamps, highly permeable soil, very low to low soil fertility, localised rock outcrop.
Deep Creek	Holocene silty to peaty quartz sand, silt and clay with ferruginous and humic cementation in places (Herbert, 1983).	Deep (>200 cm) Podzols (Uc2.2, Uc2.3) on well-drained terraces, Siliceous Sands (Uc1.2, Uc1.4) on current floodplain and Humus Podzols (Uc2.3) in low lying areas.	Flooding, extreme soil erosion hazard, sedimentation hazard, localised very low fertility and permanently high watertables.



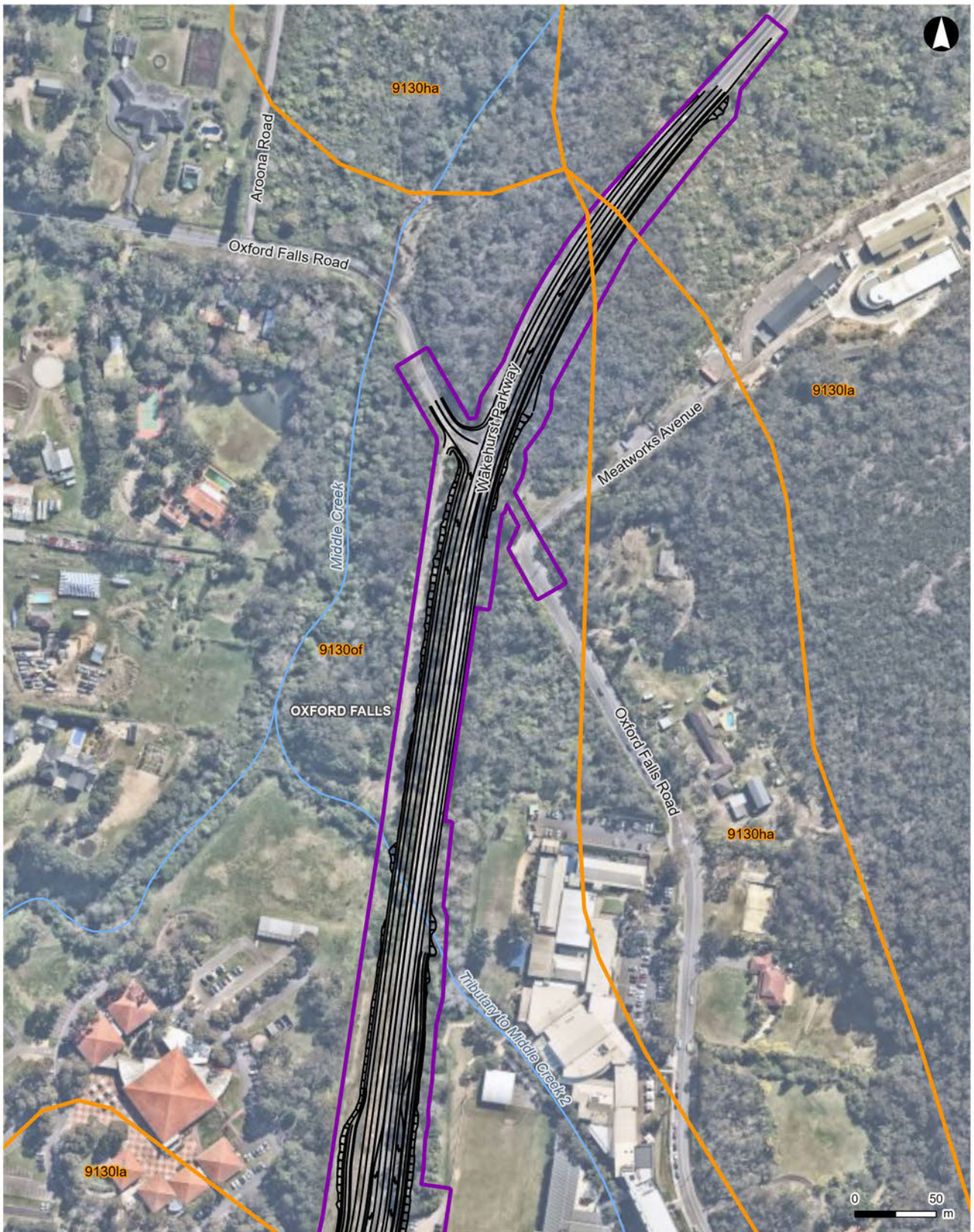
- Legend
- Proposal area
  - Soil landscapes
  - Proposal



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 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 26, 2023  
 Imagery: Nearmap 2022

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Figure 6-24, Soil landscapes - Wakehurst Parkway from Trefoil Creek to Dreadnought Road



- Legend
- Proposal area
  - Soil landscapes
  - Proposal



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 Date issued: September 26, 2023  
 Imagery: Nearmap 2022

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Figure 6-25, Soil landscapes - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road





- Legend
- Proposal area
  - Soil landscapes
  - Proposal



1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
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 Imagery: Nearmap 2022

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Figure 6-26, Soil landscapes - Wakehurst Parkway from Elanora Road to Mirrool Street

**Acid sulfate soils**

Wakehurst Parkway from Trefoil Creek to Dreadnought Road

There is no mapped risk of encountering acid sulfate soils in this area of the proposal.

Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

There is no mapped risk of encountering acid sulfate soils in this area of the proposal.

Wakehurst Parkway from Elanora Road to Mirrool Street

There is mapped occurrence of acid sulfate soils both at the proposal footprint at Elanora Road and Mirrool Street (refer to Figure 6-27). Wakehurst Parkway between Elanora Road and Mirrool Street is underlain with Class 5 and Class 2 acid sulfate soils Class 1 acid sulfate soils are mapped within the Narrabeen Lagoon, which is located 35 metres from the proposal at Wakehurst Parkway between Elanora Road and Mirrool Street.

Construction compounds

Only CC4 would be subject to any ground disturbance as a result of vegetation removal and later revegetation. At this location no Acid Sulfate Soils (ASS) is mapped and therefore there is no risk of exposure of ASS.



- Legend**
- Proposal area
  - Acid Sulfate Soils**
  - Class 1
  - Class 2
  - Class 5



1:4,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 13, 2023  
 Imagery: Nearmap 2022

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Figure 6-27, Acid sulfate soils - Wakehurst Parkway from Elanora Road to Mirrool Street

### Contamination

A search of the contaminated land record of notices maintained by the NSW Office of Environment and Heritage (EPA) on 11 September 2023 did not identify any records of contaminated sites within 500 metres of the proposal area and compound sites. The nearest contaminated site is Narrabeen Shotgun Range, located about two kilometres from the proposal area and 550 metres from CC6 at the Sydney Academy of Sport. This site has undergone remediation in the past and is currently subject to ongoing maintenance efforts.

### 6.5.3 Potential impacts

#### Construction

##### Soil disturbance

##### Proposal area

Construction activities have the potential to impact soils through erosion and sedimentation, however these would be temporary in nature and confined to the construction phase of the project.

Soil disturbance for construction of the proposal would primarily be related to vegetation removal, excavation for the road widening and installation of utilities and drainage. Without management measures in place, erosion and sedimentation could potentially impact on downstream water quality, via entering the stormwater network or onsite runoff. Potential impacts to surface water quality resulting from erosion and sedimentation is further detailed in Section 6.3.

Construction work that is likely to disturb soil would include:

- clearing of vegetation (trees)
- stripping, stockpiling and managing of topsoil for paving works
- excavation to relocate utilities and stormwater services
- bulk earthworks activities, including:
  - excavation of new batters, rock cuttings and retaining walls
  - excavation of new road pavements, medians and road verges
- road sub-grade preparation and road pavement work
- transport and handling of soil and materials to and from the proposal site.

The road widening would result in minor changes to topography alongside Wakehurst Parkway.

Detail of key soil characteristics within the construction footprint and associated implications for the proposal are provided in Table 6-21.

Table 6-21: Summary of key soil characteristics

Soil characteristic	Details	Implication
Dispersive soils and soil erodibility	There is a high risk of soil erosion for the Lambert, Hawkesbury, Oxford Falls and Deep Creek soils along Wakehurst Parkway from Trefoil Creek to Oxford Falls Road and Wakehurst Parkway from Elanora Road to Mirrool Street.	Potential for soil erosion to impact construction work, surrounding land uses and the water quality of surrounding waterways. Highest risk sections include where Hawkesbury (refer Figure 6-24 and Figure 6-25) and Deep Creek (refer to Figure 6-26) soils are located.
Acid sulfate rock	Exposure of acid sulfate soils is a risk for the proposal at Wakehurst Parkway from Elanora Road to Mirrool Street due to the presence of Class 2 ASS, and proximity to Class 1 ASS in Narrabeen Lagoon.	The excavation of actual and potential ASS and lowering the groundwater table in the vicinity of ASS during construction could cause the oxidation of sulfidic compound within these soils.  Oxidation of acid sulfate rock during construction has to generate acidic runoff, leachate and mobilise other contaminants (namely heavy metals) into the

Soil characteristic	Details	Implication
		environment, potentially impacting the health of terrestrial and aquatic ecosystems, environmental receivers, and the project personnel and general public.
Soil fertility	Low fertility associated with Lambert, Hawkesbury, Oxford Falls and Deep Creek soils along Wakehurst Parkway from Trefoil Creek to Oxford Falls Road and Wakehurst Parkway from Elanora Road to Mirrool Street.	Potential difficulty in vegetating slopes for erosion reduction and slope stability across the proposal.

The main construction activities with the potential to cause impacts associated with soils are presented in Table 6-22.

Table 6-22: Potential impacts on soils from construction activities

Construction activity	Details	Potential impact
Site establishment and access tracks	Activities involve movement and use of vehicles across exposed earth, excavation, vegetation clearing and grubbing, and transport of materials to and from site.	Soil erosion across the proposal footprint.
Bulk earthworks	Activities including cut and fill of existing soils, excavation of new batters, rock cuttings and retaining walls, and importing materials to work areas and stockpiling and treatment of soils. Potential cuts through acid sulfate rock.	Soil erosion across the proposal footprint. Acid rock formation resulting in more aggressive conditions and potential impacts to groundwater and/or surface water quality at Wakehurst Parkway from Elanora Road to Mirrool Street.
Pavements, medians and road verges	Excavation of existing pavements, medians and road verges	Soil erosion and waterway contamination.
Drainage work	Including excavation, vegetation clearing and grubbing, and construction of swales and drainage pipes.	
Excavation and relocation of utilities	Relocation of utilities using trenching and/or under-boring techniques	
Site restoration and landscaping	Restoration and landscaping of disturbed areas (including construction compounds and access roads) where required	

Construction work would be carried out to a depth of up to six metres throughout the proposal. Due to the excavation planned and the soil landscapes throughout the proposal, there is a high risk of erosion and sedimentation impacts without mitigation in place. There would be in turn a risk of surface water quality impacts due to the proximity of waterways to the proposal. With the safeguards summarised in Sections 6.2.4, 6.3.4, 6.5.4, potential erosion and sedimentation risks would be reduced to moderate and impacts caused by the proposal would be appropriately mitigated.

#### Construction compounds

Earthworks are not proposed in any of the construction compounds. However, in CC4 there is vegetation removal proposed that would result in soil disturbance and potentially erosion or sedimentation risks. The nearest waterway to CC4 is a tributary to Middle Creek that runs through the Oxford Falls Grammar campus, about 120 metres north of the compound.

Vehicle movements in and around the construction compounds may result in soil tracking and sedimentation, whilst stockpiling of materials at construction compounds may result in erosion and sedimentation. This would be minimised by stabilisation of stockpiles.

Activities occurring at ancillary facilities include movement and use of vehicles across exposed earth to transport material, stockpiling, vegetation clearing and grubbing.

### Contamination

#### Proposal area

Exposure of acid sulfate soils is a risk for the proposal at Wakehurst Parkway from Elanora Road to Mirrool Street due to the presence of Class 2 ASS, and proximity to Class 1 ASS in Narrabeen Lagoon. The excavation of actual and potential ASS and lowering the groundwater table in the vicinity of ASS during construction could cause the oxidation of sulfidic compound within these soils. This would in turn could generate acidic runoff, leachate and mobilise other contaminants (namely heavy metals) into the environment, potentially impacting the health of terrestrial and aquatic ecosystems, environmental receivers, and the project personnel and general public.

Impacts during construction to soil also includes the risk of spills and leaks causing contamination, such as fuels or automotive oils. This risk would be managed by bunding fuel tanks and other potentially hazardous liquids.

There is little risk for soil contamination to occur in the proposal due to leaching from the nearest contaminated site, Narrabeen Shotgun Range. This is due to the substantial distance between the Narrabeen Shotgun Range and the proposal area and construction compounds.

#### Construction compounds

At CC4, there is a risk of disturbing unexpected contamination in the form of asbestos when removing vegetation or revegetating the compound site.

Impacts during construction to soil also includes the risk of spills and leaks causing contamination, such as fuels or automotive oils. To reduce the risk of spills or leaks contaminating the ground, bunding of fuel tanks and other potentially hazardous liquids.

### Operation

No operational impacts to soils are expected.

## 6.5.4 Safeguards and management measures

Table 6-23: Soils safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Soils	All stockpiles will be designed, established, operated and decommissioned in accordance with Transport's <i>Stockpile Site Management Guideline, 2011</i> .	Contractor	Pre-construction & Construction
Soils	Work areas are to be stabilised progressively during the works.	Contractor	Construction
Chemical storage	The storage of chemicals and hazardous materials will be conducted in accordance with the relevant Safety Data Sheets (SDS) and in accordance with requirements of the <i>Environmentally Hazardous Chemicals Act 1985</i> .	Contractor	Construction
Contamination	Further investigation will be carried out to identify potential contaminants.	Contractor	Detailed design
Contamination	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
Contamination	any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Senior Manager Environment and Sustainability and/or EPA.		
	The Soil and Water Management Plan would include a contingency plan for any acid sulfate soils or salinity identified during the construction phase.	Contractor	Pre-construction & Construction

## 6.6 Traffic and transport

### 6.6.1 Methodology

The traffic and transport assessment involved the following:

- a review of the existing conditions within the proposal area including the road network, road performance, intersection layouts, road safety concerns, public transport amenity, pedestrian and cyclist facilities and residential access
- a review of the traffic model of future conditions within the proposal area without Wakehurst Parkway being upgraded between Trefoil Creek and Oxford Falls Road, and Elanora Road and Mirrool Street
- a review of the traffic model of future conditions within the proposal area with Wakehurst Parkway being upgraded between Trefoil Creek and Oxford Falls Road, and Elanora Road and Mirrool Street
- assessment of the likely impacts of construction traffic and work during the construction of the proposal and the impacts on the local community and residential access
- a review of the road safety objectives and necessary mitigation measures and strategies to improve road safety and to reduce or minimise impacts.

The assessment was carried out in accordance with the following guidelines:

- Transport for NSW Technical Direction (TTD 2017/001) Operational modelling reporting structure, May 2017
- Transport for NSW Traffic Modelling Guidelines
- Transport for NSW Technical Directions: Traffic Signals in Microsimulation Modelling - TTD 2018/002.

#### Traffic modelling

A traffic model representing 2023 traffic conditions was developed for the 9.6-kilometre section of Wakehurst Parkway between Frenchs Forest and Pittwater Road. The traffic model was developed using VISSIM software (version 2023), a network modelling tool, in accordance with Transport for NSW's Traffic Modelling Guidelines.

The network model was developed for AM two-hour peak period between 7am and 9am and for PM two-hour peak period between 4pm and 6pm. Traffic models were developed for future years, 2026 and 2046.

The network modelling tool was used to assess intersection performance of the following key intersections within the proposal area:

- Wakehurst Parkway and Dreadnought Road
- Wakehurst Parkway and Oxford Falls Road
- Wakehurst Parkway and Elanora Road
- Wakehurst Parkway and Mirrool Street
- Wakehurst Parkway and service road (near Palm Terrace).

Overall intersection performance is reported as an estimate of the average delay that all vehicles encounter at a particular intersection and the Level of Service (LoS), which categorises the average delay into bands A to F. The band of categories are defined further in Table 6-24.

Intersection modelling was carried out for year of opening (2026) and future year (2046) for the scenario without the proposal (do nothing option) and with the proposal.

Table 6-24: Level of service - average delay per vehicle in seconds

LoS	Operation (Traffic signals and roundabouts)	Operation (Give way and stop signs)	Average delay per vehicle in seconds (signalised movements)
A	Good operation	Good operation	<15
B	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity	15 to 28
C	Satisfactory	Satisfactory, but accident study required	29 to 42
D	Operating near capacity	Near capacity & accident study required	43 to 56
E	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode	57 to 70
F	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing	>71

The network modelling tool was also used to provide an overview of the road network performance and identify the impact of the proposal on the broader road network. Traffic network performance is measured by total Vehicle Hours Travelled (VHT), Vehicle Kilometres Travelled (VKT) of the broader network which includes Dreadnought Road, Oxford Falls Road, Elanora Road, Mirrool Street (west), and Wakehurst Parkway Service Road (near Palm Terrace) intersections. The indicators of traffic network performance are defined in Table 6-25.

Table 6-25: Indicators of network performance

Criteria	Definition
Total Vehicle Hours Travelled (VHT)	Total vehicle hours travelled in the proposal
Total Vehicle Kilometres Travelled (VKT)	Total vehicle kilometres travelled across the proposal
Total stops	The cumulative total of every instance when a vehicle comes to a stop within the network. A stop is defined as a vehicle's speed dropping below five kilometres per hour until it accelerates to above ten kilometres per hour
Latent demand	Total number of vehicles that cannot enter the model due to model constraints such as congestion

## 6.6.2 Existing environment

### Road network and intersection performance

Wakehurst Parkway is a designated B-double route between Frenchs Forest Road, Frenchs Forest, and Pittwater Road, Narrabeen. Heavy vehicles with a maximum vertical height clearance of 4.6 metres are allowed on Wakehurst Parkway. The general alignment of Wakehurst Parkway between Frenchs Forest Road and Pittwater Road is mostly a two-way undivided carriageway with one lane in each direction. Overtaking lanes are limited along Wakehurst Parkway.

On the existing Wakehurst Parkway southbound approach to Oxford Falls Road, road users have been observed to reduce speed in anticipation of a vehicle stopped to turn right into Oxford Falls Road, given that there is no space to get past a stopped vehicle at this location. The constrained sight distance on the approach to this intersection also adds to this issue.

Similarly, at the Mirrool Street intersection, road users travelling south on Wakehurst Parkway currently do not have space to pass a vehicle stopped to turn right into Mirrool Street, which presents an issue for traffic capacity and road safety.



On the existing southbound approach to Dreadnought Road intersection, a left and through lane is added to the southbound carriageway, and the kerbside lane continues about 300 metres beyond the intersection to the south before merging back into a single southbound lane. Given that the duplication of southbound lanes is relatively short, utilisation of the kerbside lane has been observed to be relatively low. This indicates that the benefit to traffic capacity through this area is minimal.

#### Existing traffic volumes

Table 6-26 shows existing daily traffic volumes on Wakehurst Parkway in 2023. Wakehurst Parkway through the proposal area carried between 24,500 and 27,400 vehicles per day on an average weekday. The heavy vehicles proportion on Wakehurst Parkway is between eight per cent and 13 per cent of total traffic on an average weekday.

Table 6-26: Daily traffic volumes on Wakehurst Parkway (2023)

Wakehurst Parkway sections	Average weekday daily volumes (vehicles per day)		
	Total vehicles	Heavy vehicles	% Heavy vehicles
Wakehurst Parkway, between Frenchs Forest Road and Dreadnought Road	24,500	1,960	8
Wakehurst Parkway, between Oxford Falls Road and Narrabeen Sports Academy	27,400	3,590	13
Wakehurst Parkway, between Caley Trail and Elanora Road	26,300	2,030	8

Table 6-27 shows existing weekday AM and PM peak hour traffic volumes on Wakehurst Parkway. The AM peak hour represents between 8 am and 9 am and PM peak hour represents between 5 pm to 6 pm traffic conditions.

In the AM peak, Wakehurst Parkway carries higher traffic volumes in the southbound direction (towards Frenchs Forest Road). About 1,140 to 1,340 vehicles per hour were recorded in the southbound direction.

In the PM peak, higher traffic volumes were observed in the northbound direction (towards Pittwater Road). About 1,180 to 1,400 vehicles per hour were recorded in the northbound direction.

Table 6-27: AM and PM peak hour traffic volumes on Wakehurst Parkway (2023)

Wakehurst Parkway sections	AM(8am to 9am)			PM(5pm to 6pm)		
	Northbound	Southbound	Two-way	Northbound	Southbound	Two-way
Wakehurst Parkway, between Frenchs Forest Road and Dreadnought Road	900	1,140	2,040	1,180	830	2,010
Wakehurst Parkway, between Oxford Falls Road and Narrabeen Sports Academy	830	1,340	2,170	1,390	890	2,280
Wakehurst Parkway, between Caley Trail and Elanora Road	770	1,320	2,090	1,400	870	2,270

#### Future traffic volumes

The average weekday traffic volumes on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road –re predicted to grow from 24,500 - 27,400 vehicles per day in 2023 to 24,900 - 27,800 vehicles per day in 2026.

In 2046, traffic volumes on Wakehurst Parkway are predicted to increase to 27,300 - 30,600 vehicles per day, equivalent to a 12 per cent increase against existing traffic volumes.

Table 6-28 shows predicted daily traffic volumes on Wakehurst Parkway in the opening year (2026) and future year (2046), in comparison to existing (2023) daily traffic volumes.

Table 6-28: Average weekday volumes on Wakehurst Parkway in 2026 and 2046

Wakehurst Parkway sections	Average weekday volumes (vehicles per day)		
	2023	2026	2046
Wakehurst Parkway, between Frenchs Forest Road and Dreadnought Road	24,500	24,900	27,300
Wakehurst Parkway, between Oxford Falls Road and Narrabeen Sports Academy	27,400	27,800	30,600
Wakehurst Parkway, between Caley Trail and Elanora Road	26,300	26,700	29,300

**Intersection performance**

Table 6-29 shows the existing (2023), opening (2026) and future (2046) LoS for Dreadnought Road, Oxford Falls Road, Elanora Road, Mirrool Street, and the service road (near Palm Terrace) intersections without the proposal for AM (7am to 9am) and PM peak hours (4 pm to 6pm).

Table 6-30 shows the existing LoS for Dreadnought Road on all approaches to the intersection without the proposal.

Under existing conditions, traffic was found to be performing at LoS B at Wakehurst Parkway and Oxford Falls Road intersection and at LoS A at the Wakehurst Parkway intersections with Elanora Road, Mirrool Street, and the service road (near Palm Terrace) during the AM and PM peaks.

However, modelling at Wakehurst Parkway and Dreadnought Road intersection indicates that traffic performance is at LoS F during both the AM and PM peaks. Average delays without the proposal would increase to 42 seconds in the AM peak (a 54 per cent increase) and 47 seconds in the PM peak (a 55 per cent increase) by 2046. This indicates that there are existing capacity constraints at Dreadnought Road intersection, highlighting the need to improve traffic capacity at this intersection.

Table 6-29: Existing and future level of service for key intersections along Wakehurst Parkway without the proposal

Intersections	Control	2023		2026		2046	
		Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS
<b>AM peak hour</b>							
Wakehurst Parkway / Dreadnought Road	Traffic signals	78	F	97	F	120	F
Wakehurst Parkway / Oxford Falls Road	Stop sign	24	B	24	B	29	C
Wakehurst Parkway / Elanora Road	Give Way	12	A	22	B	45	D
Wakehurst Parkway / Mirrool Street	Give Way	1	A	1	A	2	A
Wakehurst Parkway / service road (near Palm Terrace)	Give Way	1	A	1	A	3	A
<b>PM peak hour</b>							
Wakehurst Parkway / Dreadnought Road	Traffic signals	85	F	102	F	132	F
Wakehurst Parkway / Oxford Falls Road	Stop sign	17	B	18	B	38	C
Wakehurst Parkway / Elanora Road	Give Way	12	A	13	A	35	C
Wakehurst Parkway / Mirrool Street	Give Way	1	A	2	A	2	A

Intersections	Control	2023		2026		2046	
		Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS
Wakehurst Parkway / service road (near Palm Terrace)	Give Way	1	A	2	A	2	A

Table 6-30: Existing (2023) delays and LoS by approaches for Wakehurst Parkway and Dreadnought Road intersection

Approach	Control	2023 AM		2023 PM	
		Average delay (sec)	LoS	Average delay (sec)	LoS
Wakehurst Parkway (N)	Traffic signals	57	E	41	C
Dreadnought Road (E)	Traffic signals	364	F	484	F
Wakehurst Parkway (S)	Traffic signals	12	A	34	C
Dreadnought Road (W)	Traffic signals	37	C	44	D
<b>Overall Intersection</b>		<b>78</b>	<b>F</b>	<b>85</b>	<b>F</b>

#### Broader network performance

The broader network performance of Wakehurst Parkway between Frenchs Forest Road and Pittwater Road is expected to deteriorate in its existing configuration in response to higher traffic volumes. Table 6-31 shows the performance of the broader road network in 2023, 2026 and 2046 without the proposal.

Between 2023 and 2046, the total vehicle hours travelled would increase by 58 per cent in the AM peak and 30 per cent in the PM peak. In contrast, the total vehicle kilometres travelled (VKT) would increase by 2 per cent and 10 per cent respectively. Such scenarios where travel time greatly outstrips growth in travel distance indicates a highly congested network without the proposal.

Table 6-31: Existing and future network performance without proposal in 2023, 2026 and 2046

Time Period	2023		2026		2046	
	AM	PM	AM	PM	AM	PM
Total trips (vehicles)	3,243	3,259	3,289	3,291	3,751	3,697
Latent demand (vehicles)	9	2	20	0	165	90
% Unreleased demand	0.27%	0.05%	0.62%	0.01%	4.40%	2.43%
Total Vehicle Hours Travelled (VHT)	423	417	443	428	670	542
Total Vehicle Kilometres Travelled (VKT)	20,583	21,789	20,815	22,054	21,041	23,970
Average network speed (km/h)	49	52	47	52	31	44
Stops	9,268	7,004	11,131	7,771	35,653	18,165

The travel times for motorists are expected to increase on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road. Table 6-32 shows the existing and future travel times on Wakehurst Parkway in 2023, 2026 and 2046.

Without the proposal, between 2023 and 2046, the travel time northbound is expected to increase by 2.4 minutes in the AM peak and 2.1 minutes in the PM peak. In the southbound direction, the travel time is expected to increase by 4.8 minutes in the AM peak and 1.3 minutes in the PM peak.

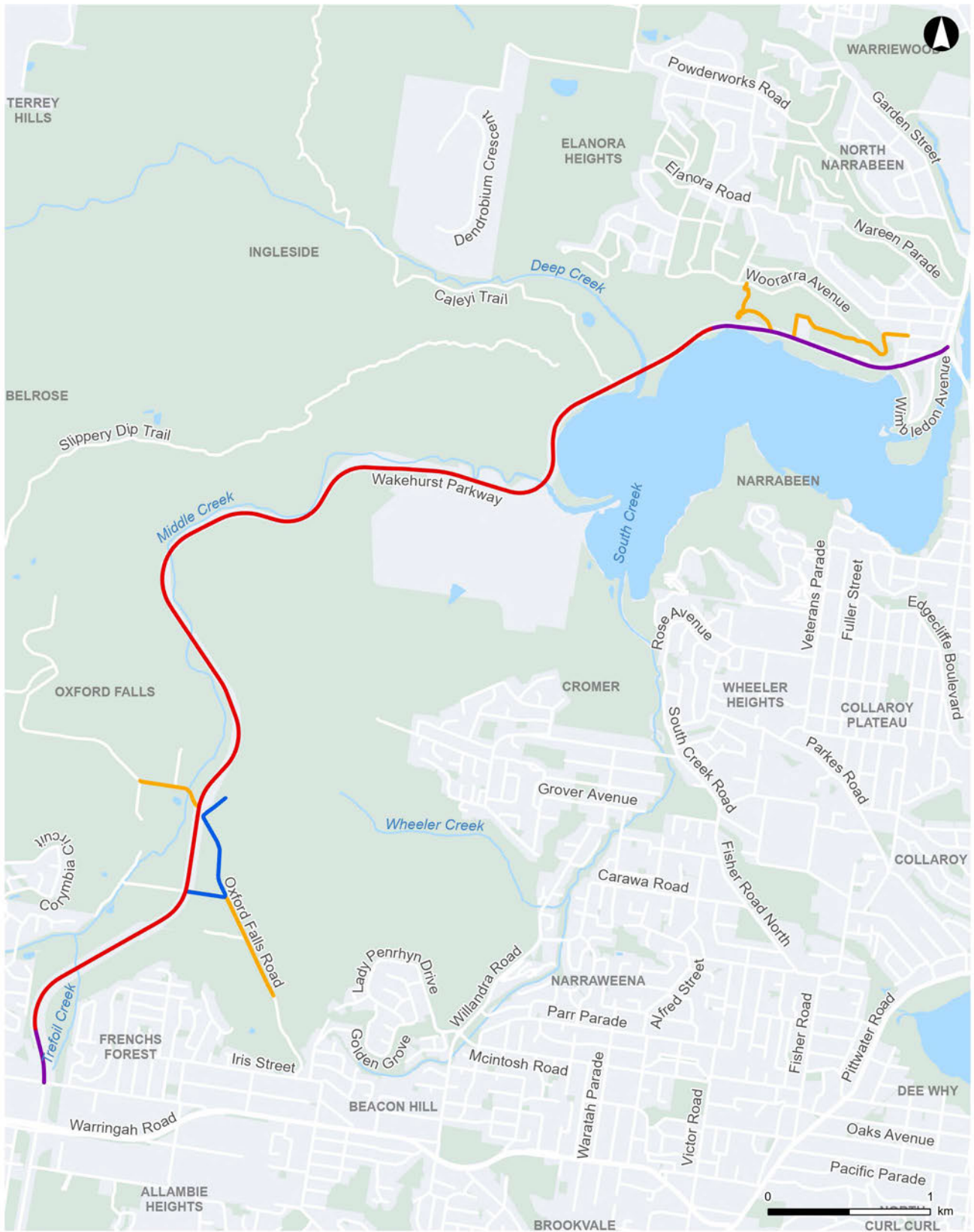
Table 6-32: Existing and future travel times without the proposal in 2023, 2026, and 2046






Direction	Travel time savings (minutes)					
	2023		2026		2046	
	AM	PM	AM	PM	AM	PM
Northbound	9.1	9.6	9.2	9.7	11.9	11.5
Southbound	11.5	10.1	12.0	10.2	16.3	11.4

### Road and speed environment

The posted speed limit on Wakehurst Parkway within the study area varies between 70 to 80 kilometres per hour depending on the location. An existing school zone is applied on Dreadnought Road (east), extending from Dreadnought Road intersection to along Oxford Falls Road (east) past Oxford Falls Grammar. For the school zone, 40 kilometres per hour speed limit is applied between 8 am and 9.30 am in the AM peak and between 2.30 pm and 4 pm in the PM peak.

Figure 6-28 shows the posted speed limits along Wakehurst Parkway between Frenchs Forest and Narrabeen.



- Legend**
-  Watercourse
  - Travel speed**
  -  80 kmph
  -  70 kmph
  -  50 kmph
  -  50 kmph (School zone)

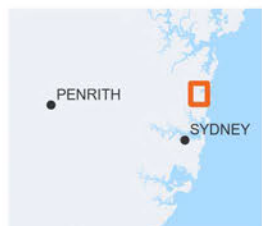


Figure 6-28, Existing posted speed limits on Wakehurst Parkway

**Crash analysis**

Detailed crash reports were obtained for Wakehurst Parkway and the key intersections for the five-year period between January 2017 to December 2021 to identify any crash trends. The crash analysis takes into account several factors, including the locations where certain crash types have occurred repeatedly, the times of day during which crashes are occurring, lighting condition, and various other considerations. Further detail is provided below.

Wakehurst Parkway from Trefoil Creek to Oxford Falls Road (via Dreadnought)

16 crashes were recorded between 2017 and 2021:

- three (19 per cent) were serious injury crashes and ten (81 percent) were minor to moderate injury crashes. These crashes led to a total of 14 casualties, of which three (21 per cent) were serious injury casualties.
- rear end crashes (44 per cent of all crashes, and 67 per cent of serious injury crashes) were the prevailing crash type (refer to Figure 6-29)
- one crash with a pedestrian occurred at Dreadnought Road intersection which led to a moderate injury.

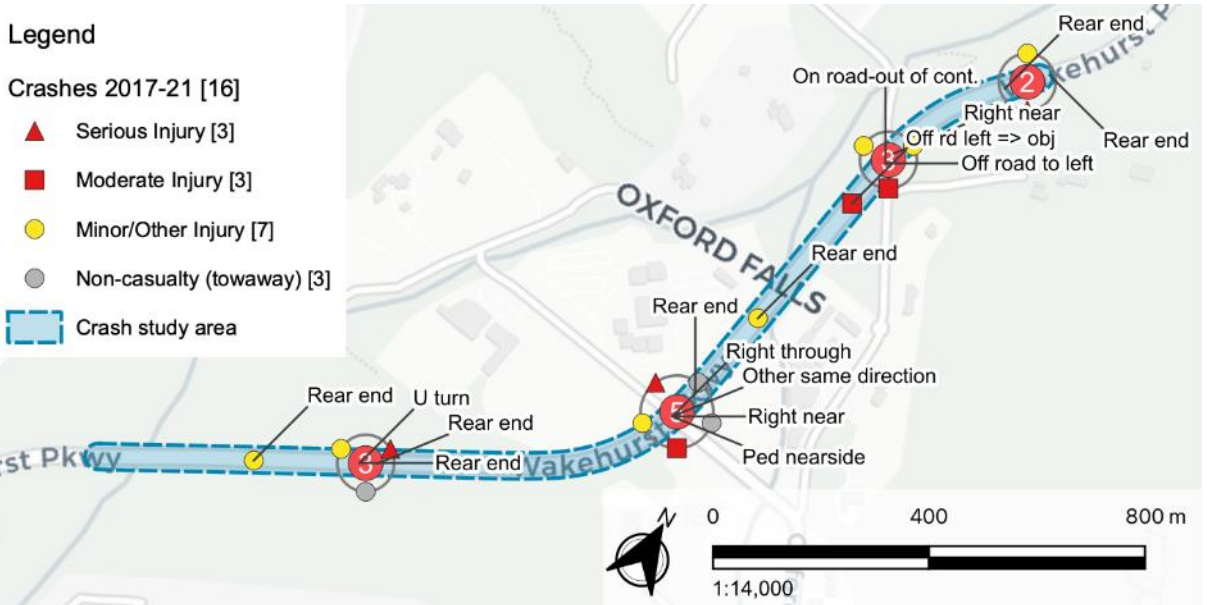


Figure 6-29: Crashes by severity and road user movement on Wakehurst Parkway between Trefoil Creek and Oxford Falls Road (2017 to 2021)

Wakehurst Parkway from Elanora Road to Mirrool Street

Ten crashes were recorded between 2017 and 2021:

- three (30 per cent) were serious injury crashes and seven (70 per cent) were minor to moderate injury crashes. These crashes led to a total of ten casualties, of which six (60 per cent) were serious injury casualties.
- adjacent direction crashes at intersections (30 per cent of all crashes, and 33 per cent of serious injury crashes) were the prevailing crash type. There were also two head on crashes, one of which resulted in a serious injury (refer to Figure 6-30)
- one crash involved a pedestrian on Wakehurst Parkway which resulted in a serious injury.

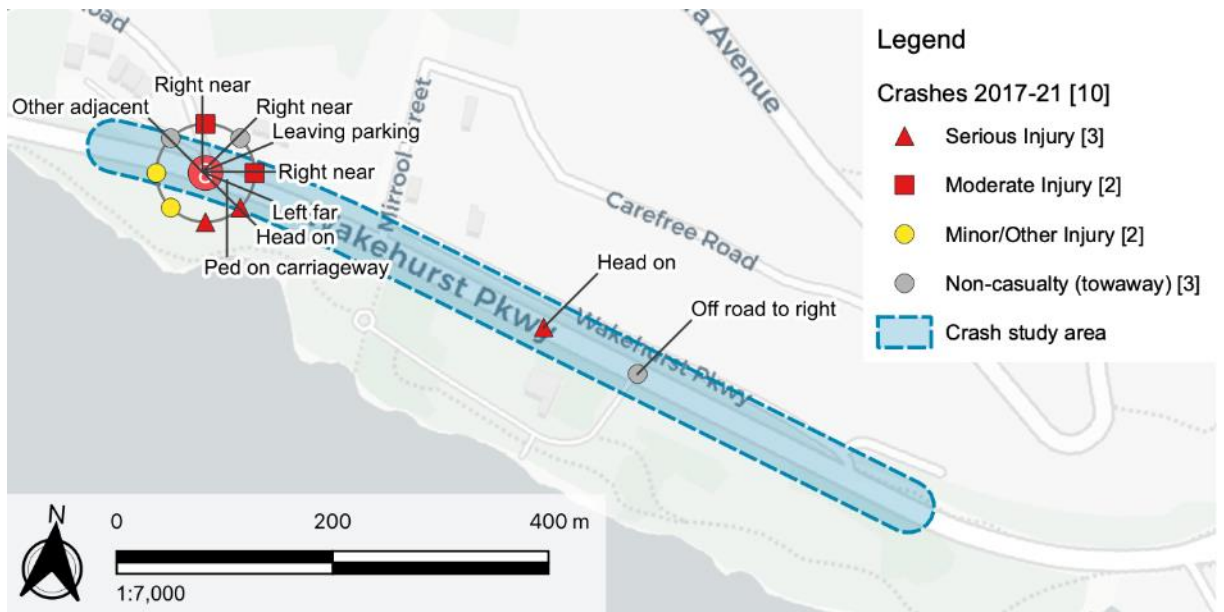


Figure 6-30: Crashes by severity and road user movement on Wakehurst Parkway between Elanora Road and Mirrool Street (2017 to 2021)

**Public transport**

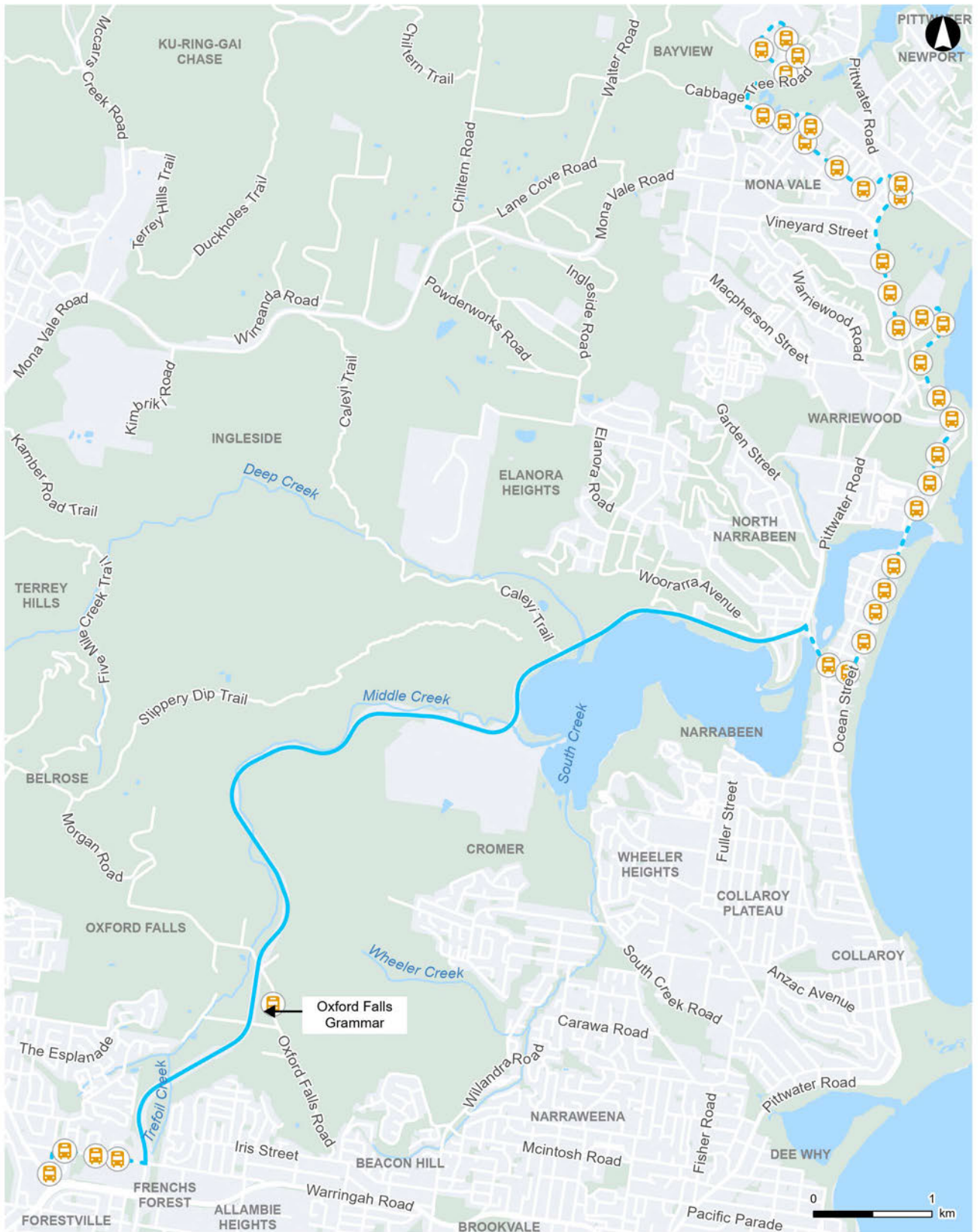
The proposal area is serviced by one public bus route (Bus route 155, as shown in Figure 6-31), which travels from Bayview Garden Village to Narrabeen and Frenchs Forest on weekdays. There are also a number of school bus services that operate during the AM and PM peaks during school days only (refer to Table 6-33).

There are no other existing bus stops within the proposal area.

The nearest train station, Roseville Station, is located about nine kilometres away from the proposal.

Table 6-33: Existing bus services within the proposal study area

Bus No.	Route	Frequency
115	Starkey Street at Warringah Road to Oxford Falls Grammar school	1 service in AM peak
136	Pittwater Place Shopping Centre to Oxford Falls Grammar school	1 service in AM peak
137	Matar Maria College to Oxford Falls Grammar school	1 service in AM peak
139	Sydney Japanese International School to Oxford Falls Grammar school	1 service in AM peak
144	Covenant Christian School to Oxford Falls Grammar school	1 service in AM peak
203	Oxford Falls Grammar school to Pittwater Place Shopping Centre	1 service in PM peak
205	Oxford Falls Grammar school to Myoora Road before Booralie Road	1 service in PM peak
211	Oxford Falls Grammar school to Pittwater Place Shopping Centre	1 service in PM peak
212	Oxford Falls Grammar school to Wyatt Avenue opposite Lockhart Place	1 service in PM peak
249	Oxford Falls Grammar school to Pittwater Place Shopping Centre	1 service in PM peak
250	Oxford Falls Grammar school to Myoora Road before Booralie Road	1 service in PM peak
251	Oxford Falls Grammar school to Pittwater Place Shopping Centre	1 service in PM peak
298	Oxford Falls Grammar school to Galstaun school	1 service in PM peak
721N	Balgowlah to Oxford Falls Grammar school	1 service in AM peak
722N	Oxford Falls Grammar to Seaforth Shops	1 service in PM peak
723N	Manly Wharf to Oxford Falls Grammar school	2 services in PM peak with a bus every 30 minutes
724N	Oxford Falls Grammar school to Queenscliff	1 service in PM peak
774N	Oxford Falls to Pittwater House	1 service in PM peak
781N	Manly Wharf to Oxford Falls Grammar school	1 service in AM peak



- Legend**
-  Bus stops
  -  Bus route 155
  -  Watercourse

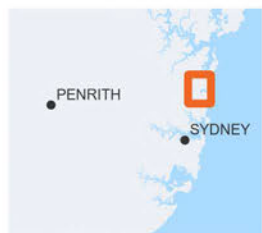


Figure 6-31, Bus route 155

1:48,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: September 22, 2023





## **Parking**

No on-street parking is available within the proposal area on Wakehurst Parkway, Dreadnought Road, Oxford Falls Road, Elanora Road and Mirrool Street. However, street parking is available along local roads within the vicinity of the proposal as detailed below.

### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

On the northern side of Dreadnought Road, west of the intersection, 'No parking' restrictions extend from the traffic signals to the driveway into C3 SYD church. Private parking is available within the C3 SYD church property. Except for driveways, unrestricted street parking is available from this point to the end of Dreadnought Road.

On the southern side of Dreadnought Road, west of the intersection, 'No stopping' restrictions extend about 45 metres west from the traffic signals into the road. Except for driveways, unrestricted street parking is available from this point to the end of Dreadnought Road. Private parking is available in St Pius X Treacy Education Complex and Sporting Fields, accessible by a driveway about 260 metres west from the intersection.

On the northern side of Dreadnought Road, east of the intersection, there are no restrictions on parking. Private parking on the property of Oxford Falls Grammar school is accessible by a driveway located about 100 metres east of the intersection.

On the southern side of Dreadnought Road, east of Dreadnought Road intersection, 'No stopping' restrictions extend about 20 metres from the traffic signals. From that point until the driveway to Oxford Falls Peace Park, 'No parking between 7:30 am to 9:30 am, and 2:30 pm to 4 pm on school days' is enforced. Beyond this driveway until the end of Dreadnought Road, no restrictions on parking are in place.

On the western side of Oxford Falls Road, 'No stopping 7:30 am to 9:30 am, and 2:30 pm to 3:30 pm Monday to Friday' restrictions are in place from the intersection with Dreadnought Road to the nearest driveway further north. North of this driveway, unrestricted street parking is available until the front gate of Oxford Falls Grammar. North of this driveway, 'No parking between 8am to 9:30am School days only' enforced. 'No stopping' restrictions are in place until north of the roundabout. Unrestricted street parking continues from this driveway until the end of the road. Access to the outdoor parking on the property of Oxford Falls Grammar school is provided at the roundabout.

### Wakehurst Parkway from Elanora Road and Mirrool Street

Unrestricted street parking is available along Mirrool Street and the service road (near Palm Terrace), primarily servicing vehicles of local residents.

Claude's Carpark is located south of Wakehurst Parkway, about 200 metres east from the Mirrool Street intersection. This provides ticketed public parking to visitors of Narrabeen Lagoon, Bilarong Reserve, and the Narrabeen Lagoon Trail.

Unrestricted street parking is available along Wimbledon Avenue.

## **Cycling facilities**

One on-road cycle lane is available on Wakehurst Parkway northbound approach to Dreadnought Road intersection (refer to Figure 6-33). There are no other dedicated cycle paths provided within the proposal area along Wakehurst Parkway, Dreadnought Road, Oxford Falls Road, Elanora Road and Mirrool Street. As such, cyclists primarily ride alongside traffic along the road corridor. The shared path Narrabeen Lagoon Trail is within the vicinity of the proposal, located adjacent to Narrabeen Lagoon. This trail is also used by mountain bike riders accessing adjacent fire trails located to the west of Wakehurst Parkway.

Average weekend and weekday cycling trips along the Wakehurst Parkway from October 2021, January 2022 and May 2022 was gathered from Strava Metro and shown on Figure 6-32. May 2022 was chosen as the representative month and the average week of cycling trips in this month along Wakehurst Parkway is summarised in Table 6-34. Links intersecting and around Wakehurst Parkway were included to provide an indication of cycling demand around the corridor. Cycling trips were the highest on Sundays, with an average of 51 trips in May 2022.

The highest number of cyclist trips are concentrated adjacent to the Narrabeen Lagoon shared path from Middle Creek Reserve to Pittwater Road, experiencing between 500 to 3,600 trips per day.

Table 6-34: Average weekend and weekday trips on Wakehurst Parkway in May 2022

Impact	Weekday	Saturday	Sunday
Average number of cycling trips on Wakehurst Parkway	32	27	51

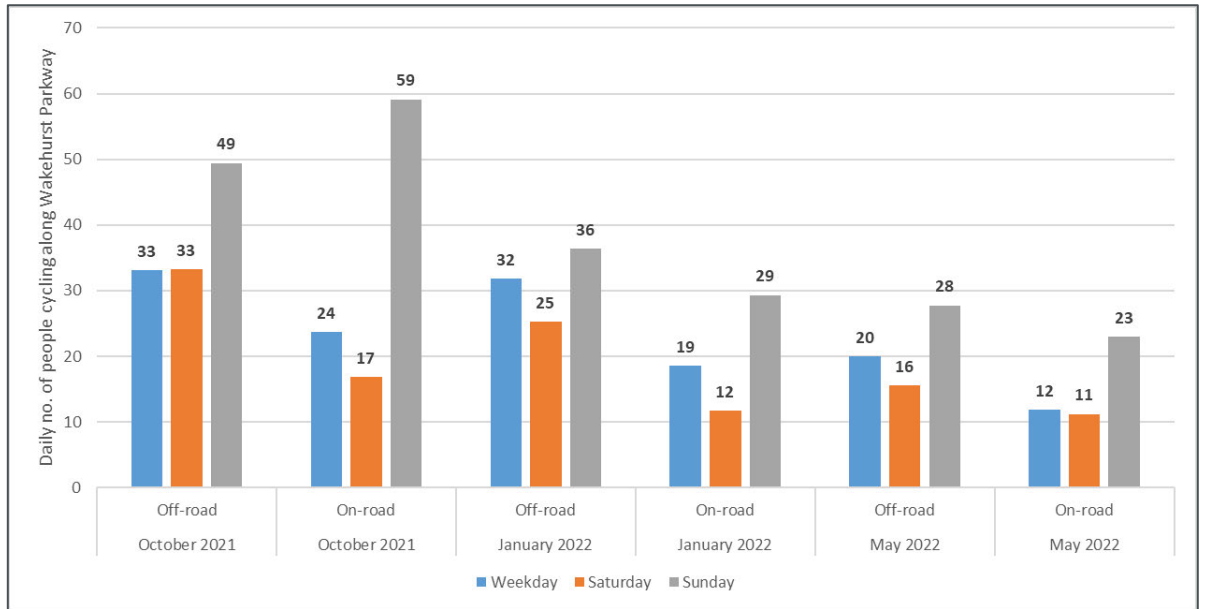


Figure 6-32: Strava cyclist activity along Wakehurst Parkway



Figure 6-33, Existing cycling facility - Wakehurst Parkway

### Pedestrian facilities

A signalised pedestrian crossing is provided on the northern leg of Wakehurst Parkway and Dreadnought Road intersection. On the northern side of Dreadnought Road, a pedestrian footpath extends west from the traffic control signals at the north-western corner of the intersection to C3 SYD church. On the southern side of Dreadnought Road, a pedestrian footpath starts 30 metres from the south-western corner of the intersection and continues west to the end of Dreadnought Road.

A pedestrian footpath is also provided on the northern side of Wakehurst Parkway, extending east from the Wakehurst Parkway and service road (near Palm Terrace) intersection to Bristol Lane.

No other pedestrian footpaths are provided along Wakehurst Parkway, Dreadnought Road, Oxford Falls Road, Elanora Road and Mirrool Street within the proposal area.

Narrabeen Lagoon Trail is within the vicinity of the proposal, located adjacent to Narrabeen Lagoon.

## 6.6.3 Potential impacts

### Construction

#### Traffic performance

Some impacts to traffic flow within the proposal area may occur during the construction phase of the proposal due to an increase in light and heavy vehicles, as estimated in Table 6-35. The proposal would generate between 140 and 160 vehicle movements per day at Wakehurst Parkway from Trefoil Creek to Oxford Falls Road, and 60 to 80 vehicle movements per day at Wakehurst Parkway from Elanora Road to Mirrool Street. The distribution of these movements on the road network would depend on the particular construction activities being undertaken at the time, the destination of the workforce, the source of imported material and the destination of exported material.

Table 6-35: High-level estimated daily construction vehicle movements

Location of proposal	Estimated daily construction vehicle movements on Wakehurst Parkway		
	Light vehicle movements	Heavy vehicle movements	Total
Wakehurst Parkway from Trefoil Creek to Oxford Falls Road	100 to 120	40	140 to 160
Wakehurst Parkway from Elanora Road to Mirrool Street	40 to 60	20	60 to 80

Daily construction vehicle movements and existing average weekday daily traffic on Wakehurst Parkway are shown in Table 6-36. For planning purposes, a vehicle travelling in and out from the site is considered as two vehicle movements. Construction traffic would increase volumes on Wakehurst Parkway from between 0.2 to 0.7 per cent depending on each location. These increases would be minor and not impact the operational performance of Wakehurst Parkway. Roads within the proposal area would remain open during the construction period, however partial road closures would be required. Lane closures would be carried out primarily out of hours in accordance with road occupancy licences, to minimise disruption to traffic.

Construction of the proposal is planned to commence in mid to late 2024, with a staged approach. Construction speed limits of between 40 to 60 kilometres per hour would be in place during construction and stop/slow signage and controls would be used to ensure the safety of construction personnel. Temporary delays would occur for road users, though any delays would likely be short-term or minor in nature. Detours may also be implemented, with adequate signage to be installed to direct road users.

Some traffic congestion may result from construction vehicles accessing construction compound sites, though this impact would be limited to the construction phase of the proposal. Deliveries would be staged to minimise disruption to traffic.

Table 6-36: Impacts of construction traffic on Wakehurst Parkway

Location of proposal	Existing average weekday traffic on Wakehurst Parkway	Daily construction vehicle movements on Wakehurst Parkway	Per cent increase on Wakehurst Parkway
Wakehurst Parkway, between Frenchs Forest	24,500	140 to 160	0.6 to 0.7 per cent

Location of proposal	Existing average weekday traffic on Wakehurst Parkway	Daily construction vehicle movements on Wakehurst Parkway	Per cent increase on Wakehurst Parkway
Road and Dreadnought Road			
Wakehurst Parkway, between Caley Trail and Elanora Road	26,300	60 to 80	0.2 to 0.3 per cent

### Parking

Construction activities have the potential to temporarily impact local parking in the vicinity of the proposal due to the increase in construction vehicles. Where possible, construction staff and personal vehicles would be parked within construction compounds. Should there be insufficient parking for construction staff at the compounds, on-street parking adjacent to the work site would need to be considered. This would be assessed as required by the construction contractor and considered alongside the parking availability and capacity of the area. This could temporarily impact local street parking available on Dreadnought Road, Oxford Falls Road (east of Dreadnought Road intersection), Mirrool Street, and within Claude's Carpark during construction.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

The on-street parking subject to potential temporary construction impacts along Dreadnought Road and Oxford Falls Road (east of Dreadnought Road intersection) may be used by students, visitors, and/or staff of Oxford Falls Grammar, St Pius X College, and C3 SYD church, which are facilities located within the vicinity of the proposal. However, as detailed in Section 6.6.2, each of these facilities has private parking available. This includes Oxford Falls Grammar, which has a new undercover carpark accessible from Dreadnought Road along with an outdoor car park accessible from Oxford Falls Road (east of Dreadnought Road intersection). Impacts to these facilities would therefore be minimal.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

Street parking is limited on Mirrool Street and the Wakehurst Parkway service road (near Palm Terrace) due to the width and length of these roads. Impacts to street parking along both roads would potentially affect local residents. Similarly, potential impacts to Claude's Carpark would limit parking access for visitors of the Narrabeen Lagoon, Narrabeen Lagoon Trail and Bilarong Reserve.

Construction workers would be encouraged to park at nearby construction compounds and car pool to site to minimise the need for street parking. Impacts to parking in this area would be temporary as the car parking spaces would be available for use after the completion of construction work.

#### Construction compounds

Adjacent to CC9, street parking is likely to be reduced at the frontage on Wimbledon Avenue to allow for vehicles to enter and exit the compound site. This would likely only affect up to four vehicle parking spaces and is unlikely to cause substantial disruption to parking in this area.

Parking for construction workers would be provided at CC1, CC2, CC3, CC6 and CC8.

#### Public transport

Though there are no bus stops located within the proposal area, bus routes do utilise Wakehurst Parkway and local roads. During construction, traffic delays resulting from temporary lane closures, contraflow traffic arrangements and construction zone speed limits may result in interruptions and delays in bus services along Wakehurst Parkway. Bus operators would be notified of changes to traffic arrangements during construction.

#### Cyclists

Construction of the proposal would commence permanent removal of the existing on-road cycle lane on Wakehurst Parkway northbound on approach to Dreadnought Road intersection. Further detail on the permanent cycling arrangement is provided below under operation. Cyclists travelling north along Wakehurst Parkway during construction would have to travel with traffic through the Dreadnought intersection. Notifications and signage would be implemented during construction to forewarn cyclists of the changed arrangement.

The existing pedestrian crossing on the northern leg of Wakehurst Parkway and Dreadnought Road intersection would be unavailable for cyclists travelling east-west during construction. Measures would be in place during construction to maintain connectivity by providing alternate access. Signage would be displayed during construction to outline the diversion routes.

Narrabeen Lagoon Trail would not be impacted during construction.

#### Pedestrians

The existing pedestrian crossing on the northern leg of Wakehurst Parkway and Dreadnought Road intersection would be unavailable for pedestrian use during construction as it is proposed to be realigned to accommodate the road widening work. Measures would be in place during construction to provide alternative pedestrian and cyclist access. Signage would be displayed during construction to outline the pedestrian and cyclist diversion routes.

Given the distance of the Narrabeen Lagoon Trail from the proposal area, construction work would not affect the existing trail which serves as a pedestrian footpath and cyclist path.

#### Property access

##### Wakehurst Parkway from Elanora Road to Mirrool Street

Construction would potentially impact access to properties 92 to 106 Wakehurst Parkway and 1 Elanora Road due to the proposed widening of Wakehurst Parkway northbound between Elanora Road and Mirrool Street. Figure 6-34 shows the properties potentially affected by the proposal in this area.

Driveway adjustments for four of the above properties would be required to maintain compatibility with the modified pavement levels. These properties include:

- 106 Wakehurst Parkway
- 104 Wakehurst Parkway
- 102 Wakehurst Parkway
- 100 Wakehurst Parkway.

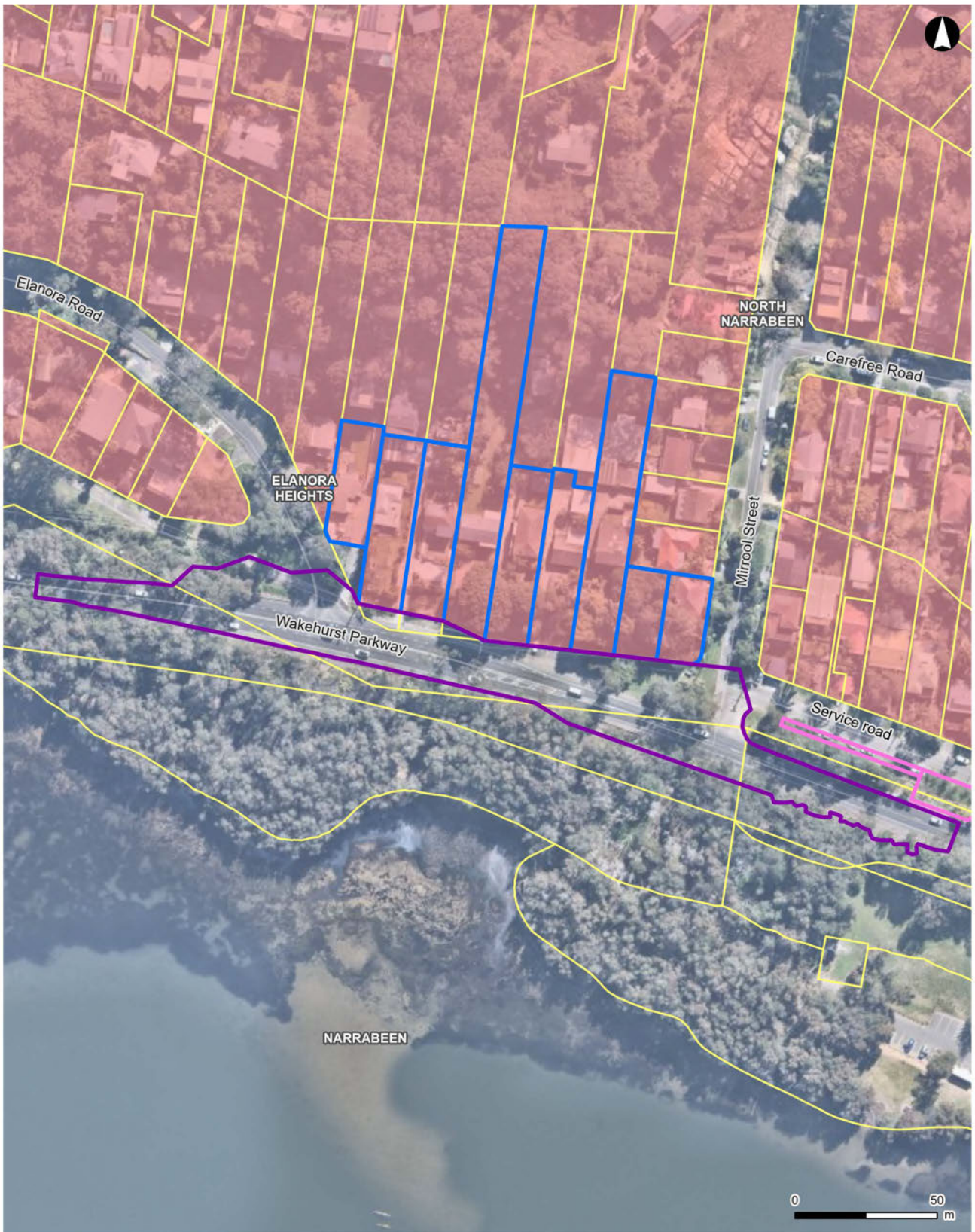
Residents would be notified of any specific temporary disruptions and impacts to property access at least five business days in advance and temporary access arrangements would be provided following consultation. The construction work in this area would largely consist of night work, in order to minimise impact on property access to residents. All access from private properties would be re-established across the widened road verge once construction is completed.

Pedestrian access is to be maintained at all times, unless otherwise agreed with the landowner.

##### Construction compounds

CC3 is adjacent to a gate providing access to the C3 SYD church. Similarly, CC4 is adjacent to a gate providing access to the Oxford Falls Grammar school oval.

Access to both gates would be maintained but closed off during construction.



**Legend**

- Proposed compound site
- Proposal area
- Properties surrounding the proposal
- Residential land use lots near the proposal



1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Neamap 2022



Figure 6-34, Properties within the vicinity of the proposal - Wakehurst Parkway between Elanora Road and Mirrool Street

**Operation**

**Intersection performance**

Operation of the proposal would have a beneficial impact on traffic capacity and traffic performance. The proposed improvements would reduce delays and improve safety for motorists travelling on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road.

By extending the added southbound kerbside lane to Trefoil Creek in the proposed design to meet the existing duplication on the approach to Frenchs Forest Road, the added southbound kerbside lane is continuous from Dreadnought Road intersection to Frenchs Forest Road intersection, and would improve traffic capacity substantially.

The proposal includes a right turn slip lane from Wakehurst Parkway southbound to Oxford Falls Road and improves the horizontal alignment and sight distance on the approach to this intersection. This addresses the existing issues in relation to a lack of overtaking lanes and the constrained sight distance, improving traffic capacity and safety of the road.

The provision of road widening at the Mirrool Street intersection allows vehicles travelling south on Wakehurst Parkway to safely pass a vehicle stopped to turn right at the intersection. This similarly, improves traffic capacity and safety for vehicles travelling through this area.

Table 6-37 provides a comparison of the intersection performance with and without the proposal in the future year scenarios 2026 and 2046 with the existing 2023 conditions.

**Table 6-37: Level of service for key intersections along Wakehurst Parkway in 2023, 2026 and 2046 with and without the proposal**

Intersections	Control	2023 (without the proposal)		2026 (without the proposal)		2026 (with the proposal)		2046 (without the proposal)		2046 (with the proposal)	
		Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS
<b>AM peak hour</b>											
Wakehurst Parkway / Dreadnought Road	Upgraded traffic signals	78	F	97	F	26	B	120	F	39	C
Wakehurst Parkway / Oxford Falls Road	Stop sign	24	B	24	B	4	A	29	C	12	A
Wakehurst Parkway / Elanora Road	Give Way	12	A	22	B	21	B	45	D	30	C
Wakehurst Parkway / Mirrool Street	Give Way	1	A	1	A	1	A	2	A	1	A
Wakehurst Parkway / service road (near Palm Terrace)	Give Way	1	A	1	A	1	A	3	A	2	A
<b>PM peak hour</b>											
Wakehurst Parkway / Dreadnought Road	Upgraded traffic signals	85	F	102	F	21	B	132	F	22	B
Wakehurst Parkway / Oxford Falls Road	Stop sign	17	B	18	B	6	A	38	C	27	B



Intersections	Control	2023 (without the proposal)		2026 (without the proposal)		2026 (with the proposal)		2046 (without the proposal)		2046 (with the proposal)	
		Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS	Average delay (sec)	LoS
Wakehurst Parkway / Elanora Road	Give Way	12	A	13	A	5	A	35	C	26	B
Wakehurst Parkway / Mirrool Street	Give Way	1	A	2	A	1	A	2	A	1	A
Wakehurst Parkway / service road (near Palm Terrace)	Give Way	1	A	2	A	1	A	2	A	1	A

The proposal would improve the LoS at Dreadnought Road intersection through the provision of a dedicated southbound through lane and southbound left turn slip lane onto Dreadnought Road. Permitting through traffic in the existing northbound left-turn lane at the intersection and the upgrade of traffic signals also contribute to an improvement in the LoS. Modelling shows that the average delay would decrease in the order of 39 seconds in AM and 63 seconds in PM future peak periods (2046) when compared to the do-nothing option (2023).

Traffic performance at Oxford Falls Road intersection would be improved through the provision of a right turn lane for southbound motorists and an accompanying through lane to add capacity and reduce queuing. In 2046, delays at Oxford Falls Road intersection would be improved in the AM peak but eventually worsened in the PM peak.

At the Elanora Road intersection, there are an increase in delays between 2023 and 2046 and a reduction in LoS (A to C in the AM peak period and A to B in the PM peak period). However, the improvement in safety at the intersection provides justification to this decrease. Additionally, the proposal would improve the broader network performance of Wakehurst Parkway as outlined below.

At the Mirrool Street intersection, the provision of a passing lane for southbound motorists similarly adds capacity and reduces queuing on Wakehurst Parkway. A dedicated left turn bay at this intersection allows vehicles to decelerate and turn into Mirrool Street without impeding the flow of traffic northbound on Wakehurst Parkway. The intersection improvements at Elanora Road, Mirrool Street and Wakehurst Parkway service road (near Palm Terrace) would provide adequate capacity and a LoS C or better in 2026 and 2046.

#### Broader network performance

Table 6-38 shows broader network performance with the proposal in 2026 and 2046. Network performance data without the proposal is shown for comparison.

Table 6-38: Future network performance with and without proposal in 2026 and 2046

Time Period	2026			2046		
	Base case (without proposal)	Project case (with proposal)	% change	Base case (without proposal)	Project case (with proposal)	% change
<b>AM peak one hour</b>						
Total trips (vehicles)	3,289	3,278		3,751	3,662	
Latent demand (vehicles)	20	1		165	114	
% Unreleased demand	0.62%	0.02%		4.40%	3.10%	
Total Vehicle Hours Travelled (VHT)	443	398	-10%	670	451	-33%
Total Vehicle Kilometres Travelled (VKT)	20,815	20,876	0.3%	21,041	22,364	6%
Average network speed (km/h)	47	52		31	50	
Stops	11,131	6,199	-44%	35,653	8,644	-76%

Time Period	2026			2046		
	Base case (without proposal)	Project case (with proposal)	% change	Base case (without proposal)	Project case (with proposal)	% change
<b>PM peak one hour</b>						
Total trips (vehicles)	3,291	3,297		3,697	3,586	
Latent demand (vehicles)	0	0		90	0	
% Unreleased demand	0.01%	0.00%		2.43%	0.00%	
Total Vehicle Hours Travelled (VHT)	428	380	-11%	542	442	-19%
Total Vehicle Kilometres Travelled (VKT)	22,054	21,976	-0.3%	23,970	24,312	1%
Average network speed (km/h)	52	58		44	55	
Stops	7,771	4,075	-48%	18,165	6,503	-64%

Source: VISSIM models

The network performance data shows that proposal would improve traffic performance of the overall road network of Wakehurst Parkway between Frenchs Forest Road and Pittwater Road. In 2026, the proposal would reduce the total Vehicle Hours Travelled (VHT) by up to 10 per cent and number of stops by up to 44 per cent. By 2046, the model shows a reduction of VHT by up to 33 per cent and number of stops by up to 76 per cent during the peak periods.

Table 6-39 shows the average travel times (minutes) for motorists travelling on Wakehurst Parkway between Frenchs Forest Road and Pittwater Road in 2026 and 2046.

Table 6-39: Travel time savings on Wakehurst Parkway in 2026 and 2046

Time Period	Average travel time (minutes)					
	2026			2046		
	Base case (without proposal)	Project case (with proposal)	Change (time savings)	Base case (without proposal)	Project case (with proposal)	Change (time savings)
<b>AM peak one hour</b>						
Northbound	9.2	9.2	0.0	11.9	9.6	2.3
Southbound	12.0	10.5	1.5	16.3	10.6	5.7
<b>PM peak one hour</b>						
Northbound	9.7	9.4	0.3	11.5	9.5	2.0
Southbound	10.2	9.6	0.6	11.4	9.7	1.7

In 2026, the proposal is expected to reduce travel time on Wakehurst Parkway by up to 1.5 minutes in the AM peak (southbound) and up to 0.6 minutes in the PM peak (northbound). By 2046, the travel time reduction is estimated to be up to 5.7 minutes in the AM peak (southbound) and up to 2 minutes in the PM peak (northbound).

Overall, the proposal would increase lane capacity and improve the operation of intersections for vehicles traveling north and south along Wakehurst Parkway. The proposed upgrades would address capacity issues at key intersections along Wakehurst Parkway and contribute to improved accessibility for the local community. Notably, the proposal would improve access to the local communities of Oxford Falls and Elanora Heights.

### Crashes

The proposal would minimise the risk of the prevailing historical crash types along the proposal by:

- easing congestion, installing additional turning bays and increasing turning bay capacity which would reduce the likelihood of rear end crashes and other crashes between vehicles travelling in the same direction
- implementing signalised pedestrian crossings and pedestrian islands which would reduce the likelihood of pedestrians being struck by vehicles
- improving sight lines and geometry at intersections, as well as upgrading signals at Dreadnought intersection to provide fully controlled right turn phases, to reduce the likelihood of opposing direction crashes.

### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

The provision of continuous southbound lanes on Wakehurst Parkway from Oxford Falls Road to Frenchs Forest Road would improve traffic capacity substantially by removing merge and diverge decision points for drivers, and in turn, reduces vehicle queuing and the associated risks of rear-end crashes and head-on collisions, the prevailing crash type.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

The provision of a left-turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road allows for a clear delineation of movement for through traffic and turning traffic and improves the horizontal alignment of the road, improving safety for vehicles travelling through the intersection. The extension of the dedicated right-turning lane on Wakehurst Parkway onto Dreadnought Road also improves safety through improvement in sight lines.

The provision of a right turn slip lane from Wakehurst Parkway southbound to Oxford Falls Road improves the horizontal alignment and sight lines on the approach to this intersection. This addresses the existing issues of a lack of passing space for through traffic, the constrained sight lines and poor horizontal alignment of the road, improving traffic capacity and road safety.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

The provision of road widening at the Mirrool Street intersection allows vehicles travelling south on Wakehurst Parkway to safely pass a vehicle stopped to turn right at the intersection, improving traffic capacity and safety. The improvement of sight lines also improves safety.

Vehicles entering Wakehurst Parkway from Elanora Road would also benefit from improved sight lines through moving the give way linemarking forward at Elanora Road. By banning right turn movements into and out of the service lane near Palm Terrace, there are fewer incidences of queuing and improved safety and efficiency along Wakehurst Parkway.

#### **Public transport**

The proposal would improve bus travel time reliability due to reduced congestion and an improvement in the broader network on Wakehurst Parkway. In 2026, the proposal would reduce network travel time by up to 1.5 minutes and number of stops by up to 44 per cent. By 2046, modelling shows network travel time reductions by up to 5.7 minutes and number of stops by up to 76 per cent during the peak periods. The improvement in travel times in the broader network along Wakehurst Parkway would benefit the movement of busses through the proposal area.

The proposal also includes addition of two dedicated bus stops on Wakehurst Parkway, east of Dreadnought Road in both the northbound and southbound direction to provide better service to commuters and students, staff and visitors to nearby schools, school playing fields and the C3 SYD church. Combined with footpath construction and signalised pedestrian crossings at Dreadnought Road intersection, this would encourage uptake of public transport for people visiting schools, sport playing fields, and the C3 SYD church in this area. This may reduce the reliance on cars to access these areas and associated vehicle movements along Wakehurst Parkway, and improve linkages from the Oxford Falls area to Northern Beaches Hospital, Frenchs Forest and the beaches located in North Narrabeen.

The addition of an extra stop for bus 155 route would add time to this route, however, the provision of this public transport service where there previously was none between Frenchs Forest Road and Pittwater Road justifies the impact. The impact would also be balanced by the improvement in travel times resulting from the proposal.

#### **Pedestrians**

The proposal would improve safety for pedestrians along Wakehurst Parkway. In the southern package, footpath construction between the proposed bus stops facilitate safer pedestrian movements to and from public transport, and improve accessibility of the area. In the northern package, footpath construction would improve pedestrian connectivity for residents between Elanora Road and Mirrool Street.

Upgraded traffic signals at Dreadnought Road intersection would provide signalised pedestrian crossings on all approaches to the intersection. The proposal also provides a signalised pedestrian crossing on the left turn slip lane onto Dreadnought Road.

These changes to the pedestrian network would improve connectivity and provide safe access to bus stops.

#### **Cyclists**

Shoulder widening, while primarily included for motorist safety, would also improve on-road cycling connectivity between Trefoil Creek to Oxford Falls Road. In comparison to the existing conditions, on-road cycling facilities are limited, forcing cyclists to ride in the lane with vehicles.

The proposal would require the permanent removal of the on-road cycleway located on Wakehurst Parkway on the northbound approach to Dreadnought Road intersection. However, the proposal would provide a shoulder on the

northbound approach to the intersection to facilitate on-road cycling. Cyclist pavement markings would be provided at the intersection only, along with a stop line placed in the northbound shoulder offset slightly ahead of the stop line for vehicles. This ensures that cyclists waiting at the stop line are clearly visible to vehicles on Wakehurst Parkway on approach to Dreadnought Road intersection, improving safety for cyclists.

The proposal also provides a shoulder to the southbound lane on Wakehurst Parkway from Trefoil Creek to Dreadnought Road, and to the northbound and southbound lanes between Dreadnought Road to Oxford Falls Road. The southbound shoulder extends into an on-road cycle lane on the approach to Dreadnought Road intersection, ending at the intersection.

#### Property access

The operation of the proposal would ban right turn movements into or out of the service road (about 380 metres east of Mirrool Street, near Palm Terrace) at the intersection with Wakehurst Parkway, redirecting all right turn movements to Mirrool Street. This would alter access to properties located on the service road, increasing the distance for vehicles from 400 metres (minimum) to 800 metres (maximum). However, the required detour for vehicles would have a minimal increase in travel time of about one minute. The proposed left turn bay on Wakehurst Parkway northbound would provide access to properties on the service road. The proposal would improve the safety and reduce conflict between turning traffic and through traffic on Wakehurst Parkway at this intersection as assessed earlier in this section.

### 6.6.4 Safeguards and management measures

Table 6-40: Traffic and transport safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Transport <i>Traffic Control at Work Sites Manual</i> (Transport for NSW, 2022) and <i>QA Specification G10 Control of Traffic</i> (Transport for NSW, 2008). The TMP will include:</p> <ul style="list-style-type: none"> <li>confirmation of haulage routes</li> <li>measures to maintain access to local roads and properties</li> <li>site-specific traffic control measures (including signage) to manage and regulate traffic movement</li> <li>measures to maintain pedestrian and cyclist access as per existing provisions</li> <li>requirements and methods to consult and inform the local community of impacts on the local road network</li> <li>access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads</li> <li>a response plan for any construction traffic incident</li> <li>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</li> <li>monitoring, review and amendment mechanisms.</li> </ul>	Contractor	Pre-construction and Construction
Traffic and transport	<p>Property access will be maintained where possible during construction including access to commercial premises and residences. Where property access would have to be temporarily disrupted during construction:</p> <ul style="list-style-type: none"> <li>property owners will be notified at five business days prior to the access closure</li> </ul>	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	<ul style="list-style-type: none"> <li>alternative access will be provided if available</li> <li>access closure will be minimised and access will be returned to the property owners as soon as possible</li> </ul>		
Traffic and transport	<p>Pedestrian and cyclist access is to be maintained throughout construction to the similar extent of existing configuration.</p> <p>Provision of signage outlining the pedestrian and cyclist diversion routes would be displayed during construction.</p> <p>There would be advance notification of any construction works that would affect pedestrians and cyclists.</p>	Contractor	Construction

## 6.7 Noise and vibration

### 6.7.1 Methodology

A Noise and Vibration Impact Assessment (NVIA) has been prepared to assess the existing environment and potential noise and vibration impacts from construction and operation of the proposal. The NVIA is provided in Appendix F.

The approach for assessing noise and vibration impacts in the NVIA was to:

- establish existing background noise levels in the vicinity of the proposal
- determine residential and non-residential sensitive receivers as defined in the Interim Construction Noise Guideline (ICNG) (DECC, 2009)
- review the construction methodology and identify potential construction plant and equipment
- model and assess potential construction noise impacts
- model and assess potential construction vibration impacts
- model and assess potential operational noise impacts
- provide mitigation measures to minimise noise and vibration impacts at receivers.

The NVIA utilised the following sources in preparing the assessment:

- *Construction Noise and Vibration Guideline* (CNVG) (Transport for NSW, Construction Noise and Vibration Guideline, 2022)
- *Road Noise Criteria Guideline* (RCNG) (Transport for NSW, 2022)
- *Application Notes for the Road Noise Criteria Guideline* (Transport for NSW, 2022)
- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)
- *Assessing Vibration: a technical guideline* (DEC, 2006)
- *Road Noise Policy* (RNP) (DECCW, 2011)
- *Construction Noise Estimator Tool*
- British Standard BS 7385-2:1993 *Evaluation and measurement for vibration in buildings: Guide for measurement of vibration and evaluation of their effects on buildings* (British Standard, BS 7385-2:1993 Evaluation and measurement for vibration in buildings: Guide for measurement of vibration and evaluation of their effects on buildings, 1993)
- British Standard BS 6472-1992 *Guide to Evaluation of Human Exposure to Vibration in Buildings*
- German standard *DIN4150-3:2016 Vibrations in buildings – Part 3: Effects on structures*

- Australian Standard AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (Standards Australia, AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites, 2010)
- *Assessing Vibration: A Technical Guideline* (DEC, 2006)
- meteorological data from the Bureau of Meteorology's Terry Hills Automatic Weather Station (number 66059), located approximately six kilometres northwest of the proposal site.

The NVIA study area considered the proposal in two sections with a 600 metre buffer:

- the northern section: Wakehurst Parkway of Elanora Road to Mirrool Street
- the southern section: Wakehurst Parkway from Trefoil Creek to Dreadnought Road, and Dreadnought Road to Oxford Falls Road.

#### Background noise monitoring

Noise loggers were deployed for a total period of eight days at two noise monitoring locations within the study area:

- NM1: 76 Wakehurst Parkway, North Narrabeen. This location is adjacent to the proposed work for the northern section Elanora Road to Mirrool Street
- NM2: 2 Dreadnought Road, Oxford Falls. This location is adjacent to the proposed work for the southern section at Dreadnought Road and Oxford Falls Road.

The location of these two noise loggers is shown on Figure 6-35 and Figure 6-36. Background noise monitoring results from NM1 have been used to inform the noise area categories and noise management levels.

#### Noise area categories

The Transport *Construction Noise Estimator Tool* uses noise area categories to represent the noise environment around a proposal and assess the potential impacts. Representative noise area categories have been selected based on the measured background noise monitoring results (refer to Table 6-55).

The noise area categories for 'day' 'evening' and 'night' levels were then categorised based on the CNVG and are outlined in Table 6-41.

Table 6-41: Assessment noise area categories

Noise area category	Description of typical environment	Average background A-weighted sound pressure level, L <sub>A90</sub>		
		Day	Evening	Night
R1	Areas with negligible transportation	40	35	30
R2	Areas with low density transportation	45	40	35

#### Noise management levels

Receivers would be considered noise impacted during construction when the predicted noise levels are above their respective Noise Management Levels (NMLs) as defined in the ICNG (DECC, 2009). NMLs for difference receivers are identified in Section 6.7.2. For non-residential receivers, such as the adjacent Oxford Falls Grammar School and C3 SYD church, these NML would only apply while the receivers are operating. In general, non-residential impacts would be limited to the day-time hours when the educational institution and place of worship are operating.

### Construction scenarios

Construction scenarios and their proposed timing for work are summarised in Table 6-42. These scenarios have been created based on the construction equipment likely to be operating simultaneously at any given time. Whilst these scenarios are unlikely to occur in reality, they assume a ‘worst-case’ scenario, providing a conservative and robust assessment. This enables the identification of any and all potential noise impacts as well as appropriate mitigation and management measures.

Table 6-42: Construction scenarios

Scenario ID	Description	Standard hours	Out of hours work		
			Day	Evening	Night
CS01	Site establishment. Installing construction boundary hoardings/ fences and traffic barriers	X	X	X	X
CS02	Utility, property, service adjustment. Adjustment of property boundaries (where required); relocation of services	X	X	X	X
CS03	Corridor clearing. General land clearing, tree and stump removal, topsoil stripping, loading	X	X	X	X
CS04	Retaining walls. Construction of retaining walls	X	X	X	X
CS05	Bulk earthworks. Formation of road alignment. Excavation of soil and rock, hammering/rock breaking, drilling, loading, haulage, compaction of fill areas, grading	X	X	X	X
CS06	Paving / asphaltting (including concrete sawing). Placement of surface material, saw cutting	X	X	X	X
CS07	Road furniture installation. Signposting and linemarking	X	X	X	X
CC	Compounds. Deliveries, plant and equipment, maintenance, office areas, storage areas	X	X	X	X

### Sound power levels

Sound power levels of construction equipment has been sourced from the *Construction Noise and Vibration Guideline* (Transport for NSW, 2016).

The scenario sound power levels are based on the loudest two items of equipment operating simultaneously. The operation for each equipment has been corrected based on the expected operation during a worst-case 15 minute period.

A 5 decibels (dBA) adjustment to the scenario sound power levels have been applied to activities that contain special audible characteristics that can be particularly annoying and disturbing. These activities are outlined in the ICNG (DECC, 2009) as:

- the use of power saws, such as cutting masonry, concrete, road pavement or steel work
- grinding metal, concrete or masonry
- vibratory rolling
- bitumen milling or profiling
- jackhammering.

The sound power levels for construction equipment used during each scenario are summarised in Table 4-4 of the NVIA (Appendix F).

### Construction noise impacts

The following noise modelling assumptions were made:

- a noise area category R1 has been selected for the northern section
- the area ground type for the northern work is assumed to be developed settlements (urban and suburban)
- a noise category R2 has been selected for the southern section

- the area ground type for the southern section is assumed to be undeveloped green fields, rural areas with isolated dwellings
- noise monitoring results from NM1 (76 Wakehurst Parkway, North Narrabeen) have been used to inform the noise area category and noise management levels for the northern section (noise area category R1)
- noise monitoring results from NM2 (2 Dreadnought Road, Oxford Falls) have been used to inform the noise area category and noise management levels for the southern section (noise area category R2)
- no line of sight (behind solid barrier) has been assumed in determining the distances for noticeable impacts, clearly audible impacts, moderately intrusive impacts. Line of sight has been assumed in determining the distances for highly intrusive impacts, and highly noise affected distances.

The construction noise assessment has been prepared for a 'worst-case' scenario, being outside of standard hours (i.e. night time) and with construction activities that generate the greatest amount of noise (bulk earthworks during construction scenario CS05).

#### **Construction traffic noise**

The proposal would need to provide mitigation if the construction vehicles for the proposal generate a 2 dB(A) increase based on the existing traffic volumes. This is in accordance with the RNP (DEECCW, 2011) which states that an increase of up to 2 dB(A) represents a minor impact that is considered barely perceptible to the average person.

#### **Operational noise assessment**

The RNCG (TfNSW, 2022) outlines the methodology for the assessment of road traffic noise from public roads on noise sensitive receivers. This methodology is outlined in the following section.

The operational noise criteria applied depends on the type of road project as defined in the RNCG. These road projects are new, redeveloped and minor works. In the context of the assessment of noise impact, the proposal is considered 'minor works' as the works involve additional lanes and left-turn slip lanes, realignment of existing lanes, additional and realignment of pedestrian crossings with the primary focus on improving safety.

The RNCG proposes that further assessment and potential mitigation is required where the minor works increase noise levels by more than 2.0 dBA relative to the existing noise levels at the worst affected receiver. This is in accordance with the RNP (DEECCW, 2011) which states that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Therefore, if road noise levels are predicted to increase by more than 2.0 dB, further assessment and mitigation pending final assessment outcomes should be applied.

#### **Construction vibration**

Vibration from surface construction plant and equipment was assessed with consideration to *Assessing Vibration: A Technical Guideline* (DEC, 2006), British Standard *BS 6472-1992 Guide to Evaluation of Human Exposure to Vibration in Buildings*, British Standard *BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in buildings* and German Standard *DIN4150-3:2016 Vibrations in buildings – Part 3: Effects on structures*.

Construction and demolition work have the potential to impact human comfort and / or cause structural damage to buildings. The 'worst-case' potential vibration inducing activities during construction have been used to provide a conservative assessment.

Safe working buffer distances to comply with the human comfort, cosmetic damage and heritage structural damage criteria were taken from the CNVG and are provided in Section 6.7.2. The heritage structural damage criteria only applies in the event that the building is found to be structurally unsafe. Heritage items near the proposal have been conservatively assumed to be structurally unsound in order to assess the potential 'worst-case' scenario.

#### **Non-residential noise management**

Non-residential receivers would be considered noise impacted during construction when the predicted noise levels are above the construction NML, and the non-residential receivers are in use. In general, these impacts would be limited to the day-time hours when commercial premises and educational institutes are operating.



**Traffic data**

Existing heavy vehicle traffic counts along Wakehurst Parkway are sourced from traffic counts conducted in February 2023. The additional vehicles required to generate a 2 dB increase based on the existing traffic volumes are listed in Table 6-55. Additionally, a high level estimate of construction traffic volumes is included in Table 6-43.

Table 6-43: Construction traffic recommendations

Location	Existing heavy vehicle traffic per day	Additional heavy vehicles required per day for a 2 dB increase	Estimated heavy vehicle construction traffic volumes per day
Wakehurst Parkway between Frenches Forest Road and Dreadnought Road	1,960	1,137	40
Wakehurst Parkway between Caley Trail and Elanora Road	2,030	1,177	20

**6.7.2 Assessment criteria**

**Residential noise management levels**

The ICNG (DECC, 2009) provides a methodology to determine the NML for residential receivers, and is based on the background noise levels recorded for the proposal at NM1 and NM2, as outlined in Table 6-44. The residential NMLs for each assessment period (day, evening and night), including sleep disturbance triggers, are outlined in Table 6-45.

Table 6-44: Noise management levels for residential receivers

Time of day	Noise management level, $L_{Aeq(15\text{ min})}$	Application notes
Recommended standard hours	<b>Noise affected:</b> RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise: <ul style="list-style-type: none"> <li>where the predicted or measured <math>L_{Aeq(15\text{ min})}</math> is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level</li> <li>the proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.</li> </ul>
	<b>Highly noise affected:</b> 75 dBA	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: <ul style="list-style-type: none"> <li>Times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences)</li> <li>If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ul>
Outside recommended standard hours	<b>Noise affected:</b> RBL + 5 dBA	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should consult with the community.

Table 6-45: Residential NMLs for each assessment period, dBA

Area of work	Standard construction hours	Outside standard construction hours (dBA)			
		Day	Evening	Night	Sleep disturbance
R1	50	45	40	35	65
R2	55	50	45	40	65

Note 1: Based on an internal noise level of 55 dBA. A 10 dBA addition has been applied to the internal noise level to account for a typical noise reduction through an open window.

#### Additional mitigation measures

Where receivers exceed NMLs for an assessment period, the CNVG (Transport for NSW, 2022) provides additional mitigation measures, which are outlined in Table 6-46.

Table 6-46: Triggers for additional noise mitigation measures

Time period	Perception	dBA above RBL	dBA above NML	Additional mitigation measure
All hours	75 dBA or greater	-	-	N, V, RO
Standard hours: Mon-Fri 7am to 6pm, Sat 8am to 1pm	Noticeable	5 to 10	0	-
	Clearly audible	11 to 20	1 to 10	-
	Moderately intrusive	21 to 31	11 to 20	N, V
	Highly intrusive	>30	>20	N, V
OOHW Period 1: Mon-Fri 6pm to 10pm, Sat 7am to 8am and 1pm to 10pm, Sun/Public Holiday 8am to 6pm	Noticeable	5 to 10	5 or lower	-
	Clearly audible	11 to 20	6 to 15	N, R1, DR
	Moderately intrusive	21 to 31	16 to 25	V, N, R1, DR
	Highly intrusive	>30	>25	V, IB, N, R1, DR, SN
OOHW Period 2: Mon-Fri 10pm to 7am, Sat 10pm to 8am, Sun/Public Holiday 6pm to 7am	Noticeable	5 to 10	5 or lower	N
	Clearly audible	11 to 20	6 to 15	V, N, R2, DR
	Moderately intrusive	21 to 31	16 to 25	V, IB, N, SN, R2, DR
	Highly intrusive	>30	>25	AA, V, IB, N, SN, R2, DR

**Non-residential noise management levels**

The following NMLs for non-residential receivers in Table 6-47 only apply when the property is in use.

Table 6-47: Noise management levels for other sensitive land uses

Sensitive land use	Noise management level, $L_{Aeq(15\text{ min})}$ dBA
Commercial premises	70 (external)
Industrial	75 (external)
Educational institutes	55 (external) <sup>1</sup>
Places of worship	55 (external) <sup>1</sup>
Active recreation	65 (external)

Note 1: Based on an internal noise level of 55 dBA. A 10 dBA addition has been applied to the internal noise level to account for a typical noise reduction through an open window.

**Construction vibration criteria**

Humans can detect vibration at levels well below those capable of causing damage to a building. The NVIA has adopted intermittent vibration limits for human comfort, based on the British Standard BS 6472-1992 as outlined in Table 6-48.

Table 6-48: Human comfort intermittent vibration limits

Receiver type	Period	Intermittent vibration dose value ( $m/s^{1.75}$ )	
		Preferred value	Maximum value
Residential	Day (7 am to 10 pm)	0.2	0.4
	Night (10 pm to 7 am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

The vibration limit criteria for general structures (British Standard, *BS 7385-2:1993 Evaluation and measurement for vibration in buildings: Guide for measurement of vibration and evaluation of their effects on buildings, 1993*) is provided in Table 6-49. Vibration sensitive structures such as heritage buildings are not assumed to be more sensitive to vibration unless

they are found to be structurally unsound. Unless indicated otherwise (by inspection), the criteria set out in Table 6-49 would be adopted for any heritage items within vibration buffer areas of the proposal.

Table 6-49: Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures. Residential or light commercial type building	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Safe working buffer distances to comply with the human comfort, cosmetic damage and heritage structural damage criteria were taken from the CNVG and are provided in Table 6-50. Cosmetic damage for light frames structures are based on British Standard BS 6472-1992 *Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)* (British Standard, 1992). Cosmetic damage to heritage and other sensitive structures are based on German standard *DIN4150-3:2016 Vibrations in buildings – Part 3: Effects on structures* (German Standard, 2016).

Table 6-50: Vibration safe working buffer distances

Plant Item	Cosmetic damage		Human response (EPA's vibration guideline)
	Light-framed structures (BS 6472-1992)	Heritage and other sensitive structures (DIN 4150-3)	
Vibratory roller (1-2 tonnes)	5 m	14 m	15 m to 20 m
Vibratory roller (2-4 tonnes)	6 m	16 m	20 m
Vibratory roller (4-6 tonnes)	12 m	33 m	40 m
Vibratory roller (7-13 tonnes)	15 m	41 m	100 m
Vibratory roller (13-18 tonnes)	20 m	54 m	100 m
Vibratory roller (>18 tonnes)	25 m	68 m	100 m
Pile Boring	2 m (nominal)	5 m	4 m

The predominant vibration for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers and excavators occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s.

#### Construction traffic

Existing heavy vehicle traffic counts along Wakehurst Parkway were sourced from traffic counts conducted in February 2023. The RNP (DECCW, 2011) states that any increase in the total noise level at existing residences and other sensitive land uses affected by traffic generation on existing roads should be limited to 2 dBA above current levels. This limit only applies when the noise level without the development is within 2 dBA or exceeds the road traffic noise criterion provided in the RNP. The additional vehicles required to generate a 2 dB increase based on the existing traffic volumes are listed in Table 6-51.

Table 6-51: Construction traffic noise

Location	Existing heavy vehicle traffic per day	Additional heavy vehicles movements* required per day for a 2 dB increase
Wakehurst Parkway between Frenches Forest Road and Dreadnought Road	1,960	1,137
Wakehurst Parkway between Caley Trail and Elanora Road	2,030	1,177

\* For planning purposes, a vehicle travelling in and out from the site is considered as two vehicle movements

### Operational noise criteria

The RNCG (Transport for NSW, 2022) outlines the methodology for assessment of road traffic noise from public roads on noise sensitive receivers. The operational noise criteria is dependent on the type of road project as defined in the RNCG. Based on the RNCG, the proposal is considered minor works as the work:

- involves additional lanes and left-turn slip lanes, realignment of existing lanes, additional and realignment of pedestrian crossings with the primary focus on improving safety.

Minor works road projects do not require an assessment for road traffic noise 10 years after project opening. Assessment during the opening year is undertaken to determine the potential for noise issues arising from opening of the road project. These issues can assist in determining the potential community reaction to the changes in noise level. The assessment years for the operational noise assessment are provided in Table 6-52.

Table 6-52: Assessment timeframes

Scenario	Description	Adopted year for assessment
Existing	The current year	2023
Future	The year of the project road opening	2026

Where the road traffic noise levels are predicted to increase above 2 dBA, the criteria outlined in Table 6-53 apply. Road traffic noise assessment criteria for non-residential receivers have not been provided as the most affected receivers are residential.

Table 6-53: Road traffic noise assessment criteria

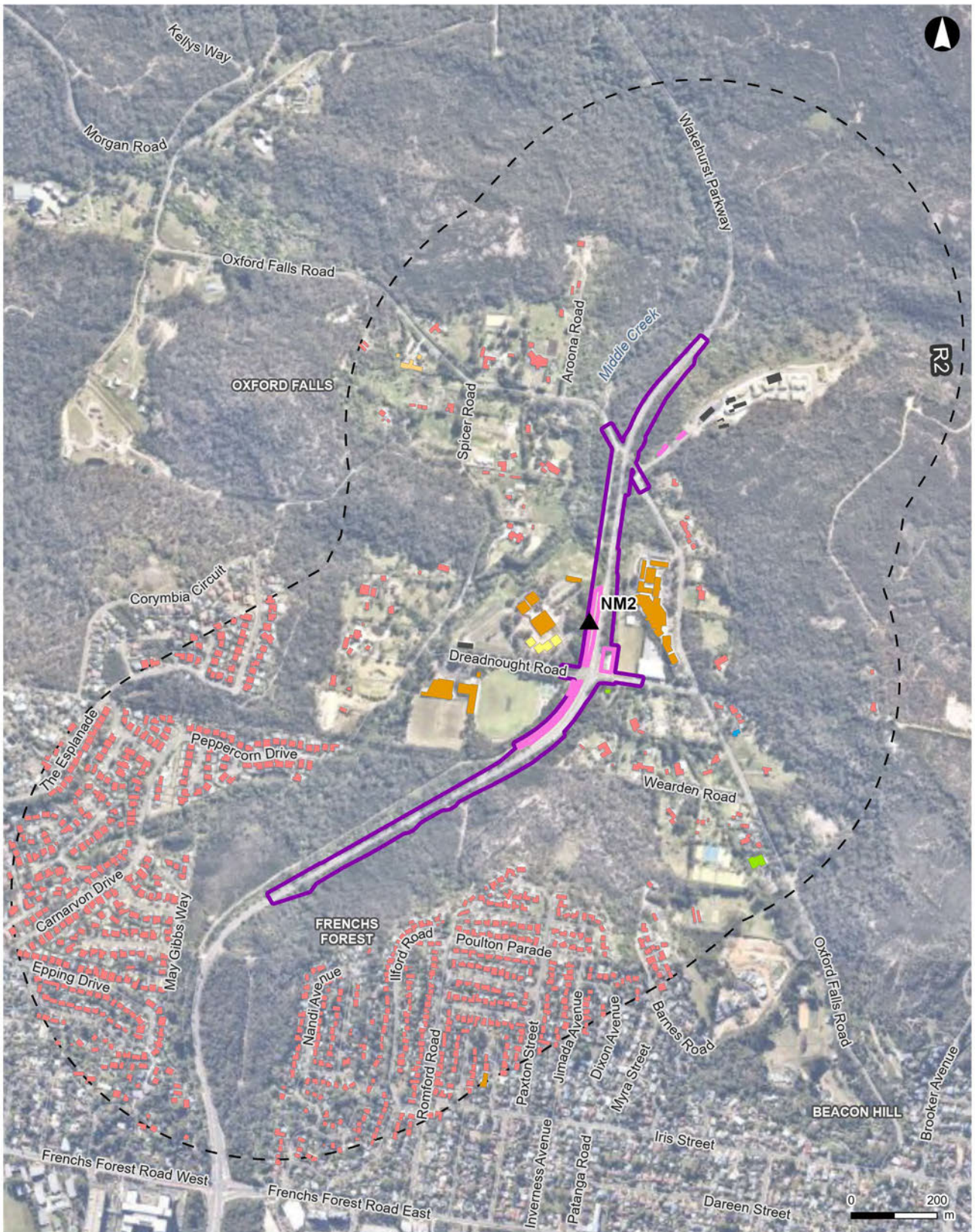
Road category	Type of project/land use	Receiver type	Assessment criteria, dBA	
			Day 7 am to 10 pm	Night 10 pm to 7 am
Arterial / sub-arterial roads	Existing residences affected by noise from redevelopment of existing arterial/sub-arterial roads	Residential	L <sub>Aeq(15 hour)</sub> 60 (external)	L <sub>Aeq(9 hour)</sub> 55 (external)
		School classrooms	L <sub>Aeq(1 hour)</sub> 40 (internal)	-
		Open space (passive use)	L <sub>Aeq(15 hour)</sub> 55 (external)	-

## 6.7.3 Existing environment

### Sensitive receivers

Works in the northern location have the closest proximity to noise sensitive receivers, with many residential receivers fronting Wakehurst Parkway directly (refer to Figure 6-36, which shows the location of sensitive receivers within the northern study area).

Works in the southern location mostly occur around Dreadnought Road and Wakehurst Parkway, with three large education campuses located adjacent the intersection. There are also many residential receivers within 600 metres from Wakehurst Parkway, however they are generally located at a set back from Wakehurst Parkway (refer to Figure 6-35, which shows the location of sensitive receivers within the southern study area).



**Legend**

- |                           |                                   |             |
|---------------------------|-----------------------------------|-------------|
| Proposal area             | Sensitive receivers<br>Child care | Recreation  |
| Proposed compound site    | Commercial                        | Residential |
| Study area                | Educational                       |             |
| Noise monitoring location | Industrial                        |             |
|                           | Place of worship                  |             |



Figure 6-35, Noise sensitive receivers in proximity to Wakehurst Parkway between Trefoil Creek and Oxford Falls Road



**Legend**

- |                           |                                |             |
|---------------------------|--------------------------------|-------------|
| Proposal area             | Sensitive receivers Commercial | Residential |
| Proposed compound site    | Educational                    |             |
| Study area                | Industrial                     |             |
| Noise monitoring location | Place of worship               |             |
|                           | Recreation                     |             |



Figure 6-36, Noise sensitive receivers in proximity to Wakehurst Parkway between Elanora Road and Mirrool Street

1:10,750 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2023



### Non-residential sensitive receivers

The following non-residential sensitive receivers and their typical hours of operation are provided in Table 6-54.

Table 6-54: Non-residential receivers near the proposal boundary

Receiver type	Name	Address	Hours of operation
Educational establishment	Elanora Heights Primary School	43 Elanora Rd, Elanora Heights NSW 2101	Monday to Friday: 8:55 am to 2:55pm
Educational establishment	St Joseph's Primary School	108 Ocean St, Narrabeen NSW 2101	Monday to Friday: 9 am to 3 pm
Religious establishment	Catholic Church of St Joseph	21 Lagoon Street, Narrabeen NSW 2101	Monday to Friday: 7:30 am to 8 pm Saturday: 10 am to 6 pm
Religious establishment	Narrabeen Baptist Church	13 Grenfell Ave, North Narrabeen NSW 2101	Monday to Friday: 9 am to 5 pm Sunday: 9:30 am to 5 pm
Religious establishment	C3 SYD Pentecostal Church and associated Christian College	2 Dreadnought Rd, Oxford Falls NSW 2099	Monday to Friday: 9 am to 5 pm Saturday: 8 am to 6 pm
Educational establishment	St Pius X College playing fields and sporting facilities	1 Dreadnought Rd, Oxford Falls NSW 2099	Monday to Friday: 8 am to 4 pm
Educational establishment	Oxford Falls Grammar school	1078 Oxford Falls Rd, Oxford Falls NSW 2099	Monday to Friday: 8:30 am to 4 pm

### Measured noise levels

The two noise monitoring locations (NM1 and NM2) were used to quantify existing noise levels within the NVIA study area for the rating background levels (Table 6-55) and existing road traffic noise levels (Table 6-56).

Table 6-55: Measured rating background noise levels, dBA

Area ID	Description	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
NM1	76 Wakehurst Parkway, North Narrabeen	52	36	30(27 actual) <sup>1</sup>
NM2	2 Dreadnought road, Oxford Falls	59	40	34

Note 1: The minimum night time background level of 30 dBA is applied for the purposes of defining the criteria.

Table 6-56: Measured road traffic noise levels, dBA

Area ID	Description	Day 7am to 10pm	Night 10pm to 7am
NM1	76 Wakehurst Parkway, North Narrabeen (21 metres to road edge)	64	57
NM2	2 Dreadnought Road, Oxford Falls (22 metres to road edge)	67	60

### Existing traffic levels

Traffic volumes for the 2021 year period was provided by Transport and is provided in the table below.

Table 6-57: Wakehurst Parkway AM—and PM peak one hour traffic volumes - current

Area of Wakehurst Parkway	AM Peak 1-hour (number of vehicles)	PM peak 1-hour (number of vehicles)
North of Frenchs Forest Road	1300	1690
North of Dreadnought Road	1450	1730
North of Oxford Falls Road	1830	1930

Existing heavy vehicle traffic counts along Wakehurst Parkway are sourced from traffic counts conducted in February 2023 (refer to Table 6-58).



Table 6-58: Existing heavy vehicle traffic counts

Location	Existing heavy vehicle traffic count (per week)
Wakehurst Parkway between Frenches Forest Road and Dreadnought Road	1,960
Wakehurst Parkway between Caley Trail and Elanora Road	2,030

## 6.7.4 Potential impacts

### Construction

#### Predicted construction noise levels

Construction noise levels were predicted using the Transport *Construction and Maintenance Noise Estimator Excel Tool*. Results from are considered to be conservative, therefore all exceedances of noise management levels are expected to be captured using this assessment methodology. For each indicative construction scenario, a distance-based assessment has been conducted to provide the distances for different exceedances of the noise management levels.

The construction noise affected distances are predicted to be the greatest during bulk earthwork activities, and followed by corridor clearing. For other construction activities, the noise affected distances are predicted to be lower.

#### Southern section: Wakehurst Parkway at Trefoil Creek to Dreadnought Road, and Dreadnought Road to Oxford Falls Road

Construction activities in this area include vegetation clearing along both the northbound and southbound lanes of Wakehurst Parkway, earthworks to support drainage work and road widening along both sides of Wakehurst Parkway, utility adjustments, rock cutting at Oxford Falls Road to facilitate road widening and creating the rock cutting retaining structure, operation of construction compounds and paving/asphalting with road furniture installation (including signage). The noisiest activity is bulk earthworks followed by corridor clearing. The receivers that would be more highly affected by noise include the education and religious land uses around Dreadnought Road intersection (C3 SYD church and Oxford Falls Grammar School), and residential receivers at 2591 Oxford Falls Road, 33 Dreadnought Road and 1100 Oxford Falls Road.

The construction noise affected distances for the southern section of the proposal is provided in Table 6-59 and Table 6-60. In this section, the following scenarios are predicted to exceed the NMLs at the following distances from the work:

- 105 metres for bulk earthworks and 85 metres for corridor clearing (standard hours)
- 700 metres for bulk earthworks and 605 metres for corridor clearing (night work).

The highly noise affected level is predicted to be exceeded for receivers within 60 metres of bulk earthworks and 45 metres of corridor clearing work.

Figure 6-36 shows the noise contours based on the dBA above the RBL for night work in the southern section. During bulk earthworks and corridor cleaning scenarios, up to two dwellings would be highly noise affected.

#### Northern section: Wakehurst Parkway at Elanora Road to Mirrool Street

Construction activities in this area include vegetation clearing along the southbound lane of Wakehurst Parkway and at the northwestern corner of Mirrool Street intersection, earthworks to support drainage work and road widening, utility adjustments, construction of the retaining structure on the southbound side of Wakehurst Parkway opposite Mirrool Street, operation of construction compounds and paving/asphalting with road furniture installation (including signage). At the entrance to the service lane near Palm Terrace, the only activity would be installing signage to facilitate left-in and left-out movements only. The noisiest activity is bulk earthworks followed by corridor clearing. The receivers that would be more highly affected by noise are located between households at 6 Elanora Road, 7 Elanora Road, 8 Mirrool Street, 61 Carefree Road, and 68 Wakehurst Parkway.

The construction noise affected distances for the northern section of the proposal is provided in Table 6-60. In this section, the following scenarios are predicted to exceed the NMLs at the following distances from the work:

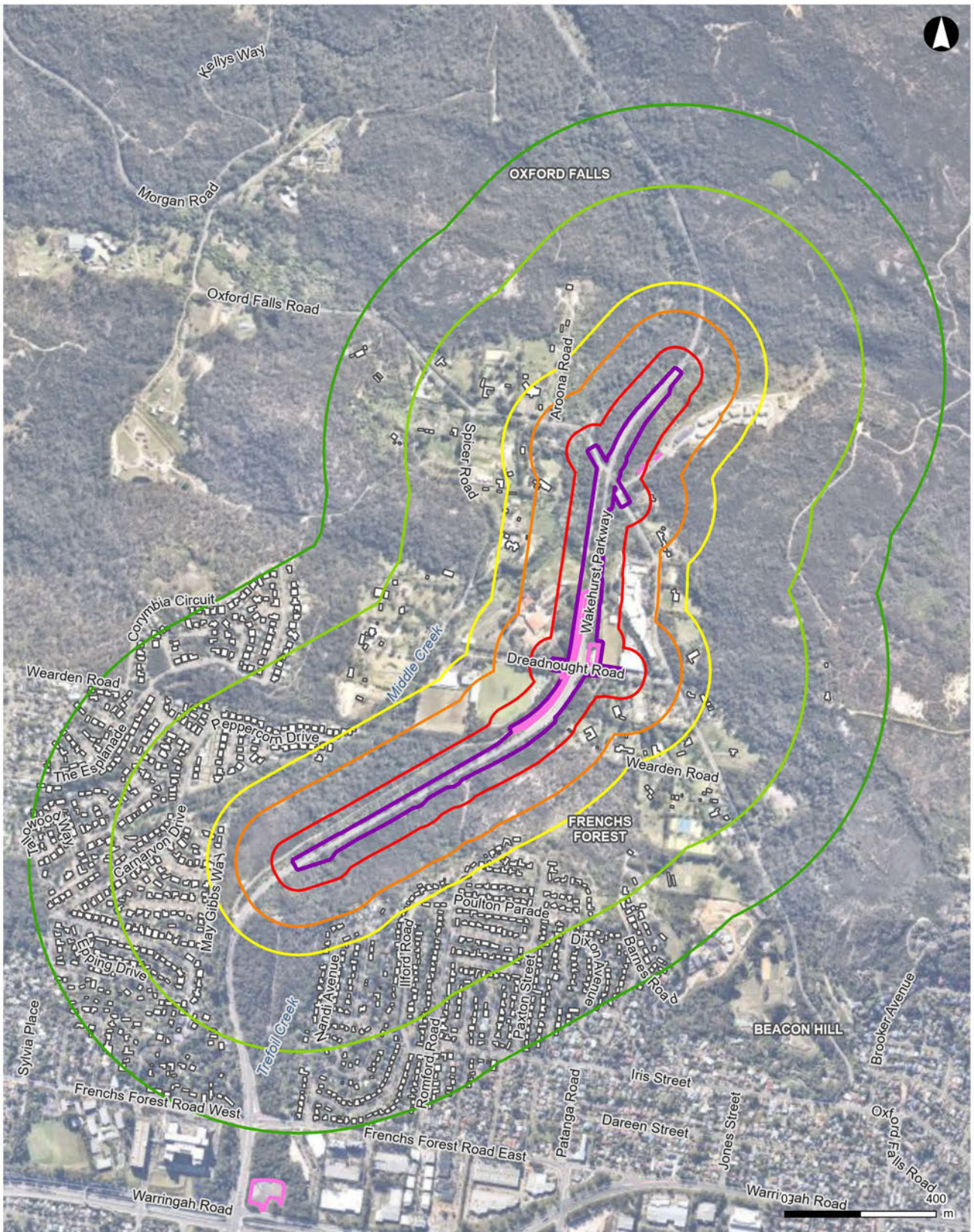
- 180 metres for bulk earthworks and 155 metres for corridor clearing (standard hours)
- 1355 metres for bulk earthworks and 1170 metres for corridor clearing (night work).

The highly noise affected level is predicted to be exceeded for receivers within 50 metres of bulk earthworks and corridor cleaning activities. There are a number of residences located along the northside of Wakehurst Parkway expected to be within this distance to construction work.

Figure 6-38 shows the noise contours based on the dBA above the RBL for night works in the northern section. During bulk earthworks, up to 41 dwellings would be highly noise affected.

#### Sleep disturbance impacts

The greatest sleep disturbance impacts are predicted to occur during asphaltting / paving construction activities and retaining wall construction activities, with an affected distance of 330 metres. Figure 6-39 and Figure 6-40 shows residential receivers within this distance.



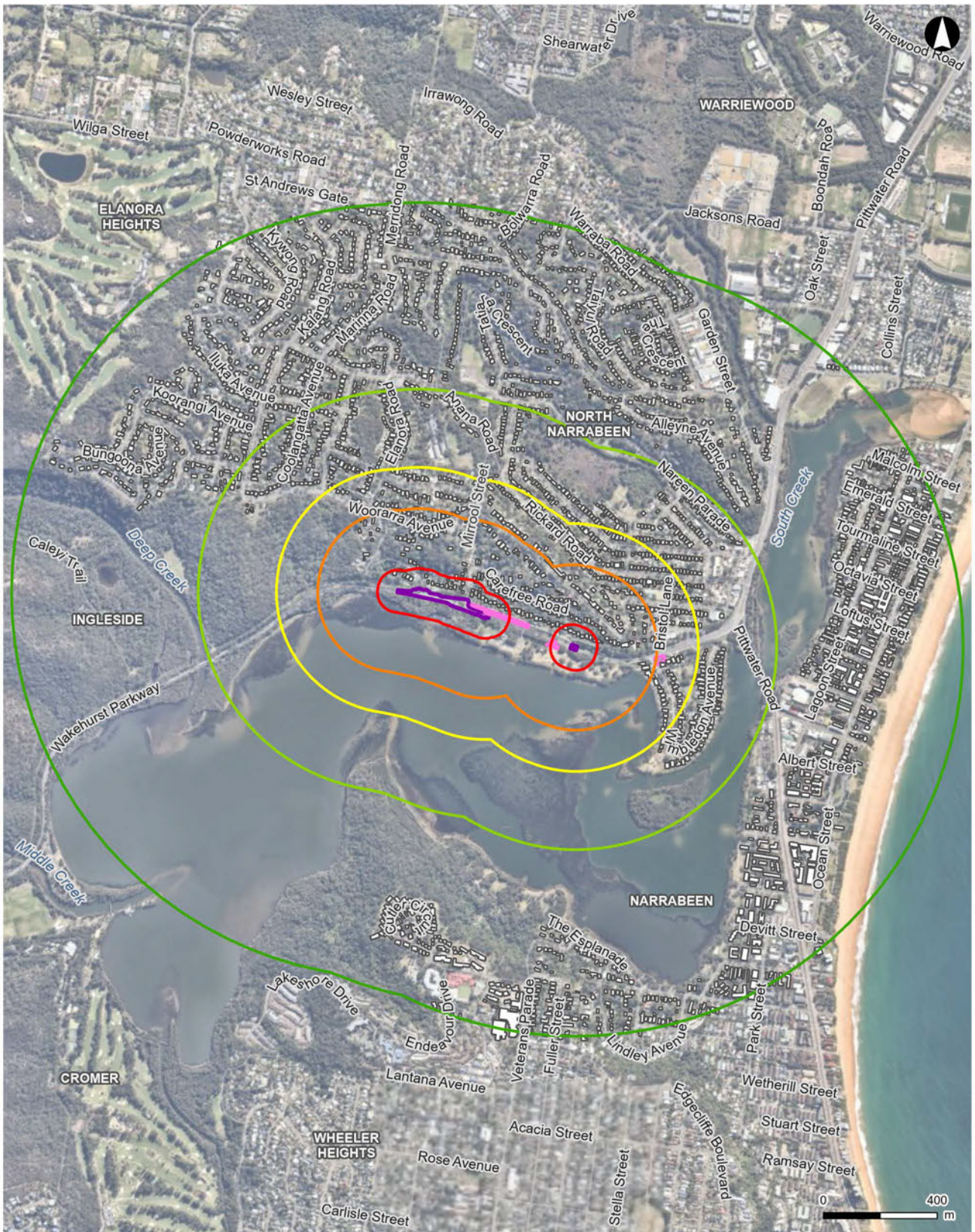
Legend			
	Proposal area		
	Proposed compound site		
	Residential dwelling		
	dBA above RBL	Highly noise affected level	
		5-10	
		10-20	
		20-30	
		>30	
			>75



Figure 3-37, Noise contours based on the dBA above the RBL in the southern section (night time bulk earthworks scenario)

1:15,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2023





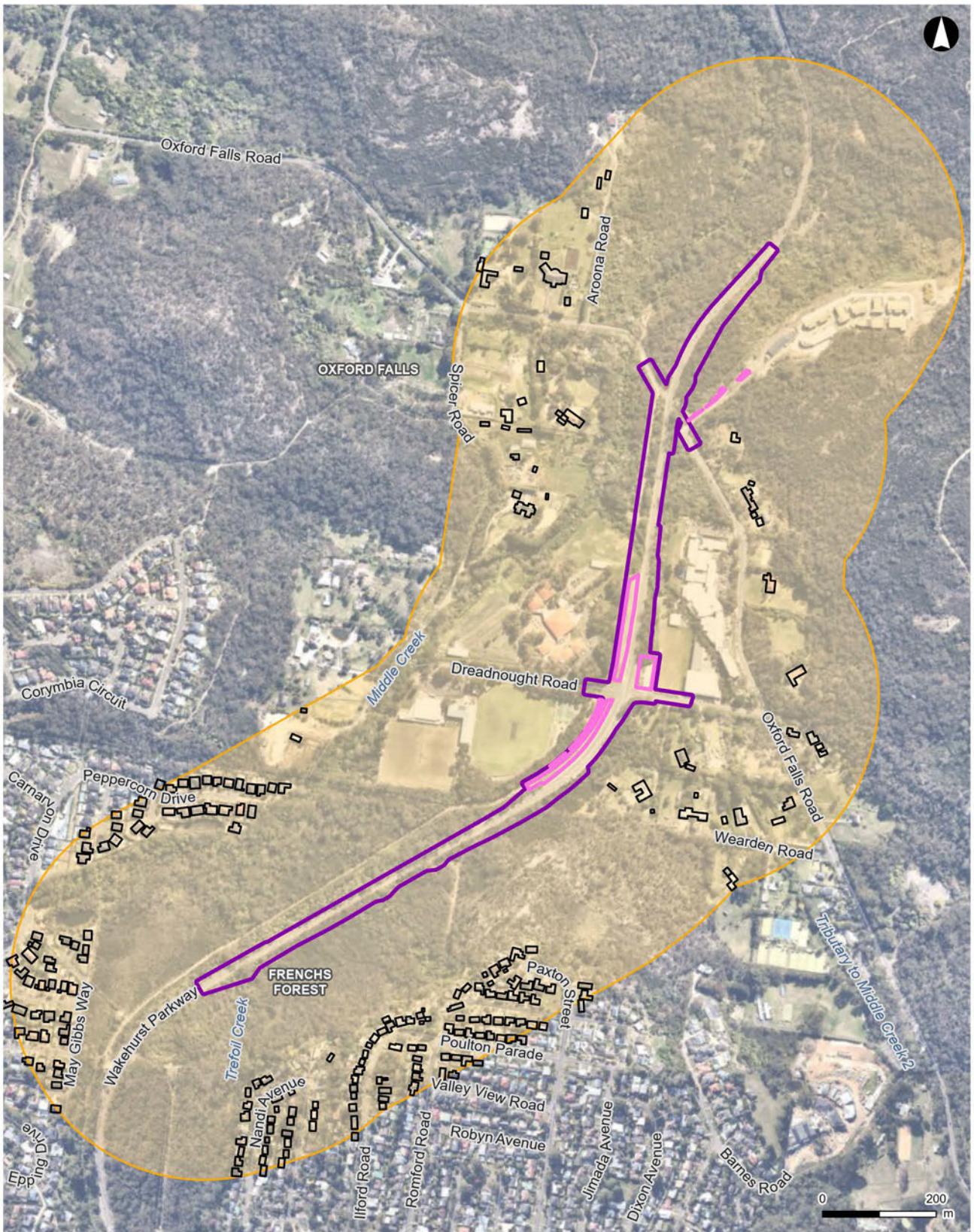
Legend		
	Proposal area	
	Proposed compound site	
	Residential dwelling	
	dBA above RBL	Highly noise affected level
		5-10
		10-20
		20-30
		>30
		>75



Figure 3-38, Noise contours based on the dBA above the RBL in the northern section (night time bulk earthworks scenario)

1:20,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearnmap 2023





Legend

- Proposal area
- Sleep disturbance buffer
- Proposed compound site
- Residential dwelling



1:10,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2023



Figure 6-39, Sleep disturbance impacts in the southern zone



Legend

- Proposal area
- Sleep disturbance buffer
- Proposed compound site
- Residential dwelling



1:8,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Neamap 2023



Figure 6-40 Sleep disturbance impacts in the northern zone

Table 6-59: Construction noise affected distances (southern section)

Scenario	Period	Affected distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Site establishment	Day	125	-	-	-	35	25	25
	Day (OOHW)	185	-	-	125	35	25	
	Evening	265	-	-	185	75	40	
	Night	390	95	390	265	125	75	
Utility, property, service adjustment	Day	135	-	-	-	45	25	25
	Day (OOHW)	195	-	-	135	45	25	
	Evening	290	-	-	195	85	45	
	Night	420	95	420	290	135	85	
Corridor clearing	Day	195	-	-	-	85	45	45
	Day (OOHW)	290	-	-	195	85	45	
	Evening	420	-	-	290	135	85	
	Night	605	230	605	420	195	135	
Retaining walls	Day	170	-	-	-	65	35	35
	Day (OOHW)	250	-	-	170	65	35	
	Evening	360	-	-	250	115	65	
	Night	525	330	525	360	170	115	
Bulk earthworks	Day	230	-	-	-	105	60	60
	Day (OOHW)	335	-	-	230	105	60	
	Evening	485	-	-	335	155	105	
	Night	700	280	700	485	230	155	
Paving / asphaltting	Day	105	-	-	-	25	20	20
	Day (OOHW)	155	-	-	105	25	20	

Scenario	Period	Affected distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
	Evening	230	-	-	155	60	30	
	Night	335	330	335	230	105	55	
Road furniture installation	Day	75	-	-	-	25	15	15
	Day (OOHW)	125	-	-	75	25	15	
	Evening	185	-	-	125	40	25	
	Night	265	95	265	185	75	35	
Compound operation	Day	75	-	-	-	25	15	20
	Day (OOHW)	125	-	-	75	25	15	
	Evening	185	-	-	125	40	25	
	Night	265	95	265	185	75	35	

Table 6-60: Construction noise affected distances (northern section)

Scenario	Period	Affected distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Site establishment	Day	215	-	-	-	85	45	25
	Day (OOHW)	330	-	-	215	85	45	
	Evening	500	-	-	330	140	85	
	Night	745	95	745	500	215	140	
	Day	235	-	-	-	95	50	25
	Day (OOHW)	360	-	-	235	95	50	



Transport  
for NSW

Scenario	Period	Affected distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Utility, property, service adjustment	Evening	540	-	-	360	155	95	
	Night	805	95	805	540	235	155	
Corridor clearing	Day	360	-	-	-	155	95	50
	Day (OOHW)	540	-	-	360	155	95	
	Evening	800	-	-	540	235	155	
	Night	1170	230	1170	800	360	235	
Retaining walls	Day	305	-	-	-	130	75	40
	Day (OOHW)	460	-	-	305	130	75	
	Evening	685	-	-	460	200	130	
	Night	1010	330	1010	685	305	200	
Bulk earthworks	Day	425		-	-	180	115	70
	Day (OOHW)	635		-	425	180	115	
	Evening	935		-	635	280	180	
	Night	1355	280	1355	935	425	280	
Paving / asphaltting	Day	180		-	-	70	35	20
	Day (OOHW)	280		-	180	70	35	
	Evening	425		-	280	115	70	
	Night	635	330	635	425	180	115	
Road furniture installation	Day	140		-	-	45	25	15
	Day (OOHW)	215		-	140	45	25	
	Evening	330		-	215	85	45	
	Night	500	95	500	330	140	85	
	Day	200		-	-	75	40	25

Transport  
for NSW

Scenario	Period	Affected distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Compound operation	Day (OOHW)	305		-	200	75	40	
	Evening	460		-	305	130	75	
	Night	685	95	685	460	200	130	

**Construction traffic**

The Road Noise Policy recommends that “any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding ‘without construction’ scenario.” Construction would generate heavy vehicle movements associated with the transportation of construction machinery, equipment, and materials to the site. Light vehicle movements would be associated with employees and smaller deliveries.

All construction traffic is expected to access site via Wakehurst Parkway. To increase the road traffic noise of these roads by 2 dB, traffic would have to increase by 58 per cent.

Existing heavy vehicle traffic counts along Wakehurst Parkway are sourced from traffic counts conducted in February 2023. The additional vehicles required to reach a 2dBA increase based on existing traffic volumes is shown in Table 6-61.

Table 6-61: Existing heavy vehicle traffic counts

Location	Existing heavy vehicle movements* traffic count (per week)	Additional heavy vehicles required for a 2 dB increase	Estimated heavy vehicles construction traffic movements* per day
Wakehurst Parkway between Frenches Forest Road and Dreadnought Road	1,960	1,137	40
Wakehurst Parkway between Caley Trail and Elanora Road	2,030	1,177	20

\* For planning purposes, a vehicle travelling in and out from the site is considered as two vehicle movements

Based on the existing heavy vehicle traffic volumes along Wakehurst Parkway, additional traffic generated during the construction phase would not result in an increase of more than 2 dB compared to existing road traffic noise levels.

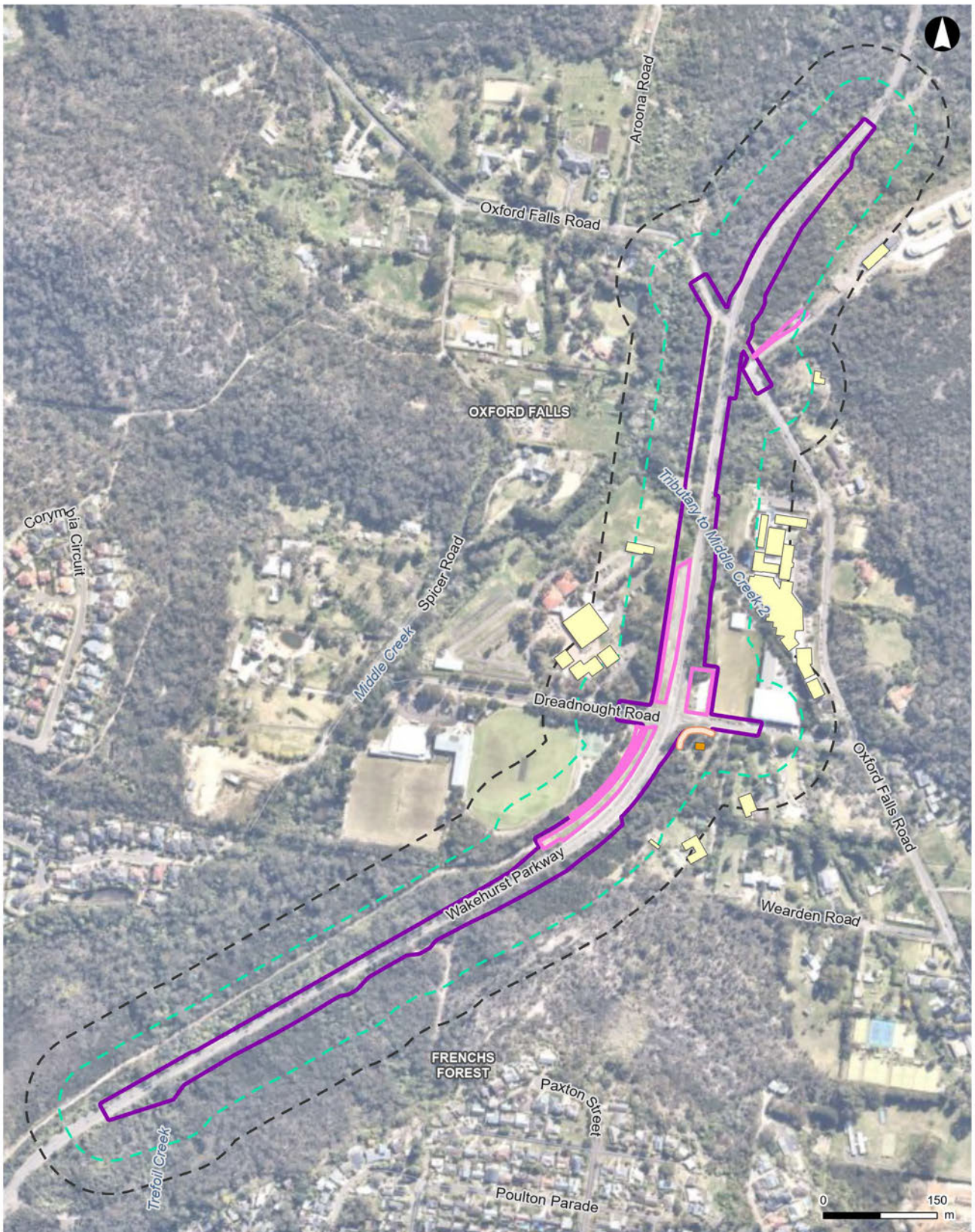
**Construction vibration**

The most vibration intensive equipment with the potential to be used on site is the use of vibratory rollers. Assuming an >18 tonne roller, the worst-case safe working distances for cosmetic damage, heritage structural damage and human comfort are 25 metres, 68 meters and 100 metres respectively. Appendix A of the NVIA (Appendix F) lists the addresses of properties within 25 metres and 100 metres of the construction footprint for both the northern and southern areas of the proposal. This is also visualised in Figure 6-41 and Figure 6-42.

Approximately five buildings are within 25 metres of the construction area and approximately 85 buildings are within 100 metres of the construction footprint. Across the two sections, approximately two heritage sites have been identified as within the 68 metre cosmetic damage buffer distance for heritage and other sensitive structures. Both sites are located at the southern end of the proposal. The heritage site of Oxford Falls Public School, including a heritage sandstone wall, has been identified to the south-east side of the intersection between Dreadnought Road and Wakehurst Parkway. Also potentially within the buffer distance is the Oxford Falls Conservation Area, located to the north-west of the intersection between Dreadnought Road and Wakehurst Parkway. This heritage item is a conservation area, as opposed to a specific man-made structure, and therefore is not considered to be a vibration sensitive receiver.

A heritage sandstone wall at the south-east side of the intersection between Dreadnought Road and Wakehurst Parkway has been identified as potentially being within the construction footprint. If the heritage cosmetic damage safe working distances cannot be maintained, the structure should be inspected by a suitably qualified heritage consultant and structural engineer to determine if the heritage structure is structurally unsound. In the event that it is, a conservative cosmetic damage objective of 3 mm/s peak particle velocity level would be considered (based on German Standard DIN 4150-3 Structural Vibration – Part 3: Effects of vibration on structure (German Standards, 2016)). Work in proximity to the Oxford Falls Public School heritage item, particularly the sandstone wall fronting the north and east of the lot, would be required to undertake additional mitigation measures to prevent vibration damage.

Where the safe working distances cannot be maintained, Section 6.7.5 provides mitigation measures for construction vibration impacts.



**Legend**

- Proposal area
- Proposed compound site
- Heritage item (Sandstone Wall)
- Potential adverse human comfort impact buffer
- Heritage structure safe work buffer
- Vibration safe work buffer
- Buildings within vibration safe work buffer
- Buildings within potential adverse human comfort impact buffer



Figure 6-41, Vibration safe buffer distances for cosmetic building damage and human health impacts (southern area)



**Legend**

- Proposal area
- Proposed compound site
- Potential adverse human comfort impact buffer
- Heritage structure safe work buffer
- Vibration safe work buffer
- Buildings within vibration safe work buffer
- Buildings within potential adverse human comfort impact buffer



Figure 6-42, Vibration safe buffer distances for cosmetic building damage and human health impacts (northern area)

1:5,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Neamap 2023

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When conducting vibration intensive work around buildings or structures that are within the relevant safe working distances it is required that alternate equipment of a smaller size or less intensive vibratory methods be employed to ensure properties are outside of the safe work buffer distances outlined. Where the vibration safe working buffer distances cannot be maintained, a building condition inspection report should be undertaken. If residual impacts are still present, then initial vibration monitoring trials should be undertaken at the commencement of vibratory rolling activities.

Monitoring would be undertaken to confirm that vibration emissions are under the vibration criteria outlined in Table 6-49. Smaller equipment shall be investigated where the vibration monitoring indicates exceedances of the vibration criteria.

**Operation**

The proposal is considered to be minor works and therefore has been assessed to determine whether existing road traffic noise levels increase by more than 2.0 dBA at the worst affected receiver. To exceed the RCNG threshold criteria of 2.0 dB, a minimum increase in traffic volumes of 58 per cent is required. The work is not anticipated to increase traffic volumes and therefore a 2.0 dB relative increase is not expected. This change is generally imperceptible to the human ear. There are no operational vibration impacts generated from the proposal, and mitigation is not required.

Additionally, the relative increase criteria can be exceeded when the new road alignment moves closer to sensitive receivers. A review of the proposed final road alignment was undertaken, and no potential exceedances of the relative increase criteria were identified as a result of changed road alignments. No further assessment or mitigation for operational traffic noise applies.

**6.7.5 Safeguards and management measures**

Table 6-62: Noise and vibration safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim Construction Noise Guideline (ICNG) (DECC, 2009) and identify:</p> <ul style="list-style-type: none"> <li>• all potential significant noise and vibration generating activities associated with the activity</li> <li>• feasible and reasonable mitigation measures to be implemented, taking into account beyond the pavement: urban design policy, process and principles (transport, 2014).</li> <li>• a monitoring program to assess performance against relevant noise and vibration criteria</li> <li>• arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures</li> <li>• contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.</li> </ul>	Contractor	Pre-construction
Noise and vibration	<p>All sensitive receivers (e.g., schools and local residents) likely to be affected will be notified at least five business days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> <li>• the project</li> <li>• the construction period and construction hours</li> <li>• contact information for project management staff</li> <li>• complaint and incident reporting</li> <li>• how to obtain further information.</li> </ul>	Contractor	Pre-construction/ Construction

Impact	Environmental safeguards	Responsibility	Timing
Noise and vibration	Locate compressors, generators, pumps and any other fixed plant as far from residences as possible and behind site structures.	Contractor	Construction
Noise and vibration	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.	Contractor	Construction
Noise and vibration	Vehicle delivery times will be scheduled where feasible to standard construction hours to minimise noise impacts from heavy vehicle movements and deliveries.	Contractor	Construction
Noise and vibration	During work hours, a community liaison phone number and site contact will be provided to enable complaints to be received and responded to.	Contractor	Construction
Noise and vibration	The environmental induction program will include specific noise and vibration issues awareness training.	Contractor	Construction
Noise and vibration	Building condition surveys will be undertaken for buildings within safe working distances.	Contractor	Pre-construction
Noise and vibration	A vibration assessment is to be prepared and included in the NVMP. The vibration assessment is to include (as a minimum): <ul style="list-style-type: none"> <li>• identification of potentially affected properties/receivers</li> <li>• a risk assessment to determine the potential for discrete work activities to affect receivers</li> <li>• a map indicating the locations considered likely to be impacted and those requiring building condition surveys</li> <li>• outline a monitoring program</li> <li>• a process for assessing the performance of the implemented mitigation measures</li> <li>• a process for resolving issues and conflicts.</li> </ul>	Contractor	Pre-construction
Noise and vibration	Construction methods must consider safe working distances for rollers and other vibration producing equipment when working adjacent to structures, including heritage structures.	Contractor	Construction
Noise and vibration	Consider alternative equipment, plant and processes which produce less vibration where safe working distances cannot be achieved, to minimise or prevent vibration impacts on heritage structures.	Contractor	Construction
Noise and vibration	Noisy works (including sawcutting, jackhammering, mulching and chainsaw use) will be completed by midnight (12 am).	Contractor	Construction
Noise and vibration	Noise curtains are to be used for all noisy works (including sawcutting, jackhammering, mulching and chainsaw use) at night.	Contractor	Construction
Noise and vibration	Works will be undertaken no more than five nights in a week.	Contractor	Construction
Noise and vibration	Consider alternative accommodation for residents that experience highly intrusive noise levels during construction.	Contractor	Pre-construction Construction

## 6.8 Aboriginal cultural heritage

### 6.8.1 Methodology

A desktop assessment was undertaken to assess the potential impacts of the proposal on Aboriginal cultural heritage. A review of the following documents and databases was carried out on 29 May 2023 to identify the existing identified sites and places of Aboriginal cultural heritage in and around the proposal footprint:

- Aboriginal Heritage Information Management System (AHIMS) database search (29 May 2023)
- Preliminary Environmental Planning and Sustainability Investigation (PEPSI) report (SNJV, 2022)
- Preliminary Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) Stage 1 assessment letter of outcome (TfNSW, 2023) (Appendix C).

### 6.8.2 Existing environment

#### **AHIMS database**

The AHIMS search was carried out on 29 May 2023 and the results are shown in Figure 6-44.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

The PEPSI prepared for the Strategic Design stage of the proposal identified one recorded Aboriginal site (ID: 45-6-1273) within the proposal area, in proximity to the Wakehurst Parkway and Dreadnought Road intersection. It is noted that AHIMS site 45-6-1273 is the nearest recorded site to the proposal area and the listed coordinates has been recorded erroneously, with the site card placing the site outside of the investigation area. The PEPSI report clarified the location of this site, as visualised in Figure 6-43. The actual site location is about 150 metres west of the erroneous AHIMS recorded site location, and about 80 metres east of the proposal boundary.

#### Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

No AHIMS registered sites were found within the proposal boundary in this location.

#### Wakehurst Parkway from Elanora Road to Mirrool Street

No AHIMS registered sites were found within the proposal boundary in this location.

#### **Native Title Register**

A search of the Native Title Register (on 29 May 2023) did not return any results within the proposal or construction boundaries.



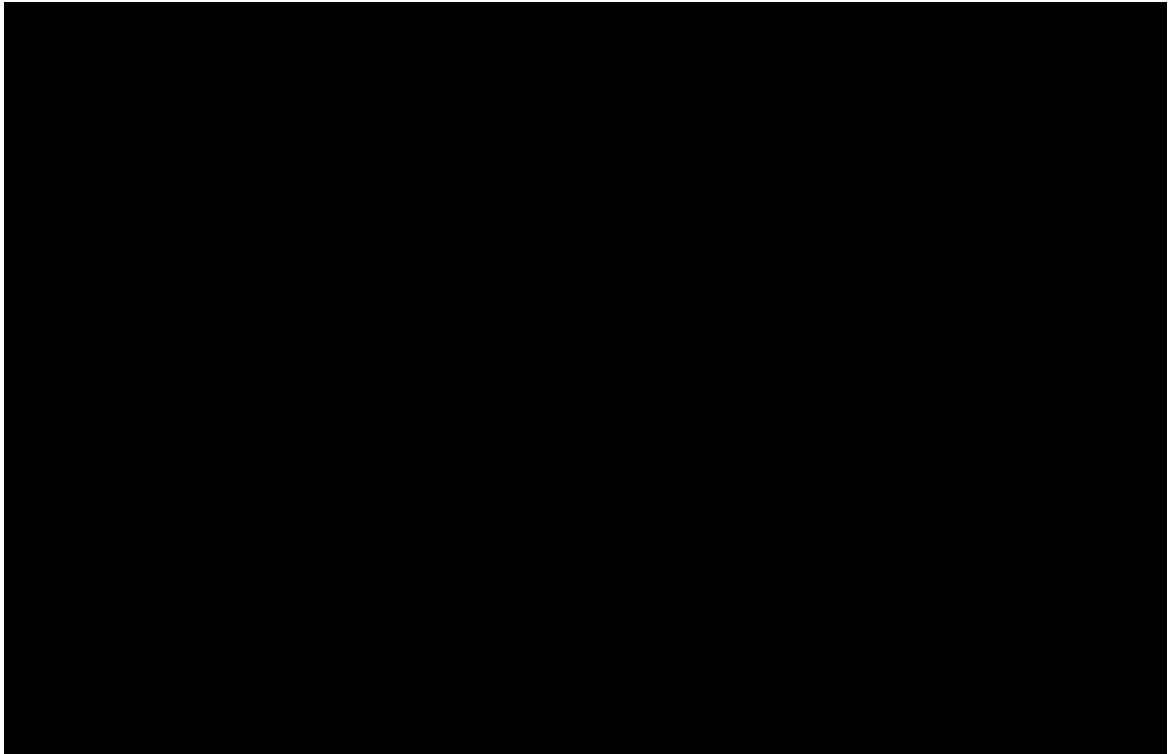


Figure 6-43: AHIMS No 45-6-1273 recorded (erroneous) location and revised location

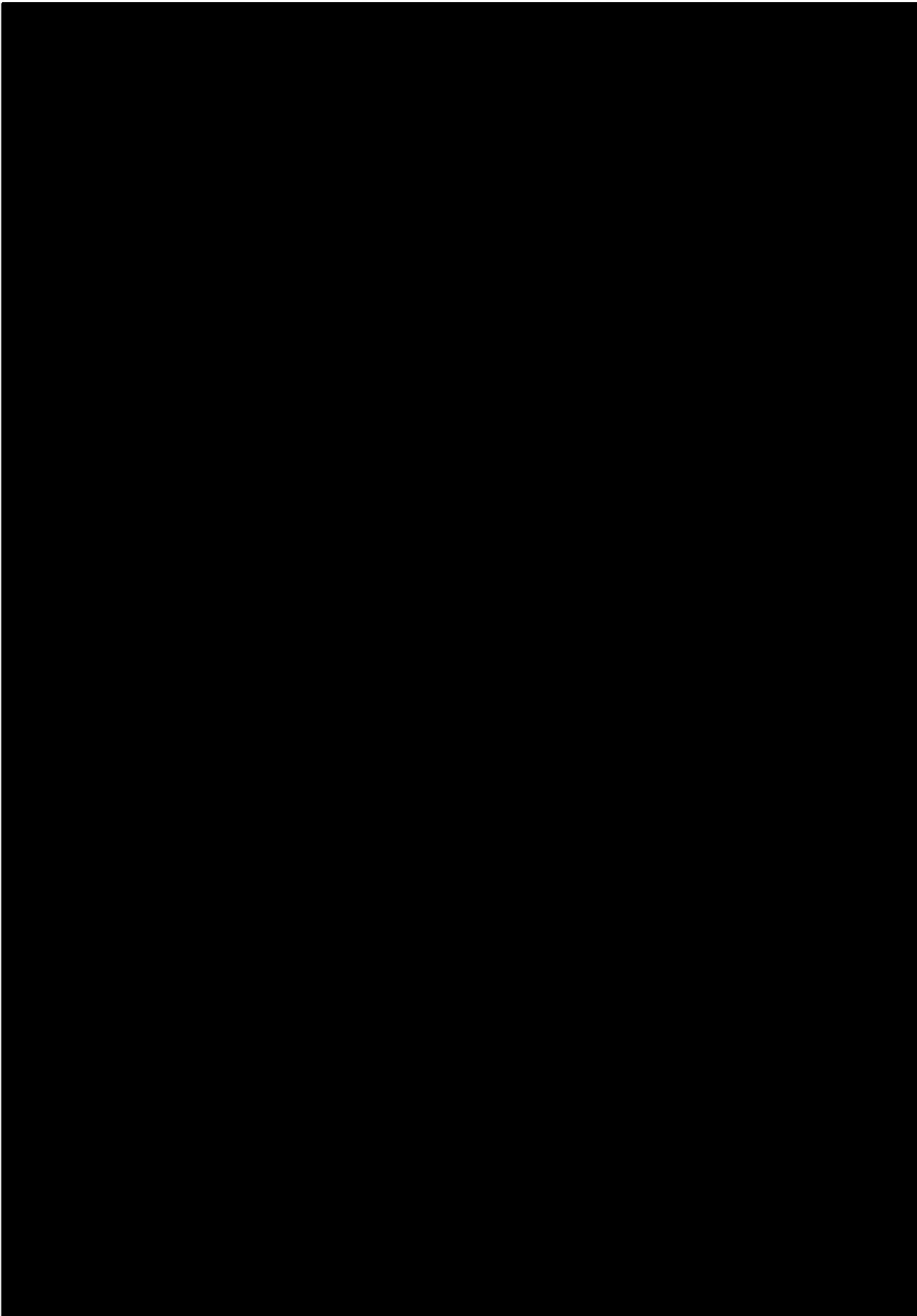


Figure 6-44, Location of Aboriginal sites near Wakehurst Parkway at Dreadnought Road, and near Trefoil Creek crossing

1:10,000 at A4  
Coordinate System: GDA2020 MGA Zone 56  
Date issued: October 3, 2023  
Imagery: Nearmap 2022



### 6.8.3 Potential impacts

#### Construction

The proposal would require ground disturbance and excavations within the proposal footprint, but beyond the current extent of developed road and road reserve. Excavation works would extend beyond the existing road and into undisturbed land, where there is a risk of unexpected Aboriginal heritage finds, particularly given the number of known Aboriginal sites and items in proximity to Wakehurst Parkway (refer to Figure 6-44). The nearest identified AHIMS site is ID 45-6-1273, located about 80 metres east of the proposal area. Excavation works would remain within the construction boundary and as such, would not directly impact the AHIMS site.

Based on the Office of Environment and Heritage's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the Roads and Maritime Services' PACHCI procedure, the following landform contexts may indicate the presence of Aboriginal objects:

- within 200 metres of waters
- located within a sand dune system
- located on a ridge top, ridge line or headland
- located within 200 metres below or above a cliff face
- within 20 metres of or in a cave, rock shelter, or a cave mouth.

As the entirety of the proposal is located within 200 metres of a waterway, including Middle Creek, Deep Creek, the Narrabeen Lagoon, and tributaries, it is possible that there are unidentified Aboriginal objects in the vicinity of the proposal. However, the work proposed within waterways are limited to those previously disturbed and require work to existing infrastructure, such as extension of culverts, thereby reducing the risk. An unexpected heritage finds protocol would be implemented as part of the CEMP to manage and reduce the risk of damage or disturbance of Aboriginal heritage sites or items during construction.

The Stage 1 PACHCI letter of outcome prepared for the proposal determined that impacts to Aboriginal cultural heritage were unlikely. This is based off the following due diligence considerations:

- the project is unlikely to harm known Aboriginal objects or places
- the AHIMS search did not indicate moderate to high concentrations of Aboriginal objects or places in the study area
- the study area does contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the Roads and Maritime Services' procedure.

**Operation**

No operational impacts to Aboriginal cultural heritage are anticipated due to the proposal.

**6.8.4 Safeguards and management measures**

Table 6-63: Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Aboriginal heritage	<p>The <i>Standard Management Procedure - Unexpected Heritage Items</i> (Transport, 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 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.</p> <p>Work will only re-commence once the requirements of that Procedure have been satisfied.</p>	Contractor	Pre-construction / construction

## 6.9 Non-Aboriginal heritage

### 6.9.1 Methodology

Non-Aboriginal heritage items in the vicinity of the proposal were identified by conducting searches of the following databases:

- Warringah LEP 2011
- Pittwater LEP 2014
- NSW State Heritage Register
- Transport for NSW s170 Heritage Register
- Australian Heritage database.

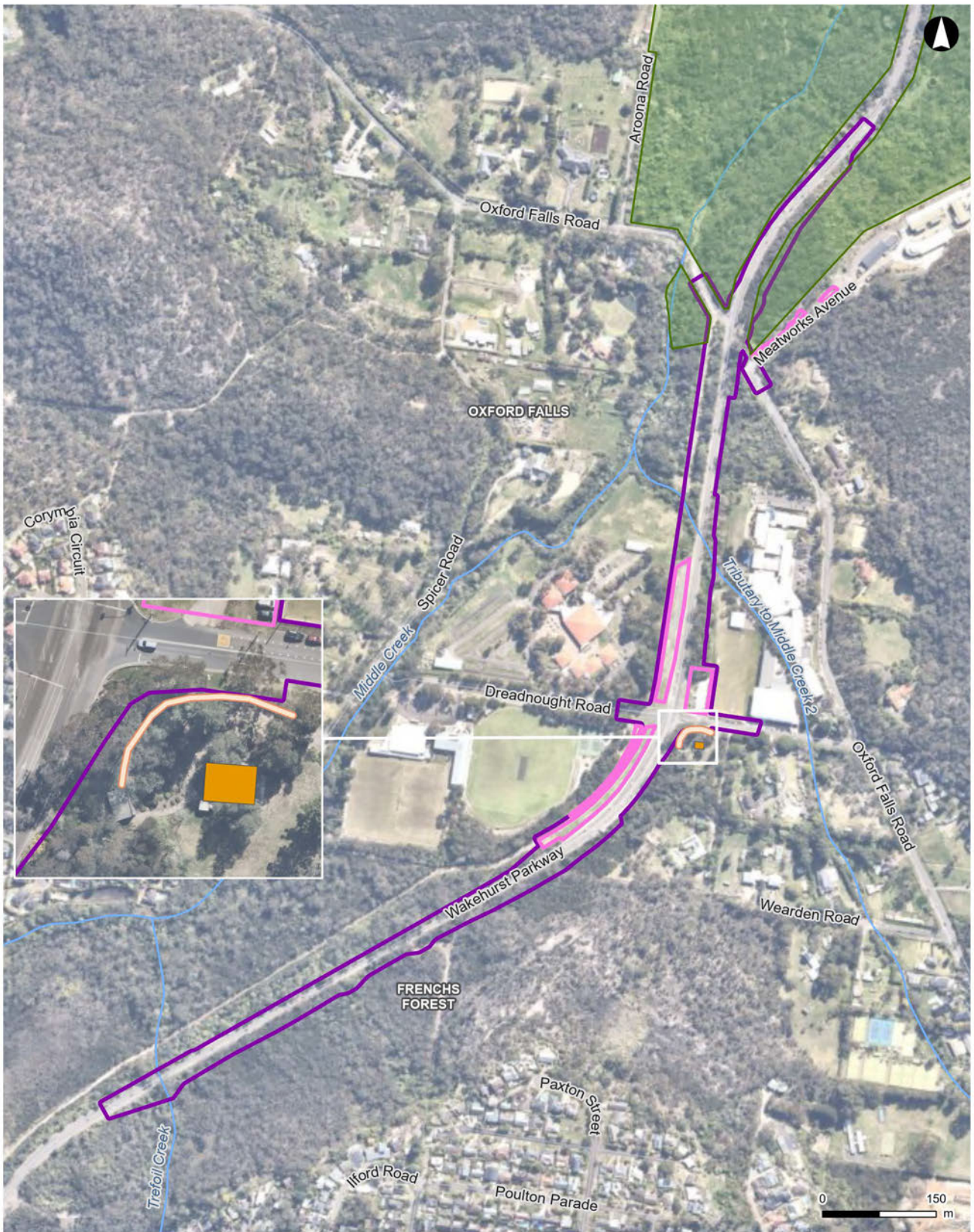
The search results are provided in Appendix G and are summarised below.

### 6.9.2 Existing environment








The results of the database searches indicate that there is one non-Aboriginal heritage item and one conservation area within the proposal area. These sites are shown in Figure 6-45 and summarised in Table 6-64.

Table 6-64: Non-Aboriginal heritage items in the proposal area

Item	Heritage significance	Description	Address	Listing	Location (approximate)
Oxford Falls Public School	Local	A representative small inter-war school building. Displays high integrity with much original fabric. Historically provides evidence of the extent of development in the inter-war period & was also the last single teacher school in Sydney when it closed.  This heritage item also includes a sandstone wall at the north-western corner.	Corner Dreadnought Road and Wakehurst Parkway	I116, Warringah LEP 2011	Wakehurst Parkway from Trefoil Creek to Dreadnought Road.  South east corner of intersection of Wakehurst Parkway and Dreadnought Road.
Oxford Falls Conservation Area	Local	Contains considerable aesthetic appeal and is valued by the community as a striking natural feature, a good viewing platform, a place for recreation, and a valued geological education site. Ecological values are generally high along the mid-reaches of Middle Creek, with excellent examples of native riparian and floodplain vegetation, characterised by good connectivity and high species richness. This provides a good habitat for the dispersal and refuge of native fauna, as well as high recreational and landscape values.	N/A	C12, Warringah LEP 2011	Wakehurst Parkway from Dreadnought Road to Oxford Falls Road.  Vegetation north, east and west of the intersection of Wakehurst Parkway and Oxford Falls Road.



**Legend**

- |  |  |
|--|--|
|  Proposal area          |  Heritage items                 |
|  Proposed compound site |  Oxford Falls Conservation Area |
|  Watercourse            |  Oxford Falls Public School     |
|  |  Sandstone Wall                 |



1:7,500 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2023



Figure 6-45, Location of non-Aboriginal heritage items in proximity to the proposal

### 6.9.3 Potential impacts

#### Construction

The Oxford Falls Conservation Area, about 127 hectares size, is listed as a heritage item under the Warringah LEP (C12) and is regarded for its natural bushland, fauna habitat for wildlife conservation, and cultural sites. This conservation area is adjacent to the proposal footprint at the intersection of Wakehurst Parkway and Oxford Falls Road and would be impacted by vegetation removal required for road widening of the southbound lanes of Wakehurst Parkway and drainage utility work. This area is about 900 square metres and considered to be minor as the proposal would not directly impact non-Aboriginal heritage sites. Impacts to vegetation in the Oxford Falls Conservation Area would trigger offsetting under BAM and the Tree and hollow replacement guidelines.

The trees to be removed are located along the existing road verge of the southbound lane of Wakehurst Parkway at Oxford Falls Road intersection. As assessed in Section 6.1, the trees along the road verge have minimal biodiversity value due to edge effects and high levels of disturbance. The removal of these trees would not substantially impact the heritage value of the Oxford Falls Conservation Area, and therefore the impact is considered low.

The Oxford Falls Public School site (I116) is located in proximity to the proposed work at the intersection of Wakehurst Parkway and Dreadnought Road. The site features a sandstone wall at the north western corner which fronts onto Dreadnought Road intersection. During the construction phase, pavement laying and utility work would occur in close proximity to the wall. Risks to the wall include potential vibration impacts, which have been assessed in Section 6.7. The construction vibration assessment concluded that no impact to the heritage site is expected to occur as a result of construction work with implementation of the safeguards listed in Section 6.9.4, such as using smaller machinery like vibratory rollers during construction, are implemented during construction. Therefore it is expected that potential vibrational impacts would be effectively mitigated.

#### Operation

No ongoing impacts to heritage items would occur during operation.

### 6.9.4 Safeguards and management measures

Table 6-65: Non-Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Non-Aboriginal heritage	The <i>Standard Management Procedure - Unexpected Heritage Items</i> (Transport for NSW, 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	Pre-construction and Construction
Non-Aboriginal heritage	All workers will be inducted to the location of the nearby heritage item at Oxford Falls Public School.	Contractor	Pre-construction and Construction

Other safeguards and management measures to address non-Aboriginal heritage impacts are identified in Section 6.7.

## 6.10 Landscape character and visual impacts

### 6.10.1 Methodology

A desktop visual impact assessment was undertaken for the proposal as part of the Urban Design and Landscape Plan (SJV, 2023, Appendix H). The assessment followed the Transport for NSW's environmental impact assessment practice note EIA-N04 Guideline for Landscape Character and Visual Impact Assessment (August 2020). Based on the scope and nature of the proposal, only a visual impact assessment has been carried out to inform the REF in accordance with section 3 of EIA-N04 of the guidelines. The assessment addresses both the potential construction and operational impacts of the proposal in terms of the visual amenity in the proposal area.

The visual impact was assessed in relation to the sensitivity and magnitude of visual change from the proposal based on the quality and sensitivity of the view. The methodology used followed the landscape character and visual impact rating matrix from section 4 of the guidelines and is shown in Figure 6-46 This matrix was used to determine the sensitivity and magnitude of impact the proposal may have on the selected viewpoints within the visual catchment area.

The definitions of sensitivity and magnitude are outlined below and in section 4 of the guidelines:

- **Sensitivity** refers to the qualities of an area, the number and type of receivers and how sensitive the existing character of the setting is to the proposed nature of change
- **Magnitude** refers to the physical scale of the project, how distant it is and the contrast it presents to the existing condition.

		Magnitude			
		High	Moderate	Low	Negligible
Sensitivity	High	High	High-Moderate	Moderate	Negligible
	Moderate	High-Moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Figure 6-46: Landscape character and visual impact rating matrix

Ten viewpoint locations were chosen within the visual catchment area to show where the proposal design features (including retaining structures) and tree removal would be visible to the public, such as pedestrians and commuters passing through the area. The viewpoint locations are shown in Figure 6-47 to Figure 6-49.

The potential visual impact of the proposal was informed by the arborist assessment included in Appendix E. The arborist assessment outlined which trees may need to be removed as well as those that would be retained, with and without tree protection zones.





Legend

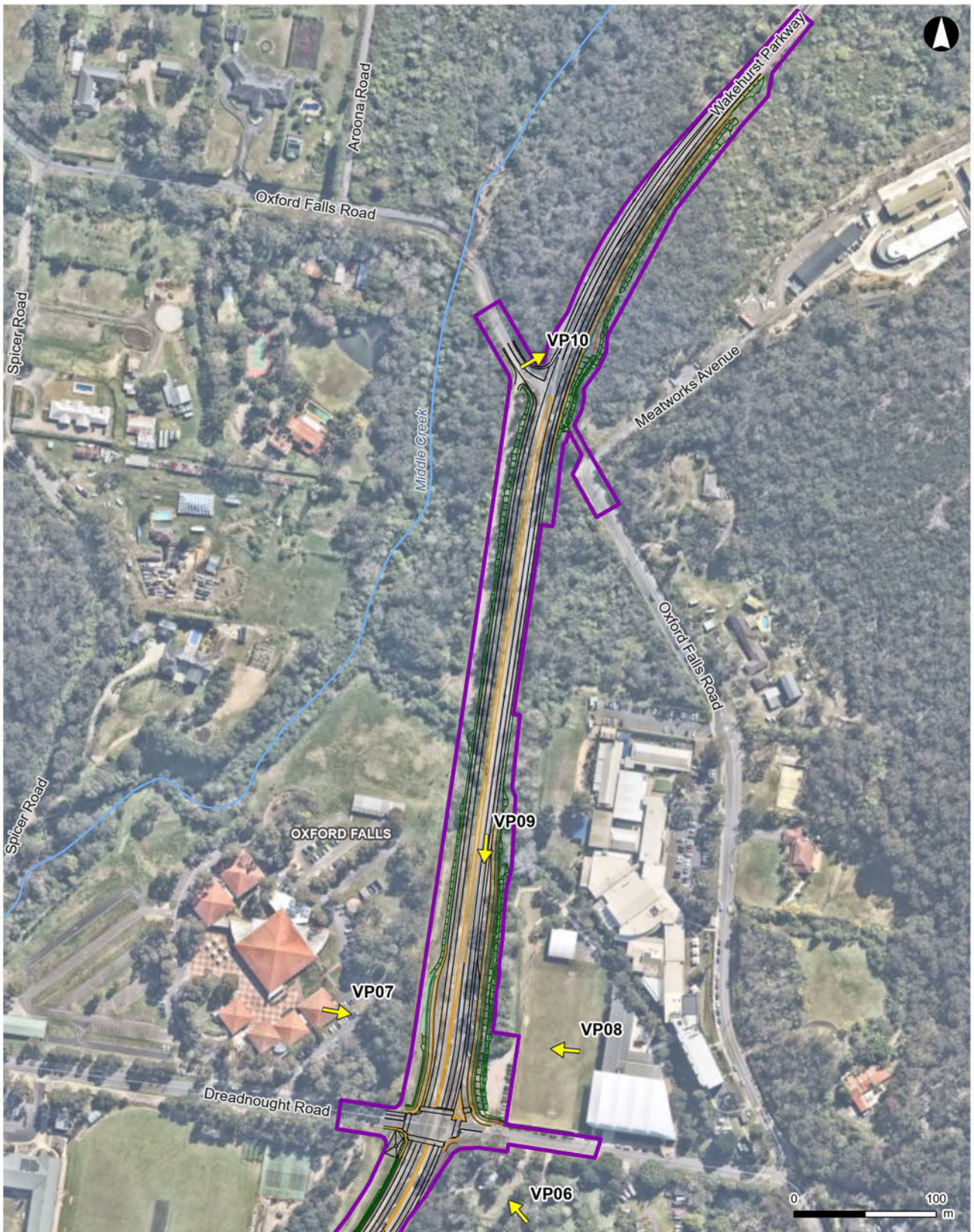
- |                 |                |
|-----------------|----------------|
| Viewpoints      | Safety barrier |
| Proposal area   | Retaining wall |
| Watercourse     | Earthworks     |
| <b>Proposal</b> | Kerb/Median    |
| Line marking    | Road design    |
| Footpath        |                |



Figure 6-47, Visual impact assessment viewpoints - Wakehurst Parkway from Trefoil Creek to Dreadnought Road

1:5,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2023





Legend

- |                 |                |
|-----------------|----------------|
| Viewpoints      | Safety barrier |
| Proposal area   | Retaining wall |
| Watercourse     | Rock cutting   |
| <b>Proposal</b> | Earthworks     |
| Line marking    | Kerb/Median    |
| Footpath        | Road design    |

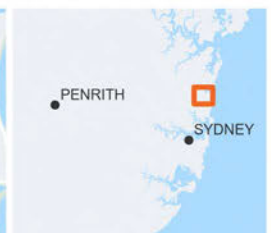


Figure 6-48, Visual impact assessment viewpoints - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

1:4,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2023





Legend

- |                 |                |
|-----------------|----------------|
| Viewpoints      | Safety barrier |
| Proposal area   | Retaining wall |
| <b>Proposal</b> | Earthworks     |
| Line Marking    | Kerb/Median    |
| Footpath        | Road design    |

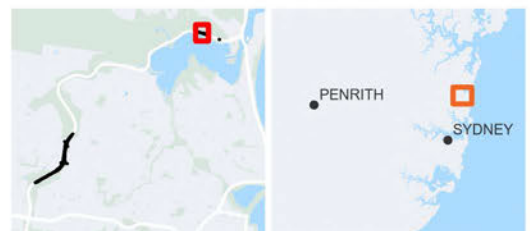


Figure 6-49, Visual impact assessment viewpoints - Wakehurst Parkway from Elanora Road to Mirrool Street

1:2,000 at A4  
 Coordinate System: GDA2020 MGA Zone 56  
 Date issued: October 3, 2023  
 Imagery: Nearmap 2023




### 6.10.2 Existing environment


The proposal is located in predominantly rural and semi-rural areas with increased urban development occurring near the intersections at Dreadnought Road, Elanora Road and Mirrool Street. Development surrounding the proposal footprint consists of residential, educational, religious, and recreation premises, and includes Oxford Falls Grammar school.


The land use character is consistent with the land zonings under the Warringah LEP and Pittwater LEP, as described in Section 4.1.2. There is one built heritage item within the study area (Oxford Falls Public School, ID: I116), and one heritage conservation area (Oxford Falls Conservation Area, ID: C12), both listed on the Warringah LEP and located adjacent to or partially within the proposal area.


Trees are present in the study area both as exotic and native plantings along Wakehurst Parkway at Dreadnought Road, Elanora Road and Mirrool Street, as well as existing remnant vegetation along Wakehurst Parkway between Oxford Falls Road and Elanora Road. Nine viewpoint locations within the study area were selected representing locations with direct line of sight to the intersection and trees impacted by the proposal. Images and a description of each viewpoint is provided in Table 6-66.

Table 6-66: Viewpoints

Viewpoint	Location and view	Description	Image
VP01	Wakehurst Parkway west from the westbound carriageway to the Elanora Road intersection.	<p>The view is of a suburban road with dense vegetation framing and overhanging the corridor and in the surrounding areas. There are strong natural and urban visible elements in generally equal proportion.</p> <p>Urban elements include paved lanes and shoulders with a continuous metal, safety barrier. Overhead powerlines and street lighting located along the northern verge are prominent features along with driveway entries and residential boundary fences. Trees and vegetation from the adjacent reserve, streets, local bushland and planting from private gardens, including exotic species such as Banana (<i>Musa spp.</i>) trees are visible and contribute to a semi-natural landscape setting.</p>	


Viewpoint	Location and view	Description	Image
VP02	Wakehurst Parkway northeast near the northbound carriageway and residential driveway access points towards the Mirrool Street intersection.	The view is of a semi-rural road with tree canopy and vegetation framing and overhanging the road corridor. The vegetation comprises a mix of native and exotic species with dense vegetation at the middle and ground levels preventing views of the surrounding landscape. A continuous w-beam safety barrier separates the westbound carriageway from Bilarong Reserve.	


Viewpoint	Location and view	Description	Image
VP03	<p>Wakehurst Parkway and Mirrool Street intersection from nearby properties including one and two story dwellings near the intersection along an existing unnamed local service road. Some views are looking down towards the intersection from a higher elevation.</p>	<p>Views are generally indirect or filtered by trees and vegetation unless at ground level and consist of a “T”-intersection with adjoining paved access road, overhead utilities, lighting, road signs and turfed verges. The intersection is framed by surrounding dense, low and midlevel vegetation and mature tree canopy.</p>	 <p>The image shows a paved road intersection with a dashed white line marking a specific area of vegetation. Two arrows point from the text 'Approximate vegetation removal extent' to this area. The surrounding area is filled with dense, mature trees and foliage.</p>

Viewpoint	Location and view	Description	Image
VP04	South of Dreadnought Road looking southwest from the Wakehurst Parkway southbound carriageway.	Dual lane carriageway with narrow shoulders in both directions. View includes the southbound lane widening to two lanes about 200 metres past the viewpoint. The road is contained on both sides by dense, mostly low and midstory vegetation with tree canopy appearing above as well as low rock cutting walls. A transmission tower can also be seen in the distance.	





Viewpoint	Location and view	Description	Image
VP05	Wakehurst Parkway north from the northbound carriageway to the Dreadnought Road intersection.	<p>The view is of the approach to the Wakehurst Parkway Dreadnought Road intersection. The road is wide and prominent as it accommodates additional turning lanes.</p> <p>Other urban components include traffic signals, overhead powerlines with wire stays, signs, filtered views of Oxford Falls Grammar School buildings and an open concrete channel along the shoulder edge.</p> <p>Dense bushland vegetation and tree canopy is a main element with the view as it frames the edge of the southbound carriageway and the horizon with a low hill in the background.</p>	

Viewpoint	Location and view	Description	Image
VP06	Oxford Falls Peace Park towards Wakehurst Parkway and the Dreadnought Road intersection.	Views from the park are filtered from trees in the foreground as well as a low sandstone wall along the park boundary. The foreground also includes grassed areas, a pathway, flagpole and memorial as part of the park. An informal car park in the road reserve is visible on the other side of Dreadnought Road as well as Wakehurst Parkway and low buildings as part of the C3 SYD church in the background.	

Viewpoint	Location and view	Description	Image
VP07	C3 SYD church external areas such as car parking areas and landscaped grounds.	The foreground view consists of car parking areas and large areas of open lawn with trees. Wakehurst Parkway is in the centre of the view with a portion of the informal parking area outside Oxford Falls Grammar School visible, along with low vegetated hills in the background.	 <p>The image shows a wide, paved parking area in the foreground. To the left, there is a wooden utility pole with a street light. In the background, a dense line of trees and shrubs is visible. A white dashed line is drawn across the trees, indicating the 'Approximate vegetation removal extent'. The sky is clear and blue.</p>

Viewpoint	Location and view	Description	Image
VP08	Views from the sports fields or elevated covered sports fields and an education facility building with first level windows at a distance of approximately 50-80 metres.	<p>Views comprise semi-urban development with Wakehurst Parkway and the Dreadnought Road intersection and overhead utilities and power poles comprising built elements within the view. Filtered views of roofs in the surrounding area, including at the C3 SYD church property would also be evident.</p> <p>The view contains bushland in the surrounding areas forming a continuous canopy as well as foreground vegetation screening Wakehurst Parkway approximately 50m north of the Dreadnought intersection.</p>	

Viewpoint	Location and view	Description	Image
VP09	Wakehurst Parkway south from the southbound carriageway towards the Wakehurst Parkway Dreadnought Road intersection.	<p>The view consists of Wakehurst Parkway in the foreground as it rises, curves and disappears to the southwest beyond the intersection. There are urban components including traffic signals, overhead powerlines with wire stays and general signage.</p> <p>Dense vegetation and tree canopy are prominent visual elements framing the view of Wakehurst Parkway. A low vegetated hill contains views to the immediate area.</p>	

Viewpoint	Location and view	Description	Image
VP10	Northbound from the intersection of Wakehurst Parkway and Oxford Falls Road.	<p>Two lane carriageway with narrow shoulders on both sides bending to the east. Low vegetation from native bushland frames and terminates the view with tree canopy in the background appearing above the foreground vegetation.</p> <p>A low rock cutting is visible along the northbound lane shoulder.</p>	

### 6.10.3 Potential impacts

#### Construction

The majority of visual impacts would be caused by equipment associated with the utility adjustment and road widening, including temporary fencing, signage and construction machinery. This would have the potential to result in visual clutter in the streetscape during construction work.

The main construction activities would include site establishment, vehicle movement, and preparation for operation, which would include the following main visual activities:

- earth-moving equipment for civil work within the project site
- earthworks including foundations and trenches
- movement of trucks, forklifts, excavators, and 50 tonne mobile crane
- stockpiles of excavated materials
- construction compound including a site office and amenities
- laydown areas.

Visual impacts from the construction of the project are likely to be Low to Negligible. Although the identified activities are likely to be visible from surrounding locations, there are no visual receivers identified with a high sensitivity rating.

#### Operation

The proposal would result in the following key visual changes:

- road widening at Wakehurst Parkway and Mirrool Street, Wakehurst Parkway and Oxford Falls Road, and Wakehurst Parkway and Dreadnought Road
- removal of mature and immature trees, both native and non-native
- rock cutting retaining wall at the intersection of Oxford Falls Road and Wakehurst Parkway
- addition of a sandstone retaining wall at the bus bay for northbound traffic at Dreadnought Road and Wakehurst Parkway intersection
- retaining wall at the Mirrool Street and Wakehurst Parkway intersection along the southbound lane
- landscaped medians at the approach to the intersection of Dreadnought Road and Wakehurst Parkway
- landscaping at the intersection of Dreadnought Road and Wakehurst Parkway
- Relocation and installation of new power and lighting poles
- changes to signage, including removal of the Oxford Falls Grammar school sign from the road reserve at Dreadnought Road intersection

The impact assessments for each section of the proposal are provided in the sections below. The assessments rely on the incorporation of mitigation strategies provided within the concept design to assist in reducing visual impacts. These strategies include:

- the use of local, natural materials such as sandstone
- planting and revegetation utilising native species suited to the local conditions
- working with the local geology and soils such as sandstone cutting walls
- avoiding the use of shotcrete in sandstone cutting walls. Where required, minimising its use and colour adapting to the local stone
- retaining trees and native vegetation where practicable and replanting with seed collected from locally endemic species.

#### Wakehurst Parkway from Trefoil Creek to Dreadnought Road

The impact assessment of the proposal at this location is summarised in Table 6-67.

Overall, the risk of operational visual impacts or changes to landscape character in this area is negligible to low.

Table 6-67: Visual impact assessment - Wakehurst Parkway from Trefoil Creek to Dreadnought Road

Viewpoint	Sensitivity	Magnitude	Overall rating of impact	Comment
VP04	Low Motorists are traveling along an arterial road at a high speed along a road corridor with their would focus on the road itself.	Low Road widening and vegetation removal along one side of the road.	Low	Changes are limited to one side of the carriageway where sensitivity of visual receivers is assessed as low.
VP05	Low Motorists have short viewing times unless stopped at the intersection. Sensitivity is considered Low due to a range of elements in the road corridor including drains, fencing, utilities, signs, traffic lights and school buildings. The vegetation in the middle ground includes exotic species visually incongruous with the surrounding landscape reducing the sensitivity related to it.	Low Changes are as associated with the widened pavement and tree and vegetation removal central in the view. More of the Oxford Falls Grammar campus would be opened up to the view although this may be perceived as a positive outcome from increased visual connectivity. The vegetated hills in the view have the capacity to absorb the foreground tree and vegetation removal in the short term while the new landscape planting establishes.	Low	The proposal would increase the urban aspects of the view from additional road width and infrastructure however the changes are generally consistent with the current view and the visual amenity could be considered positive from a more visually unified landscape.
VP06	Low Visual receivers in the park are temporary visitors with short viewing times. Views are generally contained within the park from the boundary wall and existing trees.	Negligible Generally minor changes associated with the upgrade of Wakehurst Parkway including an additional turn lane and new landscaping in the middle to background of the view.	Negligible	Removal of the informal car parking and replacement with new landscape would positively contribute to the view. Changes are congruous with the existing visual environment.

Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

The impact assessment of the proposal at this location is summarised in Table 6-68.

Overall, the risk of ongoing visual impacts or changes to landscape character in this area is negligible to low-moderate. The assessment rating of viewpoint 08 is assessed as Moderate-Low as the Magnitude rating is assessed as Moderate primarily due to trees and vegetation removal in the foreground of the view. This rating however is tending towards Low as new replacement trees, grass and planting is proposed and would mitigate impacts in the view.



Table 6-68: Visual impact assessment - Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

Viewpoint	Sensitivity	Magnitude	Overall rating of impact	Comment
VP07	Low Visual receivers are temporary visitors and workers with short viewing times accessing buildings from car parking areas. Their attentions are focused on the activities within the facility rather than Wakehurst Parkway.	Moderate There are direct views of the existing vegetation removal in the road reserve opening views of the Oxford Falls Grammar school campus. Replacement tree planting in the same location would however generally offset the removal. The existing vegetation consists of native and exotic species that reduce the rating to Moderate. The widened road is at a similar level and would not be a prominent feature.	Low-Moderate	Tree and vegetation removal would result in visual impacts however the impacts would be offset by new landscape including tree planting in the road reserve. New elements in the view would contribute to an increase in the urban character of the area although this could potentially be perceived as a positive visual impact. Visual connectivity between campuses would increase.
VP08	Low Visual receptors include students, teachers, workers and visitors to the school and sports fields and are short term visual receptors focused on activities at the school.	Low Removal of trees and vegetation would be the most substantial impact however impacts would be offset by new tree planting in grass areas and planted batters.	Low	The changes are congruous with the existing view apart from foreground tree and vegetation removal. The rating is Low as the vegetation comprises generally low quality vegetation from exotic weed species.
VP09	Low	Moderate Changes are predominantly associated with the widened road in the foreground and removal of trees and vegetation along the eastern edge of Wakehurst Parkway currently preventing views towards Oxford Grammar School and areas further east.	Low-Moderate	The view contains both urban and landscape elements and therefore has capacity to absorb the changes. The proposal could be perceived as a positive visual outcome through a clearer delineation of the road and landscape and better overall visibility of the adjacent landscape and uses contributing to improved legibility for motorists.

Viewpoint	Sensitivity	Magnitude	Overall rating of impact	Comment
	Motorists have short viewing times as they move at speed along the corridor. The natural aspects of the view are counterbalanced by strong urban elements such as residential development, signs, traffic lights, power poles and overhead wires. Road edges are undefined with chainwire fencing and exotic, overgrown vegetation also visible and contributing to a Low rating.			
VP10	Low Visual receptors are motorists with short viewing times traveling at relatively high speeds or temporarily stopped at the intersection. Sensitivity is tending towards moderate due to the natural aspect of the view however the bushland is continuous and there are no substantial landmark features visible.	Low The new sandstone cut retaining wall would be noticeable however congruous with existing low sandstone walls at this location.	Low	Changes are noticeable but congruous with the existing overall road corridor landscape that contains rock cutting walls in varying locations.

Wakehurst Parkway from Elanora Road to Mirrool Street

The impact assessment of the proposal at this location is summarised in Table 6-69.

Overall, the risk of ongoing visual impacts or changes to landscape character in this area is negligible to low.

Table 6-69: Visual impact assessment – Wakehurst Parkway from Elanora Road to Mirrool Street

Viewpoint	Sensitivity	Magnitude	Overall rating of impact	Comment
VP01	<p>Low</p> <p>Anticipated visual receivers are primarily motorists using Wakehurst Parkway, Elanora Road and driveways accessing these roads. The duration of viewing would typically be short. Visible overhead utilities, road elements such as safety barriers and mixed exotic species reduce the sensitivity rating.</p>	<p>Negligible</p> <p>Although changes may be visible, they are relatively minor in the context of a paved arterial road with carriageways and turn lanes and are consistent with the existing view.</p>	Negligible	<p>There are both urban and natural landscape elements that define the visual aspects and the existing landscape has the capacity to absorb the relatively minor changes that would be visually consistent in the semi-suburban setting.</p>
VP02	<p>Low</p> <p>Anticipated visual receivers are primarily motorists and pedestrians along using Wakehurst Parkway with short duration of views. Sensitivity is lowered due to the informality of the northern verge and driveways including mixed exotic and native planting and overhead utilities.</p>	<p>Low</p> <p>An additional turn lane and adjacent removal of verge vegetation would be visible. The widening of pavement in the shoulder area is generally considered minor as an additional widening of the existing road.</p>	Low	<p>Changes to the road corridor are considered to provide a positive contribution through clearer delineation of the northern road shoulder and landscaped verge comprising kerbing, turf and trees. Impacts associated with the removal of roadside vegetation would be isolated to the foreground verge and absorbed by the surrounding vegetation.</p>
VP03	<p>Low</p> <p>Sensitivity is reduced as views include an arterial road, intersection and overhead infrastructure. Views are short term as they are potentially from balconies, gardens, garages and are likely indirect or filtered.</p>	<p>Low</p> <p>Tree and vegetation removal from the edge of the road is visible as are low level intersection upgrades from the additional pavement area and a new safety barrier.</p>	Low	<p>The proposal would provide a clearer delineation of the road and verge areas. Tree and vegetation removal would not impact the overall view that consists of a heavily vegetated corridor from the adjacent surrounding bushland.</p>

## 6.10.4 Safeguards and management measures

Table 6-70: Landscape character and visual safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Visual amenity	The work site will be left in a tidy manner at the end of each workday.	Contractor	Construction
Visual amenity	Construction plant and equipment will not remain onsite any longer than necessary after work is completed.	Contractor	Construction
Visual amenity	Landscaping is to be designed in line with Transport’s Landscape Design Guidelines, 2018.	Transport	Detailed design

## 6.11 Socio-economic, property and land use

### 6.11.1 Methodology

A desktop review of the following information was carried out on 30 May 2023 to assess the potential impacts of the proposal on socio-economic surroundings, property and land use:

- review of socio-economic data obtained from the Australian Bureau of Statistics (ABS, 2022)). This data was taken from the most recent census, carried out in 2021.
- review of Warringah LEP 2011 and Pittwater LEP 2014 land use planning and zone mapping.

### 6.11.2 Existing environment

#### Demography

The proposal is located within the Northern Beaches LGA in northeast Sydney. According to the most recent census data (ABS, 2021), this LGA has a population of 263,554, with a median age of 41. Around 51.1 per cent of the population is female and 48.9 per cent is male.

Around 72,448 families are currently living in the Northern Beaches, with an average of 1.8 children per family. There are 105,017 occupied private dwellings in the Northern Beaches. Of these, there is an average of 2.7 people per household with a median weekly household income of \$2,592. Most dwellings are separate houses (57.3 per cent), with 33.4 per cent being flats or apartments and 8.8 per cent being semi-detached.

The 2021 Census data indicated that the most common ancestries reported included 41.2 per cent English, 31.1 per cent Australian, 12.5 per cent Irish, 10.8 per cent Scottish, and 5.5 per cent Italian. Of the population of the LGA, 66.7 per cent reported Australia as their country of birth.

The most common occupation in the Northern Beaches LGA is professionals (30.5 per cent), managers (20.9 per cent), clerical and administrative workers (12 per cent) and technicians and trade workers (10.8 per cent).

#### Residential properties, religious facilities and businesses

The land surrounding the proposal is a mix of education, residential, religious use, private and public recreation use and undeveloped bushland. Residential land fronts the proposal footprint at the intersections of Wakehurst Parkway and Elanora Road and Wakehurst Parkway and Mirrool Street.

The C3 SYD church is located on the north-western corner of the intersection of Wakehurst Parkway and Dreadnought Road. The church is accessed by pedestrians and vehicles via Dreadnought Road.

The Oxford Falls Grammar school is located on the north-eastern corner of the intersection of Wakehurst Parkway and Dreadnought Road. The school is accessed by pedestrians and vehicles primarily via Oxford Falls Road. The St Pius X Treacy Education Complex and Sporting Fields is located on the south-western corner of Wakehurst Parkway and Dreadnought Road and is accessed via Dreadnought Road.

### Access

Footpaths along Wakehurst Parkway are separated (i.e. the Narrabeen Lagoon trail) or are informal along the hard shoulder or landscaped road reserve.

### 6.11.3 Potential impacts

#### Construction

The proposal would have the potential to create socio-economic impacts on the community through:

- traffic and access impacts, including from temporary traffic control measures (Section 6.6)
- construction noise and vibration (Section 6.7)
- visual impacts from the removal of vegetation (Section 6.10)
- possible temporary loss of services and utilities during relocation and reconnection of services such as electricity and water (Section 1.1)
- property acquisition and adjustment required to accommodate proposed road upgrades.

Surrounding residential, commercial and community properties would be exposed to increased noise levels while construction occurs, which would reduce local amenity. Vibrational impacts may also disturb the community near to the study area and result in potential discomfort or annoyance, for instance those who are resting or working from home. This would be mitigated as far as possible by safeguard measures listed in Section 6.11.4.

Potential traffic impacts may also occur, especially when work is required within the road corridor. This may result in delays and detours that could create longer journey times, frustration, and confusion in navigating any detours. It is anticipated that most work requiring road closures would occur at night to minimise impacts to traffic during peak periods during the day. Despite this, there would still be some delays experienced for drivers using the roads. However, once the proposal is completed, it is expected that traffic flow and congestion would improve.

Construction may also impact pedestrian movements where footpaths and crossings are temporarily closed during work in the road verge. Pedestrians may feel disoriented or unsafe if clear alternative pedestrian routes are not demarcated well and separated from active construction work zones. Alternative detours for pedestrians would be provided with clear signage to aid direction and ensure safety.

Access to driveways for all properties would always be maintained during construction, except when driveways are being re-established in the new road verge. Access may be temporarily impacted during these works. If this is required, landowners would be consulted prior to disruptions to access. Pedestrian access would be maintained to properties at all times, unless otherwise agreed with landowners. Access to the properties at the intersection of Dreadnought Road and Wakehurst Parkway (C3 SYD church, Oxford Falls Grammar school and St Pius X playing fields) may be interrupted during the construction phase of the proposal. However, construction would be scheduled for night-time hours where possible, during which these facilities would be unlikely to operate. Access to residential developments at Wakehurst Parkway, Elanora Road and Mirrool Street would similarly be interrupted during construction.

Property acquisition is required at three properties located at Wakehurst Parkway and Oxford Falls Road intersection (refer to Section 3.6). Three properties would be partially acquired with a total area of 2,700 square metres, however this is subject to cadastral definition and review.

Property owners of affected properties would be consulted with, and ongoing consultation would occur during detailed design and construction stages. The cadastral boundary of affected properties is still subject to definition, and this would inform final acquisition quantities.

More information regarding access during construction is available in Section 3.3.

During utility work, some services such as electricity, gas and communications may also be interrupted temporarily for nearby properties. This may be an inconvenience and source of frustration. Service interruptions would occur where property connections involve a private power pole within one metre of the property boundary being installed. Landowners would be consulted in advance of any planned power outages.

#### Operation

All property accesses impacted during construction would be reinstated so that no operational impacts would be expected. The community and road users are expected to experience a positive long-term impact once the proposal becomes operational, with reduced delays and improved travel times.

After land acquisition, the original landowners would not be able to access or use the land acquired by Transport. Landowners would receive appropriate compensation in line with the *Land Acquisition (Just Terms) Compensation Act (1991)*.

The benefits to intergenerational equity as a result of the proposal would include upgrading road capacity to accommodate future urban development needs, while improving road safety outcomes, and without reducing the cohesiveness of the community.

### 6.11.4 Safeguards and management measures

Table 6-71: Socio-economic safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Socio-economic	<p>A Communication Liaison Plan (CLP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CLP will include (as a minimum):</p> <ul style="list-style-type: none"> <li>mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions</li> <li>contact name and number for complaints.</li> <li>consideration of a multi-lingual community and need for tailored methods of communicating in relation to project notifications and signage.</li> </ul>	Contractor	Pre-construction and Construction
Property access and power supply outages during construction	<p>All businesses and residences likely to be affected by proposed construction activities (such as driveway reinstatement and utility relocation work) will be notified about upcoming work at least five days prior to it being carried out. Notification would include:</p> <ul style="list-style-type: none"> <li>contact name and details</li> <li>working hours and complaints process</li> </ul> <p>All businesses and residences requiring replacement power service connections to the property will be consulted in advance. This will include consultation on the placement of new private poles for property power connections within each impacted property and timing of works.</p>	Contractor	Pre-construction/ Construction
Socio-economic	<p>A complaints handling procedure and register would be included in the CEMP and maintained for the duration of the project. The procedure must include:</p> <ul style="list-style-type: none"> <li>how complaints are to be recorded</li> <li>how a qualified community representative or delegate would be available to respond and appropriate action community complaints</li> <li>how Transport would be informed of complaints</li> <li>how complaints are to be reported</li> <li>how complaints would be followed up and managed</li> </ul>	Contractor	Pre-construction and Construction

Impact	Environmental safeguards	Responsibility	Timing
	<ul style="list-style-type: none"> <li>how the complaints would be established and maintained</li> </ul>		
Socio-economic	Residents would be informed prior to any interruptions to utility services that may be experienced as a result of utilities relocation.	Contractor	Pre-construction and Construction
Socio-economic	Road users, pedestrians and cyclists would be informed of changed conditions, including likely disruptions to access during construction.	Contractor	Pre-construction and Construction
Socio-economic	Fencing with material attached (e.g. shade cloth) would be provided around the construction compounds and other areas to screen views of the construction compounds from adjoining properties.	Contractor	Pre-construction and Construction
Socio-economic	All property acquisition will be carried out in accordance with the <i>Land Acquisition Information Guide</i> (Transport, 2014) and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	Transport for NSW	Pre-construction

Other safeguards and management measures to address socio-economic impacts are identified in Section 6.6.4 (transport and access), Section 6.7.5 (noise and vibration) and Section 6.10.4 (visual amenity).

## 6.12 Waste and resource use

### 6.12.1 Existing environment

There are no existing sources of substantial waste within the proposal footprint. Some garden waste is generated from maintenance of verges through grass mowing and vegetation pruning. Additionally, some waste from road users in the form of litter is generated and disposed illegally along Wakehurst Parkway. Similarly, improperly disposed waste from pedestrians and recreation area users forms illegal litter within the proposal footprint. These wastes are generally minor in volume.

### 6.12.2 Potential impacts

#### Construction

Construction work would generate waste which needs to be adequately managed to minimise adverse impacts to the environment. Transport manages waste on its projects in line with the principles of waste hierarchy described in the *Waste Avoidance and Resource Recovery Act 2001*.

The proposal may generate waste from demolition of kerbs, foot paths, medians and concreted pedestrian refuge islands, excavation for road widening and utility work, removal of stormwater drainage pipelines, removal of vegetation and domestic waste created by workers.

Waste streams that may be created include:

- excess construction materials
- spoil from excavation
- packaging for materials
- wastewater
- demolition waste
- general, domestic, waste from staff
- roadside materials (such as signage, fencing)
- potentially hazardous materials if contamination is encountered.

The quantities of waste that may be generated are unlikely to be substantial. Where possible, materials would be recycled or repurposed. Cut and fill has been minimised in design, with excavation work to be minor.

Spoil generated from rock cuttings and other earthmoving activities would be classified in line with the *Waste Classification Guidelines* (EPA, 2014) with the majority of material to be reused onsite, including use in urban design features (such as retaining walls) or used as fill. Surplus material would be disposed of appropriately at a suitably licenced facility. Potentially contaminated materials would be classified and disposed of at an appropriately licensed facility.

Waste impacts would be minimised by implementing safeguards listed below.

**Operation**

No additional ongoing waste impacts are expected as a result of operation of the improved road and intersections.

**6.12.3 Safeguards and management measures**

Table 6-72: Waste management safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Waste and resources	<p>The following resource management hierarchy principles would be followed:</p> <ul style="list-style-type: none"> <li>• avoid unnecessary resource consumption as a priority</li> <li>• avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery)</li> <li>• disposal would be undertaken as a last resort (in accordance with the <i>Waste Avoidance and Resource Recovery Act, 2001</i>).</li> </ul>	Contractor	Construction
Waste and resources	<p>A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:</p> <ul style="list-style-type: none"> <li>• measures to avoid and minimise waste associated with the project</li> <li>• classification of wastes and management options (re-use, recycle, stockpile, disposal)</li> <li>• statutory approvals required for managing on- and off-site waste, or application of any relevant resource recovery exemptions</li> <li>• procedures for storage, transport and disposal</li> <li>• monitoring, record keeping and reporting.</li> </ul> <p>The WMP will align with the <i>Environmental Procedure - Management of Wastes on Transport for NSW Land</i> (Transport, 2014) and relevant Transport Waste fact sheets.</p>	Contractor	Pre-construction
Waste and resources	All wastes would be managed in accordance with the <i>Protection of the Environment Operations Act 1997</i> .	Contractor	Construction
Waste and resources	Types of waste collected, amounts, date/time and details of disposal are to be recorded in a waste register.	Contractor	Construction
Waste and resources	Suitable waste disposal locations would be identified and used to dispose of litter and other wastes on-site. Suitable containers would be provided for waste collection.	Contractor	Pre-construction and Construction



## 6.13 Other impacts

### 6.13.1 Existing environment and potential impacts

Table 6-73: Other potential impacts

Environmental factor	Existing environment	Potential impacts
Air quality	<p>A search of the National Pollution Inventory for the Pittwater and Warringah areas (searched 30 May 2023) indicated that there were multiple facilities around the proposal that emitted substances during the 2021/2022 reporting period. One facility in the Pittwater area and four facilities in the Warringah area produce 12 different substances, the nearest being the Warriewood water treatment facility in Warriewood, around 2.15 kilometres from the proposal footprint. The substances most emitted from this location included ammonia, carbon monoxide, and oxides of nitrogen.</p> <p>Air quality of the study area is considered to be typical of an urban area within Sydney. The main contributors to air quality are emissions from vehicles in the surrounding road network as well as some emissions generated from industrial activities. Typical emissions from vehicles include oxides of nitrogen, carbon monoxide and particulate matter. Sensitive air quality receivers in the area around the proposal include residential and commercial properties, pedestrians, and road users.</p> <p>Air quality was also assessed by reviewing previous records for air quality from the nearest monitoring stations in Prospect and Chullora for the previous year (2021). These stations categorised overall air quality for the area around Fairfield, and southwest Sydney more broadly, as 'good'.</p>	<p>Air quality impacts during construction would be predominantly associated with generation of dust from excavation required for widening alongside Wakehurst Parkway. Dust may settle on nearby properties alongside Wakehurst Parkway, Elanora Road and Mirrool Street. However, these potential impacts are expected to be minor as the volume of earthworks would be small.</p> <p>Operation of machinery and vehicles would emit exhaust fumes, though this would be limited to when construction is actively occurring. The emission of exhaust fumes would be minor when compared to exhaust emissions from traffic use on Wakehurst Parkway daily. Linemarking may also cause odour impacts, though these impacts would also be short-term and limited to when these activities occur during construction. As such, it is not expected that construction would cause any substantial impacts to air quality, particularly with the application of safeguards.</p> <p>The proposal would not generate additional traffic. However, it would increase turning storage capacity of Wakehurst Parkway and the intersection at Dreadnought Road by reducing delays and queuing. This may cause a minor increase in emissions from additional vehicles; however it would be negligible when compared to the numbers of vehicles that currently use the intersection. By improving the performance of the intersections, vehicles would also be idling for shorter periods of time, which may improve local air quality during peak periods.</p> <p>The proposal would not change the mix of light and heavy vehicles using the roads or intersections. As a result, it is not expected that vehicles which produce larger volumes of fumes would utilise the roads or intersections more than current levels.</p> <p>Road widening would decrease the distance between residences and traffic by up to 2.5 metres. This is a small decrease and is highly unlikely to cause greater exposure to emissions for nearby receivers.</p>
Hazard and risk	<p>The proposal is located on land designated bushfire prone as vegetation buffer and vegetation category 1. Category 1 vegetation is the highest risk for bush fire.</p>	<p><b>Construction</b></p> <p>The proposal may result in risk of bushfire if construction work is undertaken on high fire risk days. Activities that involve cutting or</p>

Environmental factor	Existing environment	Potential impacts
		<p>grinding may generate sparks, which could ignite dry vegetation. Spills and leaks from plant and equipment could also pose a risk to soils and waterways via contamination.</p> <p><b>Operation</b> The risk of bushfire would not increase during operation. The risk of spills or leaks would not increase once construction work is completed.</p>
Climate change	<p>Climate change adaptation is required to meet future challenges presented from fluctuating weather patterns and increasing intensity of weather events. The potential impacts of climate change that may directly affect the proposal include storms and periods of intense heat.</p> <p>The proposal is located on land currently subject to bushfire and flooding. Due to the proximity to the coast, there is also a risk of sea level rise and storm surge events. This risk is greater at the northern section of the proposal.</p>	<p><b>Construction</b> Construction would cause small but temporary increase in emissions of greenhouse gases as a result of machinery operating and vehicles. This would mostly be carbon monoxide from exhaust fumes.</p> <p>As the proposal is small in comparison to the broader Sydney and NSW road network, the increase in emissions is expected to be minor.</p> <p><b>Operation</b> The proposal would result in reduced congestion and queuing, with subsequent improvement to the rate of vehicle emissions.</p> <p>Climate change would result in an impact to the operation of Wakehurst Parkway due to increased flooding risk and sea level rise. The proposal would not increase the occurrence, severity or duration of these climate change risks.</p>

### 6.13.2 Safeguards and management measures

Table 6-74: Other impacts Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Air quality	<p>The CEMP will include measures to mitigate potential air quality impacts by:</p> <ul style="list-style-type: none"> <li>vehicles transporting materials to and from site will be covered</li> <li>dust will be suppressed on stockpiles and unsealed areas via water trucks, stabilisation, soil binders and other measures</li> <li>disturbed areas will be progressively rehabilitated</li> <li>plant and vehicles will be maintained in good condition and in line with manufacturer specifications</li> <li>plants and machinery will be turned off when not in use</li> <li>no burning of any material will occur</li> <li>visual monitoring of air quality will be carried out to verify effectiveness of controls.</li> </ul>	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	<ul style="list-style-type: none"> <li>adopting a process for altering management measures as required and reprogramming construction activities if the safeguards and management measures do not adequately restrict dust generation.</li> <li>work will cease when levels of visible airborne dust become excessive.</li> </ul>		
Hazards and risk management	The Landscape Plan must be developed with consideration of Asset Protection Zones and adequate setback distances from roadways to mitigate bushfire risk.	Contractor	Pre-construction and construction
Hazards and risk management	A Bush Fire Risk Management Plan (BFRMP) will be prepared as part of the CEMP to manage bush fire risk during construction and would outline procedures to reduce risk including management of bush fire hazards and safeguards to be implemented during Bush Fire Danger Periods.	Contractor	Pre-construction and construction
Hazards and risk management	The contractor will schedule works outside of the Bush Fire Danger Period where possible.	Contractor	Pre-construction and construction
Hazards and risk management	The contractor will ensure access arrangements for emergency services and evacuation routes are maintained at all times	Contractor	Pre-construction and construction
Hazards and risk management	The contractor will consult with NSW Rural Fire Service prior to disrupting water services due to construction works during Bush Fire Danger Periods if those works cannot be scheduled outside of those periods.	Contractor	Pre-construction and construction

## 6.14 Cumulative impacts

### 6.14.1 Study area

The proposal is located within the Northern Beaches LGA. It is surrounded by largely residential, community use, and recreation and conservation land.

### 6.14.2 Northern Beaches Council flood improvement work

Council is developing the design for this project following feasibility studies and options assessment. This project aims to improve flood mitigation along Wakehurst Parkway at The Bends, Middle Creek at Oxford Falls Road, and the Sydney Academy of Sport and Recreation. This project has not yet received planning approval.

This proposal does not preclude Council's future flood improvement works and Transport will continue to engage with Council to minimise cumulative impacts.

#### Construction

The construction for Northern Beaches Council's flood improvement work is expected to be complete before the proposal commences construction. Should the construction of both proposals overlap, cumulative impacts would include increased cumulative flood risk, traffic delays, cumulative noise impacts, and construction fatigue for local residents and road users.

The areas proposed for flood improvement work by Northern Beaches Council overlap with the proposal at Middle Creek just east of the proposal footprint at Oxford Falls Road intersection. Oxford Falls Road has a slope that runs downhill from the intersection with Wakehurst Parkway and Middle Creek. Mitigation to ensure sedimentation doesn't enter Middle Creek and cause downstream cumulative water quality impacts would need to be implemented, such as sediment control devices and clean stormwater diversion.

Should construction of both proposals overlap, interface meetings would be arranged to mitigate cumulative noise, traffic, soil and water and flooding impacts.

**Operation**

Upon the completion of both projects, there is an expected ongoing benefit to the operation of Wakehurst Parkway due to traffic efficiency improvements and reduced frequency of closures due to flooding.

**6.14.3 Other projects and developments**

Table 6-75: Past, present and future projects

Project	Construction impacts	Operational impacts
<p>Patyegarang, Morgan Road Belrose</p> <p>Proposal for up to 450 new residential developments, cultural community centre and protection of Aboriginal heritage sites.</p> <p>Under assessment</p>	<p>This project is in early stages, with planning proposals only submitted for land rezoning. As a result, detailed information regarding the construction phase traffic, noise, air quality and visual impacts are not available for this project. However, it is reasonable to consider cumulative construction impacts would include</p> <ul style="list-style-type: none"> <li>reduced access to construction vehicles via Oxford Falls Road,</li> <li>cumulative noise impacts to residents in Belrose, and</li> <li>a reduction in vehicle access to residents from either Morgan Road or Oxford Falls Road during work.</li> </ul> <p>As this project has not yet been approved, it is unlikely that the construction program would overlap with the proposal.</p>	<p>Approximately 30% of traffic movements to and from this development is expected to be via Oxford Falls Road. The expected date of operation for this development (if approved) however would not coincide with the construction of the proposal. The improvements of Wakehurst Parkway would facilitate traffic movements at Oxford Falls Road and Wakehurst Parkway.</p>
<p>Morgan Road bridge replacement, Oxford Falls</p> <p>Under construction</p>	<p>An update for this project published on Northern Beaches Council's website estimates the completion of construction by 'late 2023'. It is considered unlikely that the construction program would overlap with the proposal.</p>	<p>The bridge replacement project will replace an existing single-lane bridge with a two-lane bridge, as well as a separate pedestrian bridge.</p> <p>The operation of this project and the proposal would result in greater road network efficiency as vehicle queues would reduce at Oxford Falls Road west and Morgan Road.</p>
<p>Mona Vale Road East Road upgrade between the intersection of Mona Vale Road and Lane Cove Road, and Mona Vale Road and Foley Street.</p> <p>Under construction</p>	<p>There is a suitable distance (about 4.8 kilometres) between this project and the proposal, and as a result noise and vibration, air quality and water impacts are unlikely to be cumulative.</p> <p>The construction program of both the project and the proposal are unlikely to overlap.</p> <p>Motorists regularly travelling between Mona Vale Road and Wakehurst Parkway may experience construction fatigue from both the existing Mona Vale Road East improvement work and this proposal.</p>	<p>Following construction of this project and the proposal, overall traffic congestion and efficiency would improve for the region.</p> <p>No other cumulative operational impacts are anticipated.</p>
<p>Mona Vale Road West Road upgrade between the intersection of Mona Vale Road and Powder Works Road, and Mona</p>	<p>There is a suitable distance (about 3 kilometres) between this project and the proposal, and as a result noise and vibration, air quality and water impacts are unlikely to be cumulative.</p> <p>This project is in detailed design and the construction program is not yet known.</p>	<p>Following construction of this project and the proposal, overall traffic congestion and efficiency would improve for the region.</p> <p>No other cumulative operational impacts are anticipated.</p>

Project	Construction impacts	Operational impacts
Vale Road and McCarrs Creek Road. In detailed design	<p>There is a chance that the construction program of both the project and the proposal may overlap.</p> <p>Motorists regularly travelling between Mona Vale Road and Wakehurst Parkway may experience construction fatigue from both the existing Mona Vale Road West improvement work and this proposal.</p>	

#### 6.14.4 Potential impacts

Table 6-76: Potential cumulative impacts

Environmental factor	Construction impacts	Operational impacts
Construction fatigue	<p>Residents and motorists in and around the proposal area may experience construction fatigue arising from traffic delays due to the potential risk of multiple construction programs overlapping.</p> <p>During construction, this would manifest as traffic delays, visual impacts from construction work, and potentially noise and vibration, however given the scale and distance between the proposed projects this is considered minor.</p>	Upon completion of construction works, no cumulative operational impacts are expected.

#### 6.14.5 Safeguards and management measures

Table 6-77: Cumulative safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Cumulative construction impacts	The project team will liaise with concurrent projects during construction to minimise Wakehurst Parkway flood risk and to minimise cumulative impacts.	Contractor	Pre-construction & Construction
Cumulative construction impacts	The CEMP will be revised to consider potential cumulative impacts from surrounding development activities as they become known. This would include a process to review and update mitigation measures as new works begin or if complaints are received.	Contractor	Pre-construction & Construction

## 7. Environmental management

This chapter describes how the proposal would be managed to reduce potential environmental impacts during detailed design, construction and operation. A framework for managing 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 listed.

### 7.1 Environmental management plans

Safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A CEMP will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment and Sustainability Officer, Greater Sydney Area, prior to the commencement of any on-site work. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the *QA Specification G36 - Environmental Protection (Management System)*, *QA Specification G38 - Soil and Water Management (Soil and Water Plan)*, *QA Specification G10 - Traffic Management*.

## 7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed 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
GEN1	General - minimise environmental impacts during construction	<p>A CEMP will be prepared and submitted for review and endorsement of the Transport for NSW Senior Manager Environment and Sustainability prior to commencement of the activity. As a minimum, the CEMP will address the following:</p> <ul style="list-style-type: none"> <li>any requirements associated with statutory approvals</li> <li>details of how the project will implement the identified safeguards outlined in the REF</li> <li>issue-specific environmental management plans</li> <li>roles and responsibilities</li> <li>communication requirements</li> <li>induction and training requirements</li> <li>procedures for monitoring and evaluating environmental performance, and for corrective action</li> <li>reporting requirements and record-keeping</li> <li>procedures for emergency and incident management</li> <li>procedures for audit and review.</li> </ul> <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p>	Transport for NSW and Contractor	Pre-construction and Construction
GEN2	General - environmental awareness	<p>Environmental awareness training and inductions must be provided, by the contractor, to all field personnel and subcontractors. The environmental awareness training and inductions are to include (at a minimum):</p> <ul style="list-style-type: none"> <li>environmentally sensitive locations and/or no go zones</li> <li>requirement to report and the process for reporting environmental issues on site</li> <li>requirement to report and the process for reporting damaged environmental controls</li> <li>erosion and sediment control</li> <li>incident management process</li> </ul>	Contractor	Pre-construction and Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>site staff environmental responsibilities</li> </ul>		
GEN3	General – Construction compounds	A compound site plan is to be prepared and submitted for review and approval, showing the layout of each site compound or facilities. The plan is to be overlaid on an aerial photo showing structures, environment controls and perimeter.	Contractor	Pre-construction / Detailed design
GEN4	General – response to environmental incident	Transport’s Environmental Incident Procedure 2021 is to be followed in the event of an incident.	Contractor	Construction
B1	Biodiversity	<p>A Flora and Fauna Management Plan will be prepared and in accordance with Transport for NSW’s <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on Projects</i> (RTA, 2011) and implemented as part of the Construction Environmental Management Plan (CEMP). It will include (but not be limited to) the following:</p> <ul style="list-style-type: none"> <li>pre-clearing survey requirements and a site walk with appropriate site personnel including Transport for NSW representatives to confirm clearing boundaries and sensitive location prior to commencement of works.</li> <li>identification (marking) of the clearing boundary and identification (marking) of habitat features to be protected. Eg. – use of flagging tape.</li> <li>a map/ plans showing vegetation clearing boundaries, areas to be protected including sensitive areas/no go zones, protected habitat features and revegetation areas.</li> <li>incorporation of management measures identified as a result of the pre-clearing survey report, completed by an ecologist, (G40, section 2.4) and nomination of actions to respond to the recommendations made. This should include details of measures to be implemented to protect clearing limits and no go areas</li> <li>a detailed clearing process in accordance with Transport for NSW Biodiversity Guidelines (2011) including requirements of Guide 1,2, 4 &amp; 9.</li> <li>identify in toolbox talks where biodiversity will be included such as vegetation clearing or works in or adjacent to sensitive locations</li> <li>identify control/mitigations measures to prevent impacts on sensitive locations or no go zones</li> <li>procedures for unexpected threatened species finds and fauna handling</li> </ul>	Transport for NSW and Contractor	Pre-construction and Construction



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No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>procedures addressing relevant matters specified in the <i>Policy and Guidelines for Fish Habitat Conservation and Management</i> (2013)</li> <li>protocols to manage weeds and pathogens.</li> </ul>		
B2	Removal of native vegetation	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Pre-construction
B3	Removal of native vegetation	Vegetation removal will be undertaken by a qualified arborist and in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
B4	Removal of native vegetation	Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Post-construction
B5	Removal of native vegetation	Vegetation to be retained is to be protected in accordance with AS 4970-2009 – <i>Protection of trees on development sites</i> , and may require exclusion fencing of the Tree Protection Zones.	Contractor	Pre construction and construction
B6	Direct impacts to threatened species	Fauna will be managed in accordance with Guide 9: Fauna handling of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
B7	Direct impacts to threatened species	Habitat will be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
B8	Direct impacts to threatened species	The unexpected species find procedure is to be followed under Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	Contractor	Construction
B9	Direct impacts to threatened species	Retained individuals of Angus's Onion Orchid outside of the subject land are to be addressed in the CEMP. Individuals or areas of known occurrence outside the construction footprint will have exclusion zones established around them to prevent trampling or other accidental impacts.  Where practical and feasible, surveys should be undertaken prior to construction during the flowering period of this species to maximise detection of the individuals to be protected within exclusion zones. The listed survey month for this species as identified on the Threatened Species Data Collection is in October, however this species is known to have above ground features between May and October (DECCW, 2010), which may be identifiable by an ecologist experienced with surveying for this species.	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
B10	Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i> (DPI (Fisheries NSW) 2013).	Contractor	Construction
B11	Fragmentation of identified habitat corridors and impacts to connectivity and movement	A Wildlife Connectivity Strategy will be prepared as part of final design in accordance with the requirements of the Transport for NSW <i>Biodiversity Policy</i> . The strategy would be prepared and implemented in accordance with the <i>Draft Wildlife Connectivity Guidelines for Road Projects</i> (RTA 2011) or equivalent updated NSW Guidelines.	Transport for NSW and Contractor	Detailed design, during Construction and Post-construction
B12	Fragmentation of identified habitat corridors and impacts to connectivity and movement	Connectivity measures, if proposed, will be developed and designed in consultation with the project ecologist.	Contractor	Construction
B13	Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with Guide 2: Exclusion zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
B14	Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
B15	Invasion and spread of weeds	Weed species will be managed in accordance with Guide 6: Weed management of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
B16	Invasion and spread of pests	Pest species will be opportunistically monitored during construction of the project. A process on how incidental sightings will be recorded will be set out in the Construction Flora and Fauna Management Sub-plan. If it is deemed that the proposal is exacerbating the impact of pest species on the biodiversity in the proposal location management actions may be investigated and implemented.	Contractor	Construction
B17	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with Guide 7: Pathogen management of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction
B18	Light spill and shading impacts	Construction lighting impacts will be minimised as follows: <ul style="list-style-type: none"> <li>lighting would only be used as necessary to conduct construction activities at night. Lights would be turned off when not needed</li> <li>adaptive light controls to manage light timing, intensity and colour would be installed where possible</li> </ul>	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>only the object or area intended would be lit where reasonable and practical</li> <li>lights would be kept close to the ground and directed to avoid light spill. Lighting would be shielded where possible</li> <li>the lowest intensity lighting appropriate for the task would be used</li> <li>use non-reflective, dark-coloured surfaces where possible</li> <li>use lights with reduced or filtered blue, violet, and ultra-violet wavelengths where possible.</li> </ul>		
B19	Impacts to areas of geological significance	Impacts to sandstone rock will be minimised through salvage and relocation to avoided or remediated natural areas	Contractor	Construction
B20	Vehicle strike	<p>Fauna protection fencing will be installed at targeted locations along the proposal area. Fauna protection fencing will be designed to minimise impacts to threatened fauna species and species subject to vehicle strike. Locations selected will consider connectivity requirements of fauna, utilise existing crossing structures and potential fauna crossing infrastructure (i.e. canopy bridges and underpasses) to maintain connectivity.</p> <p>A monitoring strategy will be developed to detect efficacy of fauna protection fencing and maintenance requirements would be detailed as part of the Wildlife Connectivity Strategy.</p>	Transport for NSW and Contractor	Pre-construction and Construction
B21	Removal of individuals of the threatened flora species Angus's Onion Orchid	<p>Plant salvage. A salvage management plan will be prepared in consultation with the Royal Botanical Gardens (RBG) and the NSW Threatened Species Officer for Angus's Onion Orchid, with the ultimate objective of salvaging individuals within the proposal area prior to construction and replanting in suitable habitat beyond the limit of works</p> <p>The salvage management plan will likely include the following tasks:</p> <ol style="list-style-type: none"> <li>Salvage of individuals and replanting at translocation site <ul style="list-style-type: none"> <li>methodology to undertake salvage of orchid tubers from construction area</li> <li>timeframes and project program to undertake salvage, store tubers and translocate to a suitable recipient site.</li> <li>process for storage, care of individuals and preparation for replanting at RBG</li> <li>planting design for translocation site (s) to minimise inbreeding and maximise genetic diversity, fitness and resilience of translocated populations.</li> </ul> </li> <li>Ongoing monitoring</li> </ol>	Transport for NSW and Contractor	Pre-construction or construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>development of a monitoring program to measure the success of the plant salvage and translocation</li> </ul> <p>This mitigation measure will be undertaken either as early works or, if during the main contract, will have an exclusion hold point in the area around the Oxford Falls Road and Wakehurst Parkway intersection to prevent any other works occurring prior to salvage</p>		
B22	Residual impacts to native vegetation and habitat	A Biodiversity Offset Strategy and Tree and Hollow Replacement Strategy (TfNSW 2022) will be prepared which sets out how offsets will be delivered for impacts to biodiversity and other natural values.	Contractor	Pre-construction and construction
SW1	Water quality	<p>All refuelling and storage of fuels, chemicals and liquids are to be within an impervious bunded area within the construction compound, located a minimum of five metres away from:</p> <ul style="list-style-type: none"> <li>rivers, creeks or any areas of concentrated water flow.</li> <li>flooded areas.</li> <li>slopes above 10%.</li> </ul>	Contractor	Construction
SW2	Water quality	The vehicles refuelling process would include a person attending the refuelling facility / vehicle and a spill kit on the vehicle.	Contractor	Construction
SW3	Water quality	Emergency wet and dry spill kits will be kept on site at all times. Staff will be made aware of the location of the spill kit and trained in its use.	Contractor	Construction
SW4	Flooding	A Flood Contingency Plan would be prepared as part of the CEMP to manage a potential flood event during construction and would outline procedures to reduce risk including removal of all loose materials (including plant, equipment and chemicals) and stabilisation of exposed areas prior to forecast flood events.	Contractor	Pre-construction
SW5	Flooding	To reduce the instance of culvert blockage at Trefoil Creek, regular inspection and maintenance to clear accumulated debris will occur during construction for works in the area. Additional actions such as installing bollards or a screen to intercept litter will be investigated.	Contractor	Construction
SW6	Flooding	During construction works on culverts and other infrastructure, stormwater drainage function would be restored when flooding events are forecast.	Contractor	Construction
SW7	Flooding	Ensure that safe passage of flood waters across the proposal corridor is maintained at all times during construction	Contractor	Construction
SW8	Soil and water management	<p>Erosion and sediment control measures are to be implemented and maintained to:</p> <ul style="list-style-type: none"> <li>minimise sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets</li> </ul>	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>• reduce water velocity and capture sediment on site</li> <li>• minimise the amount of material transported from site to surrounding pavement surfaces</li> <li>• divert clean water around the site.</li> </ul> <p>(in accordance with the Landcom/Department of Housing Managing Urban Stormwater, Soils and Construction Guidelines (the Blue Book)).</p>		
SW9	Soil and water management	<p>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.</p> <p>The SWMP will be reviewed by a soil conservationist on the Transport list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address review outcomes.</p> <p>Mitigation measures to be developed to minimise impacts to mapped coastal wetland from site drainage during construction.</p>	Contractor	Pre-construction
SW10	Erosion and sedimentation control	<p>A site-specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan.</p> <p>The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.</p>	Contractor	Pre-construction
SW11	Vehicle wash down	Vehicle wash down and/or cement truck washout is to occur in a designated bunded area and least 50 metres away from water bodies and surface water drains.	Contractor	Construction
SW12	Hazardous liquid storage	Any fuel, oils or other liquids stored on site will be stored in an appropriately sized impervious bunded at least 120 per cent larger than the greatest container and in an area least 50 metres away from water bodies.	Contractor	Construction
SW13	Water quality	Water quality control measures are to be used to prevent any materials (eg. concrete, grout, sediment etc) entering drain inlets or waterways.	Contractor	Construction
S1	Soils	All stockpiles will be designed, established, operated and decommissioned in accordance with Transport's <i>Stockpile Site Management Guideline, 2011</i> .	Contractor	Pre-construction & Construction
S2	Soils	Work areas are to be stabilised progressively during the works.	Contractor	Construction
S3	Chemical storage	The storage of chemicals and hazardous materials will be conducted in accordance with the relevant Safety Data Sheets (SDS) and in accordance with requirements of the <i>Environmentally Hazardous Chemicals Act 1985</i> .	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
S4	Contamination	Further investigation will be carried out to identify potential contaminants.	Contractor	Detailed design
S5	Contamination	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works 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 Senior Manager Environment and Sustainability and/or EPA.	Contractor	Construction
S6	Contamination	The Soil and Water Management Plan would include a contingency plan for any acid sulfate soils or salinity identified during the construction phase.	Contractor	Pre-construction & Construction
TT1	Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the <i>Transport Traffic Control at Work Sites Manual</i> (Transport for NSW, 2022) and <i>QA Specification G10 Control of Traffic</i> (Transport for NSW, 2008). The TMP will include:</p> <ul style="list-style-type: none"> <li>• confirmation of haulage routes</li> <li>• measures to maintain access to local roads and properties</li> <li>• site-specific traffic control measures (including signage) to manage and regulate traffic movement</li> <li>• measures to maintain pedestrian and cyclist access as per existing provisions</li> <li>• requirements and methods to consult and inform the local community of impacts on the local road network</li> <li>• access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads</li> <li>• a response plan for any construction traffic incident</li> <li>• 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</li> <li>• monitoring, review and amendment mechanisms.</li> </ul>	Contractor	Pre-construction and Construction
TT2	Traffic and transport	<p>Property access will be maintained where possible during construction including access to commercial premises and residences. Where property access would have to be temporarily disrupted during construction:</p> <ul style="list-style-type: none"> <li>• property owners will be notified at five business days prior to the access closure</li> </ul>	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>alternative access will be provided if available</li> </ul> <p>access closure will be minimised and access will be returned to the property owners as soon as possible</p>		
TT3	Traffic and transport	<p>Pedestrian and cyclist access is to be maintained throughout construction to the similar extent of existing configuration.</p> <p>Provision of signage outlining the pedestrian and cyclist diversion routes would be displayed during construction.</p> <p>There would be advance notification of any construction works that would affect pedestrians and cyclists.</p>	Contractor	Construction
NV1	Noise and vibration	<p>A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim Construction Noise Guideline (ICNG) (DECC, 2009) and identify:</p> <ul style="list-style-type: none"> <li>all potential significant noise and vibration generating activities associated with the activity</li> <li>feasible and reasonable mitigation measures to be implemented, taking into account beyond the pavement: urban design policy, process and principles (transport, 2014).</li> <li>a monitoring program to assess performance against relevant noise and vibration criteria</li> <li>arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures</li> <li>contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.</li> </ul>	Contractor	Pre-construction
NV2	Noise and vibration	<p>All sensitive receivers (e.g., schools and local residents) likely to be affected will be notified at least five business days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> <li>the project</li> <li>the construction period and construction hours</li> <li>contact information for project management staff</li> <li>complaint and incident reporting</li> <li>how to obtain further information.</li> </ul>	Contractor	Pre-construction/ Construction
NV3	Noise and vibration	<p>Locate compressors, generators, pumps and any other fixed plant as far from residences as possible and behind site structures.</p>	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
NV4	Noise and vibration	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.	Contractor	Construction
NV5	Noise and vibration	Vehicle delivery times will be scheduled where feasible to standard construction hours to minimise noise impacts from heavy vehicle movements and deliveries.	Contractor	Construction
NV6	Noise and vibration	During work hours, a community liaison phone number and site contact will be provided to enable complaints to be received and responded to.	Contractor	Construction
NV7	Noise and vibration	The environmental induction program will include specific noise and vibration issues awareness training.	Contractor	Construction
NV8	Noise and vibration	Building condition surveys will be undertaken for buildings within safe working distances.	Contractor	Pre-construction
NV9	Noise and vibration	A vibration assessment is to be prepared and included in the NVMP. The vibration assessment is to include (as a minimum): <ul style="list-style-type: none"> <li>• identification of potentially affected properties/receivers</li> <li>• a risk assessment to determine the potential for discrete work activities to affect receivers</li> <li>• a map indicating the locations considered likely to be impacted and those requiring building condition surveys</li> <li>• outline a monitoring program</li> <li>• a process for assessing the performance of the implemented mitigation measures</li> <li>• a process for resolving issues and conflicts.</li> </ul>	Contractor	Pre-construction
NV10	Noise and vibration	Construction methods must consider safe working distances for rollers and other vibration producing equipment when working adjacent to structures, including heritage structures.	Contractor	Construction
NV11	Noise and vibration	Consider alternative equipment, plant and processes which produce less vibration where safe working distances cannot be achieved, to minimise or prevent vibration impacts on heritage structures.	Contractor	Construction
NV12	Noise and vibration	Noisy works (including sawcutting, jackhammering, mulching and chainsaw use) will be completed by midnight (12 am).	Contractor	Construction
NV13	Noise and vibration	Noise curtains are to be used for all noisy works (including sawcutting, jackhammering, mulching and chainsaw use) at night.	Contractor	Construction
NV14	Noise and vibration	Works will be undertaken no more than five nights in a week.	Contractor	Construction



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No.	Impact	Environmental safeguards	Responsibility	Timing
NV15	Noise and vibration	Consider alternative accommodation for residents that experience highly intrusive noise levels during construction.	Contractor	Pre-construction Construction
AH1	Aboriginal heritage	The <i>Standard Management Procedure - Unexpected Heritage Items</i> (Transport, 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 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	Pre-construction / construction
NH1	Non-Aboriginal heritage	The <i>Standard Management Procedure - Unexpected Heritage Items</i> (Transport for NSW, 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	Pre-construction and Construction
NH2	Non-Aboriginal heritage	All workers will be inducted to the location of the nearby heritage item at Oxford Falls Public School.	Contractor	Pre-construction and Construction
L1	Visual amenity	The work site will be left in a tidy manner at the end of each workday.	Contractor	Construction
L2	Visual amenity	Construction plant and equipment will not remain onsite any longer than necessary after work is completed.	Contractor	Construction
L3	Visual amenity	Landscaping is to be designed in line with Transport's Landscape Design Guidelines, 2018.	Transport	Detailed design
E1	Socio-economic	A Communication Liaison Plan (CLP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CLP will include (as a minimum): <ul style="list-style-type: none"> <li>mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions</li> <li>contact name and number for complaints.</li> <li>consideration of a multi-lingual community and need for tailored methods of communicating in relation to project notifications and signage.</li> </ul>	Contractor	Pre-construction and Construction
E2	Property access and power supply outages during construction	All businesses and residences likely to be affected by proposed construction activities (such as driveway reinstatement and utility relocation work) will be notified about upcoming work at least five days prior to it being carried out. Notification would include: <ul style="list-style-type: none"> <li>contact name and details</li> </ul>	Contractor	Pre-construction/ Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>working hours and complaints process</li> </ul> <p>All businesses and residences requiring replacement power service connections to the property will be consulted in advance. This will include consultation on the placement of new private poles for property power connections within each impacted property and timing of works.</p>		
E3	Socio-economic	<p>A complaints handling procedure and register would be included in the CEMP and maintained for the duration of the project. The procedure must include:</p> <ul style="list-style-type: none"> <li>how complaints are to be recorded</li> <li>how a qualified community representative or delegate would be available to respond and appropriate action community complaints</li> <li>how Transport would be informed of complaints</li> <li>how complaints are to be reported</li> <li>how complaints would be followed up and managed</li> <li>how the complaints would be established and maintained</li> </ul>	Contractor	Pre-construction and Construction
E4	Socio-economic	Residents would be informed prior to any interruptions to utility services that may be experienced as a result of utilities relocation.	Contractor	Pre-construction and Construction
E5	Socio-economic	Road users, pedestrians and cyclists would be informed of changed conditions, including likely disruptions to access during construction.	Contractor	Pre-construction and Construction
E6	Socio-economic	Fencing with material attached (e.g. shade cloth) would be provided around the construction compounds and other areas to screen views of the construction compounds from adjoining properties.	Contractor	Pre-construction and Construction
E7	Socio-economic	All property acquisition will be carried out in accordance with the <i>Land Acquisition Information Guide</i> (Transport, 2014) and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	Transport for NSW	Pre-construction
WR1	Waste and resources	<p>The following resource management hierarchy principles would be followed:</p> <ul style="list-style-type: none"> <li>avoid unnecessary resource consumption as a priority</li> <li>avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery)</li> <li>disposal would be undertaken as a last resort (in accordance with the <i>Waste Avoidance and Resource Recovery Act, 2001</i>).</li> </ul>	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
WR2	Waste and resources	<p>A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:</p> <ul style="list-style-type: none"> <li>• measures to avoid and minimise waste associated with the project</li> <li>• classification of wastes and management options (re-use, recycle, stockpile, disposal)</li> <li>• statutory approvals required for managing on- and off-site waste, or application of any relevant resource recovery exemptions</li> <li>• procedures for storage, transport and disposal</li> <li>• monitoring, record keeping and reporting.</li> </ul> <p>The WMP will align with the <i>Environmental Procedure - Management of Wastes on Transport for NSW Land</i> (Transport, 2014) and relevant Transport Waste fact sheets.</p>	Contractor	Pre-construction
WR3	Waste and resources	All wastes would be managed in accordance with the <i>Protection of the Environment Operations Act 1997</i> .	Contractor	Construction
WR4	Waste and resources	Types of waste collected, amounts, date/time and details of disposal are to be recorded in a waste register.	Contractor	Construction
WR5	Waste and resources	Suitable waste disposal locations would be identified and used to dispose of litter and other wastes on-site. Suitable containers would be provided for waste collection.	Contractor	Pre-construction and Construction
W1	Air quality	<p>The CEMP will include measures to mitigate potential air quality impacts by:</p> <ul style="list-style-type: none"> <li>• vehicles transporting materials to and from site will be covered</li> <li>• dust will be suppressed on stockpiles and unsealed areas vis water trucks, stabilisation, soil binders and other measures</li> <li>• disturbed areas will be progressively rehabilitated</li> <li>• plant and vehicles will be maintained in good condition and in line with manufacturer specifications</li> <li>• plants and machinery will be turned off when not in use</li> <li>• no burning of any material will occur</li> <li>• visual monitoring of air quality will be carried out to verify effectiveness of controls.</li> <li>• adopting a process for altering management measures as required and reprogramming construction activities if the safeguards and</li> </ul>	Contractor	Construction

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No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>management measures do not adequately restrict dust generation.</p> <ul style="list-style-type: none"> <li>work will cease when levels of visible airborne dust become excessive.</li> </ul>		
W2	Hazards and risk management	The Landscape Plan must be developed with consideration of Asset Protection Zones and adequate setback distances from roadways to mitigate bushfire risk.	Contractor	Pre-construction and construction
W3	Hazards and risk management	A Bush Fire Risk Management Plan (BFRMP) will be prepared as part of the CEMP to manage bush fire risk during construction and would outline procedures to reduce risk including management of bush fire hazards and safeguards to be implemented during Bush Fire Danger Periods.	Contractor	Pre-construction and construction
W4	Hazards and risk management	The contractor will schedule works outside of the Bush Fire Danger Period where possible.	Contractor	Pre-construction and construction
W5	Hazards and risk management	The contractor will ensure access arrangements for emergency services and evacuation routes are maintained at all times	Contractor	Pre-construction and construction
W6	Hazards and risk management	The contractor will consult with NSW Rural Fire Service prior to disrupting water services due to construction works during Bush Fire Danger Periods if those works cannot be scheduled outside of those periods.	Contractor	Pre-construction and construction
CU1	Cumulative construction impacts	The project team will liaise with concurrent projects during construction to minimise Wakehurst Parkway flood risk and to minimise cumulative impacts.	Contractor	Pre-construction & Construction
CU2	Cumulative construction impacts	The CEMP will be revised to consider potential cumulative impacts from surrounding development activities as they become known. This would include a process to review and update mitigation measures as new works begin or if complaints are received.	Contractor	Pre-construction & Construction

### 7.3 Licensing and approvals

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
<i>Roads Act 1993</i>	Road occupancy licence to dig up, erect a structure or carry out work in, on or over a road	Prior to start of 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 Section 193 of the Environmental Planning and Assessment Regulation 2021.

### 8.1 Justification

Wakehurst Parkway is a key link that connects Pittwater Road, North Narrabeen and Warringah Road, Frenchs Forest in the Northern Beaches LGA. Wakehurst Parkway and intersections along the road corridor have been identified as key pinch points. The proposed improvements would reduce delays and improve safety for motorists travelling through this location.

There is an extensive crash history along Wakehurst Parkway, and at Wakehurst Parkway and Dreadnought Road intersection there is existing poor levels of service and capacity constraints. At the intersections of Wakehurst Parkway and Elanora Road, and Wakehurst Parkway and Mirrool Street, there are existing line of sight constraints and safety concerns for cars entering Wakehurst Parkway from side streets.

The proposal would improve safety outcomes by providing more storage capacity for queuing vehicles, upgrading traffic signals at the intersection at Dreadnought Road and introduce signalised pedestrian crossings at all legs of the intersection, installing raised medians to delineate southbound and northbound traffic, improving the line of sight for traffic, and banning right turn movements into and out of the service road (about 380 metres east of Mirrool Street, near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left in, left out only.

The proposal would improve traffic efficiency along Wakehurst Parkway through the addition of lanes at the intersections of Wakehurst Parkway and Dreadnought Road and Wakehurst Parkway and Oxford Falls Road. These intersections would also be improved by the provision of turning bays and slip lanes to assist in traffic flow. Hardstand for bus stop locations are also included in the proposal, improving active transport accessibility and encouraging a mode shift to public and active transport.

This REF assessed the proposal against the 'do nothing' option, and it was assessed that the proposal would provide sufficient benefits in the form of easing of traffic congestion and safety improvements to justify the temporary impacts of construction. The proposal is expected to assist in reducing the average delays on Wakehurst Parkway and intersections between Frenchs Forest Road and Pittwater Road during peak hours and improve the average overall intersection delays. The proposal objectives are considered to be met, balanced with minimising environmental and social impacts, which are briefly discussed below. For these reasons, the proposal is considered to be justified.

#### 8.1.1 Social factors

Social and economic factors (Section 6.11), cultural heritage (Section 6.8 and Section 6.9), and visual amenity and landscape character (Section 6.10) have been assessed in this REF. Most of the work would be carried out within the existing road corridor and partially within adjoining properties.

Socio-economic impacts are anticipated as the surrounding area is mostly residential. The proposal would have the potential to create socio-economic impacts on the community through:

- construction noise and vibration
- traffic and access including temporary traffic control measures for road users and pedestrians, property access restrictions, and bus stop relocations, and permanent access change to the service road (near Palm Terrace)
- visual impacts from the removal of vegetation
- changes to property access at the service road (near Palm Terrace)
- possible temporary loss of services and utilities during relocation and reconnection of services such as electricity and water.

While socio-economic impacts are anticipated during construction, these are expected to be minor and management measures and safeguards would be in place as a mitigation.

Overall the proposal would have a long term, positive effect for the local community and businesses in the vicinity as it would improve traffic efficiency and road safety and ease traffic congestion.

This would be achieved through the provision of additional through lanes and turning lanes or slip lanes at the intersections of Wakehurst Parkway and Dreadnought Road, and Wakehurst Parkway and Oxford Falls Road. A new westbound lane would also be provided on Wakehurst Parkway in the vicinity of the Mirrool Street intersection. The proposal would improve safety conditions by providing more capacity for queuing vehicles and reducing conflicts between queuing drivers, improving pedestrian connectivity at Wakehurst Parkway and Dreadnought Road by providing signalised pedestrian crossings on all legs of the intersection, and installing raised medians to delineate between northbound and southbound lanes on Wakehurst Parkway.

### 8.1.2 Biophysical factors

Potential environmental impacts as a result of the proposal are described throughout Chapter 6 of the REF. The proposal is likely to have some biophysical impact due to vegetation removal.

The options assessment for the proposal has sought to minimise potential impacts on biodiversity, particularly the removal of native vegetation. Impacts to vegetation would be further reduced through the implementation of mitigation measures.

The proposal would result in the following direct impacts to biodiversity:

- removal of 2.38 hectares of native vegetation from within the proposal area comprising the following Plant Community Types (PCT): PCT 3586, PCT 3592, PCT 3593, PCT 595, PCT 3924 PCT 4019 and PCT 4028
- removal of 0.06 hectares of threatened ecological communities comprising of:
  - 0.02 hectares of Coastal Upland Swamps in the Sydney Basin Bioregion are listed as Endangered under the BC and EPBC Acts
  - 0.02 hectares of Swamp Sclerophyll Forest on Coastal Floodplains of New South Wales, North Coast, Sydney Basin and South East Corner Bioregion, listed as Endangered under the BC Act and River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria, listed as Critically Endangered under the EPBC Act
  - 0.02 hectares of Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregion, listed as Endangered under the BC Act, and Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland, listed as Endangered under the EPBC Act
- removal of 52 individuals of Angus's Onion Orchid across 0.21 hectares of habitat
- removal of 0.83 hectares of breeding, foraging and sheltering habitat for Red-crowned Toadlet
- removal of 1.07 hectares of foraging habitat for Southern Myotis

Mitigation measures for biodiversity impacts will be implemented in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011). More targeted measures will be adopted to mitigate the impacts of the proposal on the Endangered orchid species Angus's Onion Orchid. This will include a plant salvage and translocation project.

Temporary impacts to amenity may occur during construction including noise and vibration, visual impacts and air quality. These impacts would be managed through the application of management measures and safeguards summarised in Section 7.2.

The proposal has some long-term negative biophysical impacts that would be mitigated by vegetation offsetting, salvage of threatened species, tree replacement, and protection fencing. The impacts of the proposal would be outweighed by the long-term benefits once the proposal is operational through improvements to the transport network in and around the proposal area.

### 8.1.3 Economic factors

Economic factors have been assessed as part of the REF in Section 6.11. The proposal would not create substantial impacts to businesses in the vicinity of construction work. Some home-based businesses and employees that work from home may experience noise disturbance during the program of work as detailed in Section 6.7. These impacts would be effectively managed through respite periods and other mitigation measures as outlined in Section 7.2.

### 8.1.4 Public interest

The proposal recognises the need to ease congestion, reduce travel times and improve safety at the intersections along Wakehurst Parkway. The proposal would:

- improve the intersection performance and reduce the queueing on Wakehurst Parkway and Dreadnought Road and Wakehurst Parkway and Oxford Falls Road, with added capacity on approaches
- encourage transport mode shift to active and public transport options by providing two additional bus stops north of Dreadnought Road and Wakehurst Parkway intersection and improving pedestrian access to nearby schools and amenities by providing additional signalised pedestrian crossings and footpath pavement
- provide capacity for future traffic growth by widening Wakehurst Parkway between Trefoil Creek and Oxford Falls Road, and by providing separate turning lanes to improve capacity of through traffic at the major intersections within the proposal boundary
- improve safety for pedestrians by introducing additional signalised pedestrian crossings at Dreadnought Road and Wakehurst Parkway, and improve safety for motorists by providing additional through lanes along Wakehurst Parkway to minimise risk of rear-end collisions, and providing raised medians to separate northbound and southbound traffic.

Overall the proposal is considered to be justified in meeting its objectives with minimal short or long-term impacts, and is therefore in the public interest.

## 8.2 Objects of the EP&A Act

Table 8-1: Objects of the Environmental Planning and Assessment Act 1979

Instrument	Requirement
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The proposal would improve the transport network while minimising social, economic and environmental impacts. It is therefore consistent with the objective of promoting the social and economic welfare of the community and a better environment.
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 8.2.1.
1.3(c) To promote the orderly and economic use and development of land.	Not relevant to the proposal.
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.	<p>Construction of the proposal would result in some impacts to biodiversity along Wakehurst Parkway, as detailed in Section 6.1.</p> <p>Protection work to preserve biodiversity include:</p> <ul style="list-style-type: none"> <li>• translocation of Angus's Onion Orchid (<i>Microtis angusii</i>)</li> <li>• tree protection zones in construction compounds and at intersections where upgrades would occur.</li> </ul> <p>Biodiversity offset credits would be paid for:</p> <ul style="list-style-type: none"> <li>• PCT 3586: Northern Sydney Scribbly Gum Woodland</li> <li>• PCT 3592: Sydney Coastal Enriched Sandstone Forest</li> </ul>



Instrument	Requirement
	<ul style="list-style-type: none"> <li>• PCT 3593: Sydney Coastal Sandstone Bloodwood Shrub Forest</li> <li>• PCT 3595: Sydney Coastal Sandstone Gully Forest</li> <li>• PCT 3924: Sydney Coastal Upland Swamp Heath</li> <li>• PCT 4019: Coastal Alluvial Bangalay Forest</li> <li>• PCT 4028: Estuarine Swamp Oak Twig-rush Forest</li> <li>• Angus’s Onion Orchid (<i>Microtus angusii</i>)</li> <li>• Southern Myotis (<i>Myotic macropus</i>)</li> <li>• Red-crowned Toadlet (<i>Pseudophryne australis</i>).</li> </ul>
<p>1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).</p>	<p>Direct and indirect impacts to Aboriginal cultural heritage are unlikely as a result of this proposal. Notwithstanding, an unexpected finds protocol would be followed in the event of discovery of an archaeological artefact or site, as detailed in Section 6.8.</p> <p>Works in the proximity to the Oxford Falls Public School heritage site (ID: I116), particularly the sandstone wall fronting the north and east of the lot, would be required to undertake additional mitigation measures to prevent vibration damage. Refer to section 6.7 for more detail. Non-Aboriginal cultural heritage would not be impacted as a result of this proposal.</p>
<p>1.3(g) To promote good design and amenity of the built environment.</p>	<p>Not relevant to the proposal.</p>
<p>1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.</p>	<p>Not relevant to the proposal.</p>
<p>1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.</p>	<p>Not relevant to the proposal.</p>
<p>1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.</p>	<p>Transport has consulted Aboriginal stakeholders and Northern Beaches Council seeking feedback on the proposal. Transport has committed to continuing consultation throughout detailed design and during construction, and once operational. Consultation with the community would occur through the publication of the REF and the subsequent response to submissions report. Chapter 1 describes details on how stakeholder consultation has occurred.</p>

### 8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

#### The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

This principle was considered during the options assessment (refer to Chapter 2). The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures.

The environmental assessments forming this REF have been informed by specialist studies for ecology, arboriculture, noise and vibration, groundwater and soil contamination, and landscape character and visual amenity. The best-available technical information, environmental standards and measures have been used to minimise environmental risks.

Therefore it is considered that the precautionary principle has been incorporated in the assessment of the proposal and the environmental studies undertaken have provided the best scientific understanding of the potential impacts, and the mitigation measures proposed are suitable to reduce or minimise impacts.

#### **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 existing traffic performance levels along Wakehurst Parkway show poor present performance and worsening congestion and safety outcomes into the future. The proposal would improve levels of service at the key intersections along Wakehurst Parkway and reduce delays by increasing the storage capacity for queuing vehicles and reducing conflicts between queuing drivers. The proposal would also improve safety for motorists along Wakehurst Parkway at Elanora Road and Mirrool Street by improving sight lines and converting the eastern access for Wakehurst Parkway service road (near Palm Terrace) to a left in, left out only configuration.

The short and long term impacts of the proposed intersection upgrade have been considered and addressed through the development of the concept design and REF and on-balance would benefit both current and future generations.

#### **Conservation of biological diversity and ecological integrity**

Conservation of biodiversity was considered in the design of this proposal through the extensive ecological and arboricultural investigations.

Construction compounds have been selected with consideration to existing trees and vegetation, and any compound used during construction would include tree protection, surface water quality and erosion and soil management measures implemented.

Biodiversity offsets for unavoidable residual ecological impacts would be implemented, as described in Section 6.1.

#### **Improved valuation, pricing and incentive mechanisms**

The principle of internalising environmental costs into decision making requires consideration of all environmental resources that may be affected by the carrying out of a project, including air, water, land and living things. The proposal reflects the natural, social and economic values of the locality. This REF has examined the environmental consequences of the proposal and identified mitigation measures and safeguards to address potential adverse impacts. The proposal represents a benefit to the community in terms of improved safety for both motorists and pedestrians.

## **8.3 Conclusion**

The proposed intersection upgrades of Wakehurst Parkway between Frenchs Forest Road and Pittwater Road in the Northern Beaches LGA is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

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

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal, as described in the REF, best meets the project objectives but would still result in some impacts on biodiversity, trees, and noise and vibration. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve safety conditions for pedestrians and motorists, and reduce congestion and travel times when travelling to and from the Northern Beaches. On balance, the proposal is considered justified and the following conclusions are made.

#### **Significance of impact under NSW legislation**

The proposal would be likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act. A Biodiversity Development Assessment Report has been prepared to assess the anticipated significant

impact on the endangered Angus's Onion Orchid (*Microtis angusii*) due to the proximity of identified colonies to the intersection of Wakehurst Parkway and Oxford Falls Road.

There would be no significant impact on any other aspect of the environment. Therefore it is not necessary for an environmental impact statement to be prepared nor approval to be sought from the Minister for Planning under Division 5.1 of the EP&A Act. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

**Significance of impact under Australian legislation**

The proposal is likely to have a significant impact on threatened species, ecological communities and/or migratory species within the meaning of the EPBC Act. This REF has considered the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advice and guidelines provided by the Australian Government. The REF finds that the activity will not threaten the long-term survival of nationally-listed biodiversity matters and that suitable offset measures can be secured as set out in the Biodiversity Offset Strategy for the proposal.

This REF has been prepared to meet the requirements of the EPBC Act strategic assessment approval for Transport Division 5.1 road activities. A referral to the Australian Department of Climate Change, Energy, the Environment and Water is not required.

## 10. EP&A Regulation publication requirement

Table 10-1: EP&A Regulation publication requirement

Requirement	Yes/No
Does this REF need to be published under section 171(4) of the EP&A Regulation?	Yes

## 11. References

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## 12. Terms and acronyms used in this REF

Table 12-1: Terms and acronyms used in this REF

Term / Acronym	Description
2022 SIS	<i>State Infrastructure Strategy 2022-2042</i>
AAR	Aboriginal Assessment Report
AEP	Annual Exceedance Probability
AHIMS	Aboriginal Heritage Information Management System
AOBV	Areas of Outstanding Biodiversity Values
Area A	A term used in Section 2 of the REF, referring to Wakehurst Parkway from Trefoil Creek to Dreadnought Road
Area B	A term used in Section 2 of the REF, referring to Wakehurst Parkway and Dreadnought Road intersection. This section falls under the broader area Wakehurst Parkway from Dreadnought Road to Oxford Falls Road.
Area C	A term used in Section 2 of the REF, referring to Wakehurst Parkway and Oxford Falls Road intersection. This section falls under the broader area Wakehurst Parkway from Dreadnought Road to Oxford Falls Road.
Area D	A term used in Section 2 of the REF, referring to Wakehurst Parkway from Elanora Road to Mirrool Street.
ARI	Average Recurrence Interval
ASS	Acid Sulfate Soils
AusLink	Mechanism to facilitate cooperative transport planning and funding by Commonwealth and state and territory jurisdictions
BAM	Biodiversity Assessment Method
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BDAR	Biodiversity Development Assessment Report
BGL	Below Ground Levels
BH	Boreholes
Biosecurity Act	<i>Biosecurity Act 2015</i>
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CBD	Central Business District
CC1, CC2, CC3, CC4, CC5, CC6, CC7, CC8, CC9	Refers to the proposed construction compounds. Each of the proposed sites have been denoted a number from 1 to 9, i.e. CC1 refers to Construction Compound 1, CC2 refers to Construction Compound 2, etc.
C3 SYD church	C3 Pentecostal Church and associated Christian college
CCTV	Closed Circuit Television
CEMP	Construction environmental management plan
CLP	Communication Liaison Plan
CNVG	Construction Noise and Vibration Guideline
CoA	Conditions of Approval
dBA	Decibels
Dbh	Diameter at breast height
DCCEW	Australian Department of Climate Change, Energy, the Environment and Water

Term / Acronym	Description
DPE	Department of Planning and Environment
EEC	Endangered Ecological Community
EIA	Environmental impact assessment
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i> . Provides the legislative framework for land use planning and development assessment in NSW
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i> . Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process
ESC	Easing Sydney's Congestion
ESCP	Erosion and Sediment Control Plan
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
EY	Exceedance per Year
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GDE	Groundwater Dependent Ecosystem
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
HIL-D	Health Investigation Level D
IBRA bioregions and subregions	Interim Bioregion Regionalisation of Australia. A classification of geographically distinct areas of land with common characteristics, such as climate, geology, landforms and ecosystems.
ICNG	Interim Construction Noise Guideline
ITS	Intelligent Transport Systems
Km/h	Kilometres per hour
LALC	Local Aboriginal Land Council
LDBH	Large Diameter Boreholes
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
m	Metres
MNES	Matters of national environmental significance under the <i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
NBC	Northern Beaches Council
NEPM	National Environmental Protection Measure 1999
NML	Noise Management Level
Northbound	Traffic movement on Wakehurst Parkway towards Pittwater Road
NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
OC	Organochlorine pesticides
OEH	Office of Environment and Heritage within the Department of Planning and Environment.
OOHW	Out Of Hours Work
OP	Organophosphorous pesticides

Term / Acronym	Description
PACHCI	Preliminary Aboriginal Cultural Heritage Consultation and Investigation
PAH	Polyaromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
PCT	Plant Community Type
PEA Act	<i>Protection of the Environment Administration Act 1991.</i>
PEPSI	Preliminary Environmental Planning and Sustainability Investigation
Pittwater LEP	Pittwater Local Environmental Plan 2014
PMF	Probable Maximum Flood
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
QA Specifications	Specifications developed by Transport for use with road work and bridge work contracts let by Transport.
Ramsar wetlands	Wetlands of International Importance
RBL	Rating Background Level
RMS	NSW Roads and Maritime Services, now Transport for NSW
RNCG	Road Noise Criteria Guideline
RTA	Road Traffic Authority, now referred to as Transport for NSW
SAIL	Serious and Irreversible Impacts
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP (Biodiversity and Conservation)	State Environmental Planning Policy (Biodiversity and Conservation) 2021
SEPP (Planning Systems)	State Environmental Planning Policy (Planning Systems) 2021
SEPP (Precincts – Central River City)	State Environmental Planning Policy (Precincts – Central River City) 2021
SEPP (Precincts – Eastern Harbour City)	State Environmental Planning Policy (Precincts – Eastern Harbour City) 2021
SEPP (Precincts – Regional)	State Environmental Planning Policy (Precincts – Regional) 2021
SEPP (Resilience and Hazards)	State Environmental Planning Policy (Resilience and Hazards) 2021
SEPP (Transport and Infrastructure)	State Environmental Planning Policy (Transport and Infrastructure) 2021
SES	State Emergency Service
SMPM	Sydney Motorway Projects Model
Southbound	Traffic movement on Wakehurst Parkway towards Frenchs Forest
SWMP	Soil and Water Management Plan
TCLP	Toxicity Characteristic Leaching Procedure
TCS	Traffic Control Signals
TEC	Threatened Ecological Communities
TMP	Traffic Management Plan
Transport	Transport for NSW
Warringah LEP	Warringah Local Environmental Plan 2011
WMP	Waste Management Plan

Term / Acronym	Description
WoNS	Weeds of National Significance

# Appendix A - Consideration of section 171 factors and matters of national environmental significance and Commonwealth land

## Section 171 Factors

In addition to the requirements of the Guideline for Division 5.1 assessments (DPE 2022) and the Roads and Related Facilities EIS Guideline (DUAP 1996) as detailed in the REF, the following factors, listed in section 171 of the Environmental Planning and Assessment Regulation 2021, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
<p>a Any environmental impact on a community?</p> <p>The proposal would have construction impacts including the generation of potential traffic impacts, construction noise, and visual amenity. These impacts could negatively impact the local community as described in Chapter 6 of this REF.</p> <p>These would be managed through the implementation of the safeguards listed in Section 7.2.</p> <p>The proposal would improve traffic conditions and travel time on Wakehurst Parkway from Frenchs Forest Road to Pittwater Road, improve road freight efficiency and improve road safety for all road users. This would result in a long-term positive impact for the local community and for the Northern Beaches area.</p>	<p>Minor, negative, long-term</p> <p>Positive, long-term</p>
<p>b Any transformation of a locality?</p> <p>The construction of the proposal would temporarily impact the existing locality, predominantly through negative visual amenity impacts associated with the placement and movement of construction plant and equipment, and the removal of existing vegetation.</p> <p>These would be managed through the implementation of the safeguards listed in Section 7.2.</p> <p>Partial acquisition would be required at three properties opposite Wakehurst Parkway and Oxford Falls Road intersection. This acquisition would have no substantial effect on the functionality or viability of the current or future use of the remainder of the property.</p> <p>This work is expected to result in a long-term, minor, negative transformation of the locality.</p>	<p>Minor, negative, long-term</p>
<p>c Any environmental impact on the ecosystems of the locality?</p> <p>The proposal would involve the removal of 2.38 hectares of native vegetation from within the proposal area comprising the PCT 3586, PCT 3592, PCT 3593, PCT 595, PCT 3924 PCT 4019 and PCT 4028.</p> <p>The proposal would also require the removal of 0.06 hectares of TECs comprising of Coastal Upland Swamps in the Sydney Basin Bioregion (listed as Endangered under the BC Act and EPBC Act), Swamp Sclerophyll Forest on Coastal Floodplains of New South Wales, North Coast, Sdney Basin and South East Corner Bioregion (listed as Endangered under the BC Act), River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (listed as Critically Endangered under the EPBC Act), Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregion (listed as Endangered under the BC Act), and Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland (listed as Endangered under the EPBC Act).</p> <p>The proposal would also require the removal of 52 individuals of Angus's Onion Orchid across 0.21 hectares of habitat, 0.83 hectares of breeding, foraging and sheltering habitat for Red-crowned Toadlet, and 1.07 hectares of foraging habitat for Southern Myotis.</p> <p>There is also potential for mortality/injury of threatened species during construction.</p> <p>These impacts would be managed and minimised through the implementation of the safeguards listed in Section 7.2.</p>	<p>Minor, negative, long-term</p>

Factor	Impact
<p>As the proposal would require the removal of native vegetation and potential fauna habitat from the proposal area, Transport for NSW are required to offset these impacts on biodiversity.</p>	
<p>d Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</p> <p>During construction, the proposal would have the potential to create a reduction in the existing aesthetic quality of the local area as a result of construction impacts including dust and noise generation, visual impacts and increased traffic movements, including increased heavy vehicle movements. These impacts would be minimised as far as practicable through the implementation of the safeguards outlined in Section 7.2.</p> <p>During operation, the proposal would result in a minor reduction in the overall aesthetic quality of the local area due to the removal of 2.38 hectares of native vegetation and the alteration of the local landscape for the new road alignment (in places). A range of urban design safeguards would be implemented to reduce visual impacts (refer to Section 7.2).</p> <p>It is considered that the overall amenity of the proposal area would not be substantially reduced as a result of the operation of the proposal, however the locality would be impacted in a minor way due to the required clearance of vegetation for the new road alignment.</p> <p>Additionally, no recreational or scientific qualities of the proposal area are anticipated to be impacted during the construction or operation of the proposal.</p>	<p>Minor, negative, short-term</p> <p>Minor, negative, long-term</p>
<p>e Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?</p> <p>The proposal would not impact any Aboriginal items within the proposal area.</p> <p>The Oxford Falls Conservation Area is adjacent to the proposal footprint at Wakehurst Parkway and Oxford Falls Road intersection and would be impacted by vegetation removal required for road widening and utility work. The area is about 100 square metres and considered to be minor.</p> <p>The proposal would have potential impacts the Oxford Falls Public School site (I116) and the sandstone wall at the north-western corner of Wakehurst Parkway and Dreadnought Road intersection due to vibration impacts. The construction vibration assessment concluded that no impact to the heritage site would occur as a result of construction work if the safeguards listed in Section 7.2, such as using smaller machinery like vibratory rollers during construction, are implemented during construction. Therefore it is expected that potential vibrational impacts would be effectively mitigated.</p>	<p>Minor, negative, long-term</p> <p>Minor, negative, short-term</p>
<p>f Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)?</p> <p>The proposal would involve the removal of 2.38 hectares of native vegetation from within the proposal area comprising the PCT 3586, PCT 3592, PCT 3593, PCT 595, PCT 3924 PCT 4019 and PCT 4028.</p> <p>The proposal would also require the removal of 0.06 hectares of TECs comprising of Coastal Upland Swamps in the Sydney Basin Bioregion (listed as Endangered under the BC Act and EPBC Act), Swamp Sclerophyll Forest on Coastal Floodplains of New South Wales, North Coast, Sydney Basin and South East Corner Bioregion (listed as Endangered under the BC Act), River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (listed as Critically Endangered under the EPBC Act), Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregion (listed as Endangered under the BC Act), and Coastal Swamp Oak (Casuarina</p>	<p>Minor, negative, long-term</p>

Factor	Impact
<p>glauca) Forest of New South Wales and South East Queensland (listed as Endangered under the EPBC Act).</p> <p>Species credits would be required to offset the impacts of the proposal, as determined using the BAM credit calculator (refer to Section 6.1).</p>	
<p>g Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</p> <p>The proposal is considered unlikely to endanger any species of flora or fauna due to the limited extent of vegetation proposed to be removed. Some loss of habitat for the threatened species Angus's Onion Orchid (<i>Microtis angusii</i>), Red-crowned Toadlet (<i>Pseudophryne australis</i>), and Southern Myotis (<i>Myotis macropus</i>). Vegetation removal would be minimised during detailed design and would follow the mitigation and management measures outlined in Section 7.2.</p>	<p>Minor, negative, long-term</p>
<p>h Any long-term effects on the environment?</p> <p>Minor negative long-term impacts are expected in regard to visual impacts due to the modification of the location landscape and provision of new visual elements including bus bays, raised medians and road widening. However long-term effects on the environment are proposed to be minimised through the implementation of safeguards outlined in Section 7.2.</p> <p>The proposal would also have an overall minor negative long-term impact on the existing environment through the permanent clearance of up to 2.38 hectares of native vegetation.</p>	<p>Minor, negative, long-term</p> <p>Minor, negative, long-term</p>
<p>i Any degradation of the quality of the environment?</p> <p>The proposal would require the permanent clearance of up to 2.38 hectares of native vegetation. The site would be rehabilitated as far as practical post-construction which would reduce the risk of long-term degradation to the environment.</p> <p>Safeguards would be implemented during construction including measures to prevent the spread of noxious weeds which would have the potential to degrade the quality of the environment in the long-term (refer to Section 7.2).</p> <p>A number of potential water quality impacts have potential to result in the degradation of the quality of the environment. Water quality could be reduced as a result of pollutants such as sediment, soil nutrients, waste, and spilt fuels and chemicals entering drainage lines and creeks. Hydrology and drainage would be disturbed during construction of the proposal, potentially impacting on the existing geomorphology of the local environment. These biodiversity impacts would be managed and minimised through the implementation of the safeguards listed in Section 7.2.</p> <p>Landscape and visual amenity would be impacted during construction. An integrated design approach has been taken to minimise impacts (refer to Section 6.10).</p> <p>No additional degradation of the quality of the environment is expected to occur during the operation of the proposal.</p>	<p>Minor, negative, long-term</p> <p>Minor, negative, short-term</p> <p>Minor, negative, short-term</p>
<p>j Any risk to the safety of the environment?</p> <p>There is potential for road safety to be reduced during construction due to the need for work to be undertaken on the existing Wakehurst Parkway. Traffic management safeguards, including the preparation of a Construction Traffic Management Plan, would address these safety risks (refer to Section 7.2). Environmental management plans and work health and safety plans would be implemented to minimise any safety risk during the construction of the proposal.</p>	<p>Minor, negative, short-term</p>



Factor	Impact
<p>The proposal would result in an improvement to road safety for all road users from the intersection upgrades along Wakehurst Parkway from Frenchs Forest Road to Pittwater Road (refer to Section 6.6).</p>	
<p>k Any reduction in the range of beneficial uses of the environment? The proposal would result in traffic impacts during construction which would include an increase in the volume of heavy vehicles, interruption of traffic flow and temporary change in speed limit. These traffic impacts would reduce the beneficial use of Wakehurst Parkway during the construction. Management of traffic impacts would be undertaken in accordance with the safeguards outlined in Section 7.2. During operation, the proposal would improve travel times along Wakehurst Parkway, reduce congestion and improve overall connectivity.</p>	<p>Minor, negative, short-term  Positive, long-term</p>
<p>l Any pollution of the environment? The proposal would have the potential to result in some minor, negative shortterm water pollution risks of impacts resulting from sediments, soil nutrients, waste, and spilt fuels and chemicals. Management of water quality impacts would be undertaken in accordance with the safeguards outlined in Section 7.2. Short-term noise and air quality impacts are expected during the construction phase of the proposal from plant and machinery and the generation of dust during construction. These impacts would be managed in accordance with the safeguards outlined in Section 7.2.</p>	<p>Minor, negative, short-term</p>
<p>m Any environmental problems associated with the disposal of waste? Waste would be managed in accordance with the resource management hierarchy principles outlined in the <i>Waste Avoidance and Resource Recovery Act 2001</i>. It is not anticipated that there would be issues encountered with the disposal of waste. Potential impacts would be managed in accordance with the safeguards outlined in Section 7.2.</p>	<p>Minor, negative, short-term</p>
<p>n Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The proposal would not significantly increase demands on resources, which are, or are likely to become, in short supply. Relatively small amounts of materials would be required for the proposed work. The safeguards listed in Section 7.2 of this REF would be implemented to minimise any impacts.</p>	<p>Nil</p>
<p>o Any cumulative environmental effect with other existing or likely future activities? The proposal has the potential to have cumulative environmental effects with other existing or likely future activities including the Northern Beaches Council flood improvement work. The construction programs for both proposals are unlikely to overlap, however, should the proposals overlap, cumulative impacts would include increased traffic delays, cumulative noise impacts, and construction fatigue for local residents and road users. The proposals would result in an ongoing positive impact due to improvements to flood immunity of Wakehurst Parkway. Any potential negative impacts on the environment would be minimised with the implementation of the safeguards summarised in Section 7.2 of this REF.</p>	<p>Minor, negative, short-term</p>
<p>p Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposal area is adjacent to mapped coastal wetlands in the northern extent of the proposal and is situated on mapped proximity areas to coastal wetlands. The design and construction boundaries have been developed to avoid coastal wetlands and the proposal does not intersect the mapped areas of the coastal wetland.</p>	<p>Minor, negative, short-term</p>

Factor	Impact
Minor changes to water quality may occur throughout the construction of the proposal, as a result of sedimentation or chemical runoff, however, mitigation will be in place to prevent runoff into the coastal wetland area and Narrabeen Lagoon in accordance with safeguards in Section 7.2 of the REF.	
<p>q Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1.</p> <p>The proposal aligns with a number of local strategic planning statements, regional strategy plans and district strategic plans including Future Transport Strategy, Our Greater Sydney 2056 Central City District Plan – connecting communities, State Infrastructure Strategy 2022-2043: Staying Ahead and Greater Sydney Services and Infrastructure Plan by optimising the existing road corridor of Wakehurst Parkway and improving the network performance and safety of key intersections. The proposal would also allow for better travel efficiency between Frenchs Forest and North Narrabeen.</p>	Positive, long- term
r Other relevant environmental factors.	In considering the potential impacts of this proposal all relevant environmental factors have been considered, refer to Chapter 6 of this assessment.

## Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Department of Climate Change, Energy, the Environment and Water .

A referral is not required for proposed actions that may affect nationally-listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
a Any impact on a World Heritage property?	Nil
b Any impact on a National Heritage place?	Nil
c Any impact on a wetland of international importance?	Nil
<p>d Any impact on a listed threatened species or communities?</p> <p>The proposal will remove a total of 0.06 hectares of the following nationally listed TECs: Coastal Upland Swamp (0.02 hectares), River-flat Eucalypt Forest (0.02 hectares) and Swamp Oak Floodplain Forest (0.02 hectares). The patches of TEC to be removed are located on the edges of broader patches of the communities. In all cases, the removal of small areas from the edge of larger patches is unlikely to cause the retained areas to become unviable. The areas of each TEC to be removed is considered minor when compared to mapped areas of the communities in the local landscape and the total estimated extents.</p> <p>Some loss of habitat for the threatened species Angus’s Onion Orchid (<i>Microtis angusii</i>), Red-crowned Toadlet (<i>Pseudophryne australis</i>), and Southern Myotis (<i>Myotis macropus</i>).</p> <p>The proposal would remove 0.21 hectares including 52 individuals of habitat for Angus’s Onion Orchid. This is considered a significant impact.</p> <p>Habitat within the proposal area is considered general in nature and not of high importance for Glossy Black-cockatoo (<i>Calyptorhynchus lathami</i>), Eastern Osprey (<i>Pandion cristatus</i>), and Grey-headed Flying Fox (<i>Pteropus poliocephalus</i>) and is therefore unlikely to result in a significant impact to</p>	<p>Minor, negative, long-term</p> <p>Significant, negative, long-term</p> <p>Minor, negative, long-term</p>

Factor	Impact
a local population if removed. Extensive, similar habitat features are present in adjacent areas to the proposal area and in the wider locality.	
<p>Any impacts on listed migratory species?</p> <p>One EPBC Act listed migratory species, Eastern Osprey (<i>Pandion cristatus</i>) was recorded during surveys on the proposal area. Habitat within the proposal area is considered general in nature and not of high importance to the Eastern Osprey and is therefore unlikely to result in a significant impact upon the species.</p>	Nil
e Any impact on a Commonwealth marine area?	Nil
f Does the proposal involve a nuclear action (including uranium mining)?	Nil
<p>g Additionally, any impact (direct or indirect) on the environment of Commonwealth land?</p> <p>The proposal would permanently acquire about 2692 square metres of Commonwealth land (refer to Section 3.6).</p>	Minor, negative, long-term

## Appendix B- Statutory consultation checklists

## Transport and Infrastructure SEPP

### Certain development types

Development type	Description	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No	N/A	Section 2.110
Bus Depots	Does the project propose a bus depot?	No	N/A	Section 2.110
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	N/A	Section 2.110

### Development within the Coastal Zone

Development type	Description	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	Yes	Northern Beaches Council	Section 2.14

Note: See interactive map at [Planning Portal NSW spatial viewer - find a property](#). Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program.

### Council related infrastructure or services

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Stormwater	Are the works likely to have a <i>substantial</i> impact on the stormwater management services which are provided by council?	No	N/A	Section 2.10
Traffic	Are the works likely to generate traffic to an extent that will <i>strain</i> the capacity of the existing road system in a local government area?	No	N/A	Section 2.10
Sewerage system	Will the works involve connection to a council owned sewerage system? If so, will	No	N/A	Section 2.10

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
	this connection have a <i>substantial</i> impact on the capacity of any part of the system?			
Water usage	Will the works involve connection to a council owned water supply system? If so, will this require the use of a <i>substantial</i> volume of water?	No	N/A	Section 2.10
Temporary structures	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a <i>minor</i> or <i>inconsequential</i> disruption to pedestrian or vehicular flow?	No	N/A	Section 2.10
Road & footpath excavation	Will the works involve more than <i>minor</i> or <i>inconsequential</i> excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes	Northern Beaches Council Refer to Chapter 5	Section 2.10

**Local heritage items**

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works? 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?	Yes	Northern Beaches Council	Section 2.11

**Flood liable land**

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
Flood liable land	Are the works located on flood liable land? If so, will the works change flood patterns to more than a <i>minor</i> extent?	No, the works will not change flood patterns.	Northern Beaches Council Refer to Chapter 5	Section 2.12

Flood liable land	Are the works located on flood liable land? (to any extent). If so, do the works comprise more than minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance?	No	N/A The proposal is located on flood liable land. However minor alterations or demolitions of building, emergency works or routine maintenance would not occur as a part of the proposal.	Section 2.13
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Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled Floodplain Development Manual: the management of flood liable land published by the New South Wales Government.

**Public authorities other than councils**

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP (Transport and Infrastructure) Section
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the <i>National Parks and Wildlife Act 1974</i> , or on land acquired under that Act?	No	Environment and Heritage Group, DPE	Section 2.15
National parks and reserves	Are the works on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	Environment and Heritage Group, DPE	Section 2.15
Navigable waters	Do the works include a fixed or floating structure in or over navigable waters?	No	Transport for NSW - Maritime	Section 2.15
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service (RFS) [Refer to the NSW RFS publication: <i>Planning for Bush Fire Protection (2006)</i> ]	Section 2.15
Artificial light	Would the works increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	Director of the Siding Spring Observatory	Section 2.15
Defence communications buffer land	Are the works on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in section 5.15 of Lockhart LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.	No	Secretary of the Commonwealth Department of Defence	Section 2.15
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the <i>Mine Subsidence Compensation Act 1961</i> ?	No	Mine Subsidence Board	Section 2.15

SEPP (Precincts – Central River City) 2021 and SEPP (Precincts – Western Parkland City) 2021

Development type	Potential impact	Yes / No	If 'yes' consult with	SEPP section
Clearing native vegetation	Do the works involve clearing native vegetation (as defined in the <i>Local Land Services Act 2013</i> ) on land that is not <b>proposal area</b> (as defined in cl 17 of schedule 7 of the <i>Threatened Species Conservation Act 1995</i> )?	No	Department of Planning and Environment	Section 3.24



## Appendix C- PACHCI Letter

29<sup>th</sup> of May 2023

**Jarita Zeng**

Senior Environment and Sustainability Officer  
Environment and Sustainability Branch (Assets and Operations)  
Safety, Environment and Regulation Division  
**Transport for NSW**

Dear Jarita,

**Preliminary assessment results for Wakehurst parkway Improvements Proposal based on Stage 1 of the *Procedure for Aboriginal cultural heritage consultation and investigation (the procedure)*.**

The project, as described in the Stage 1 assessment checklist was assessed as being unlikely to have an impact on Aboriginal cultural heritage.

The assessment is based on the following due diligence considerations:

- The project is unlikely to harm known Aboriginal objects or places.
- The AHIMS search did not indicate moderate to high concentrations of Aboriginal objects or places in the study area.
- The study area does contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the Roads and Maritime Services' procedure.
- There is a number of Aboriginal Registered sites within close proximity of the project zone, (Intersection of Wakehurst Pwy and Frechs Forest Rd-North east amongst the Bushland) if the project scope was to change and they would be impacted in anyway, TFNSW would need to revisit the PACHCI process.

Your project may proceed in accordance with the environmental impact assessment process, as relevant, and all other relevant approvals.

If the scope of your project changes, you must contact The Aboriginal Engagement Section, Greater Sydney Region, and your regional environmental staff to reassess any potential impacts on Aboriginal cultural heritage.

If any potential Aboriginal objects (including skeletal remains) are discovered during the course of the project, all works in the vicinity of the find must cease. Follow the steps outlined in the Roads and Maritime Services' *Unexpected Heritage Finds Procedure*.

For further assistance in this matter do not hesitate to contact me.

Roads and Maritime Services

# Appendix D - Biodiversity Development Assessment Report

## Appendix E - Arborist Assessment Report

# Appendix F – Noise and Vibration Impact Assessment

# Appendix G – Non-Aboriginal heritage searches

Item Name	Location	Item Type	Local Govt Area	Record Owner
Bantry Bay Reservoir (WS 0008)	Kirkwood Street ALLAMBIE HEIGHTS NSW 2100	Built	Northern Beaches	SGOV
Bantry Bay Water Pumping Station (WPS 122)	Kirkwood Street SEAFORTH NSW 2092	Built	Northern Beaches	SGOV
Bantry Bluff	Bantry Bay/Seaforth entrance Middle Harbour, Garigal National Park, Wakehurst Parkway SEAFORTH NSW 2092	Landscape	Northern Beaches	LGOV
Bridge No 3 over Middle Creek	Wakehurst Parkway NARRABEEN NSW 2101	Built	Northern Beaches	LGOV
Bridge No. 3 over Middle Creek	Wakehurst Parkway NARRABEEN NSW 2101	Built	Northern Beaches	SGOV
Deep Creek Bridge	Wakehurst Parkway (SR 397) ELANORA HEIGHTS NSW 2101	Built	Northern Beaches	SGOV
Frenchs Bullock Track	Wakehurst Parkway FRENCHS FOREST NSW 2086	Landscape	Northern Beaches	LGOV
Middle Creek Bridge No 1	Wakehurst Parkway OXFORD FALLS NSW 2100	Built	Northern Beaches	LGOV
Middle Creek Bridge No 2	Wakehurst Parkway OXFORD FALLS NSW 2100	Built	Northern Beaches	LGOV
Middle Creek Bridge No. 1	Wakehurst Parkway OXFORD FALLS NSW 2100	Built	Northern Beaches	SGOV
Middle Creek Bridge No. 2	Wakehurst Parkway OXFORD FALLS NSW 2100	Built	Northern Beaches	SGOV
Oxford Falls Conservation Area	Land adjacent to Wakehurst Parkway OXFORD FALLS NSW 2100	Conservation Area	Northern Beaches	LGOV
Oxford Falls Public School	Corner Dreadnought Road and Wakehurst Parkway OXFORD FALLS NSW 2100	Built	Northern Beaches	LGOV
Ruins of Never Been Beaten Lime and Cement Works	West bank, Deep Creek, Wakehurst Parkway NARRABEEN NSW 2101	Archaeological-Terrestrial	Northern Beaches	LGOV

# Appendix H – Landscape Character and Visual Impact Assessment





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