

Mona Vale Road West Upgrade

McCarrs Creek Road, Terrey Hills to Powder Works Road, Ingleside

Review of Environmental Factors & Appendices A–C, Volume 1

February 2017



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Executive summary

Mona Vale Road is the main east-west link between the Pacific Highway, Pymble and Pittwater Road at Mona Vale totalling about 20 kilometres in length. Traffic surveys carried out in December 2013 near the intersection of Mona Vale Road and Tumburra Street indicated the volume of traffic to be about 37,000 vehicles per day, counting both directions.

Roads and Maritime Services proposes to upgrade and widen about 3.4 kilometres of Mona Vale Road between McCarrs Creek Road, Terrey Hills and Powder Works Road, Ingleside, from a two lane (one in each direction) undivided road to a four lane (two lanes in each direction) divided road.

The proposal generally comprises:

- Widening to provide four lanes (two in each direction) on Mona Vale Road between McCarrs Creek Road and Powder Works Road by:
 - Widening on the southern side of the existing carriageway between McCarrs Creek Road and Kimbriki Road
 - Deviation of the entire four lane road from the current road to the north of a rock outcrop having cultural heritage significance between Kimbriki Road and Tumburra Street
 - Widening on the northern side of the existing carriageway from about 700 metres west of Tumburra Street to Addison Road
 - Widening on both sides of the existing carriageway between Addison Road and Powder Works Road.
- Provision of a new traffic signal intersection at Kimbriki Road including additional dedicated turning lanes and a truck climbing lane
- Restricting traffic movements at the intersection of Mona Vale Road and Tumburra Street to left-in and left-out only
- Relocating the Mona Vale Road and Tumburra Street intersection to the west by about 40 metres to improve the existing steep grade on Tumburra Street
- Providing a new local road connection between Bungendore Street and Powder Works Road using the existing Harvey Road corridor and extending the new local road east of Addison Road to meet with the intersection of Mona Vale Road and Powder Works Road
- Removing bus stops on either side of the intersection at Tumburra Street and re-directing bus services along the new local road connection and Tumburra Street to serve existing and future land uses
- Relocating the existing access to the National Baha'i Centre by about 120 metres west along the new local road
- Improving fauna connectivity across Mona Vale Road between Ku-ring-gai Chase National Park and Garigal National Park by:
 - Providing a 40 metre wide fauna bridge over Mona Vale Road, east of Kimbriki Road

- Providing a fauna underpass of Mona Vale Road to the west of the intersection with Tumburra Street
- Providing a fauna underpass between Bungendore Street and Addison Road
- Closing the existing intersection at Mona Vale Road and Addison Road to general traffic and restricting future access at this intersection to emergency vehicles only
- Minor widening of Powder Works Road for a distance of about 160 metres east from the intersection with Mona Vale Road
- Constructing retaining walls and/or sandstone cuttings at various locations along the alignment
- Providing 3.0 metre wide outer shoulders in each direction to allow for on-road cyclists and vehicle breakdowns
- Constructing a shared use path on the northern side of Mona Vale Road from Kanangra Avenue to around 300 metres west of Mona Vale Road and Powder Works Road intersection before transitioning to a 1.5 metre wide footpath along the frontage of the Baha'i Temple
- Constructing a shared use path on the northern side of the new local road between Addison Road and Powder Works Road intersection
- Relocating and and/or adjusting underground and above ground utilities where required including the upgrade of street lighting
- Upgrading of the existing pavement and cross drainage structures including the construction, reconstruction and extension of pavement drainage lines
- Landscaping over the length of the proposal
- Installing traffic monitoring cameras at all signalised intersections to assist with traffic management.

Need for the proposal

The section of Mona Vale Road between McCarrs Creek Road, Terrey Hills and Powder Works Road, Ingleside has two narrow lanes, steep grades on a curved alignment and has a speed limit of 70 kilometres per hour (km/h). Traffic volumes are increasing steadily as a result of population growth and urban development leading to congestion and slow travel times, particularly during the morning and afternoon peaks. There is also a history of crashes on this section of road and limited provision for the safe movement of pedestrians and cyclists.

By providing additional capacity and a higher standard of road, the proposal would deliver improved road safety, reduced congestion and would provide for future population and employment growth. It would also improve safety for cyclists by providing dedicated off-road paths and improved on-road facilities.

Options considered

A base case 'do nothing' option and three other options (developed in 2012) were considered:

- Base case ('do nothing') – This would involve no upgrade to the existing Mona Vale Road alignment. It assumes only ongoing maintenance
- Option 1 (Widening within the existing corridor) – This would involve widening within the existing corridor and bypassing a rock outcrop (having cultural heritage significance) to the south via a viaduct structure. It would be located mainly within the existing corridor, with road shoulders generally about 2.5 metres wide throughout. The alignment would seek to minimise the impact on the endangered Duffys Forest Ecological Community and Ku-ring-gai Chase National Park located to the north
- Option 2 (Northern alignment) – This would involve building a new road and bypassing the rocky outcrop on a northern alignment. It would allow for the carriageway to be constructed without compromising the width of the road shoulders and allow for a shared use path along a majority of the length of the upgrade
- Option 3 (Split carriageway) – Splitting the carriageway and running two lanes eastbound on a new road to the north of the rocky outcrop and upgrading the existing road for westbound traffic bypassing the rocky outcrop to the south. Similar to the northern alignment option, this would avoid impact on the rock outcrop while maintaining a 2.5 metre wide shoulder and the shared path along the northern side of the road for the full length of the upgrade.

Option 2 (northern alignment option) was chosen as the preferred route because it:

- Ranks well with community feedback received on the three route options
- Provides the most flexibility to design around potential constructability issues
- Minimises the amount of national park land acquisition required
- Avoids impact on a culturally sensitive area
- Provides the best opportunities for fauna connectivity between the national parks
- Provides simpler traffic staging during construction, minimising inconvenience to road users.

Statutory and planning framework

State Environmental Planning Policy (Infrastructure) 2007 aims to facilitate the effective delivery of infrastructure across the State and applies to this proposal. Clause 94 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 a road and associated infrastructure facilities, and is to be carried out on behalf of Roads and Maritime Services, it can be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*. Development consent from Northern Beaches Council is not required.

An environment protection licence for road construction under the *Protection of the Environment Operations Act 1997* would be required.

As the proposal is likely to have a significant impact on listed species under the NSW *Threatened Species Conservation Act 1995*, a Species Impact Statement (SIS) has been prepared by SMEC Australia and is being displayed concurrently with this REF.

The proposal is also likely to impact three species listed under the *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999* and consideration of the impact upon these three species is provided in the SIS prepared for the proposal. A summary of the SIS is provided in Chapter 6 of this REF.

Roads and Maritime Services will comply with the terms of the strategic assessment process agreed to with the Federal Government to meet obligations under the EPBC Act.

Community and stakeholder consultation

Roads and Maritime Services has and would continue to carry out community and stakeholder consultation for the purpose of the proposal. Consultation has been carried out with the local community and other stakeholders such as Northern Beaches Council, the Aboriginal community and government agencies.

This Review of Environmental Factors (REF) will be displayed for community comment and a door knock carried out to discuss the proposal with directly affected residents along the road. Any submissions received will be considered in finalising the details of the proposal.

Environmental impacts

A summary of the main environmental impacts associated with the proposal is provided as follows.

Biodiversity

In the early stages of proposal development, the potential for the proposal to have a significant impact on a threatened species, population or ecological community was identified. Roads and Maritime Services submitted an application to the NSW Office of Environment and Heritage for the Director General's Requirements (DGRs) to prepare a SIS in parallel with the REF. The main impacted species, populations or ecological communities are as follows.

Duffys Forest Ecological Community: The proposal would result in the removal of approximately three hectares of Duffys Forest Ecological Community which is listed as endangered under the NSW Threatened Species Conservation Act 1995 (TSC Act).

Grevillia caleyi is listed as Critically Endangered under the TSC Act and Endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The proposal would result in the removal of 75 individuals of *G.caleyi*.

Microtis angusii is listed Endangered under the TSC Act and the EPBC Act. A total of 1469 individuals may be disturbed as a result of the proposal. Removal of these individuals is likely to have an adverse effect on the local viable population through reduction in size and extent, and loss of genetic diversity.

Genetic testing undertaken as part of the Ingleside Precinct Planning study shows strong evidence that *M.angusii* and the more widespread *M. unifolia* are the same

species and that *M. angusii* is more common than previously believed. A formal application for delisting of *M. angusii* as a threatened species has been made by the Department of Planning and Environment. The species is considered under its current status of Endangered in this REF and the SIS.

Giant Burrowing Frog: The Giant Burrowing Frog is listed as Vulnerable under the TSC and EPBC Acts. The proposal would require the removal of about 11.6 hectares of suitable non-breeding habitat for the Giant Burrowing Frog, although breeding habitat outside the study area would not be affected by the proposal as the stormwater drainage design would aim to mimic the existing conditions.

Red-crowned Toadlet: The Red-crowned Toadlet is listed as Vulnerable under the TSC Act. The proposal would require the removal of 1.1 hectares of suitable breeding and non-breeding habitat for this species. This may result in localised disturbance to Red-crowned Toadlet colonies that occupy drainage lines within the construction impact area. The disturbance of these small colonies, where breeding is unlikely to successfully occur, is unlikely to be significant to the local population as large areas of better quality habitat are available in nearby national parks and reserves.

Eastern Pygmy-possum: The Eastern Pygmy-possum is listed as Vulnerable under the TSC Act. The adjacent Ku-ring-gai Chase and Garigal National Parks have extensive areas of known and potential Eastern Pygmy-possum habitat. The existing road corridor fragments habitat and Eastern Pygmy-possum populations known to exist in the two national parks. Under the proposal, connectivity between the national parks would be improved through the provision of a 40 metre wide fauna crossing over Mona Vale Road.

The proposal would affect about 16 hectares of foraging and breeding habitat occupied by the Eastern Pygmy-possum.

Rosenberg's Goanna: The Rosenberg's Goanna is listed as Vulnerable under the TSC Act and has been identified within the study area. The species rely on termite mounds for breeding. Numerous termite mounds have been identified within the study area. The proposal would result in the removal of 16 termite mounds that may be used for nesting by the species. As Rosenberg's Goanna is known to have large home ranges the removal of these termite mounds is unlikely to have a significant impact.

A number of mitigation measures have been developed to mitigate the potential impacts of the proposal on biodiversity including:

- Construction of a fauna bridge over Mona Vale Road to connect Ku-ring-gai Chase and Garigal National Parks and facilitate fauna crossing
- Two fauna underpasses
- Fencing to direct fauna towards crossing structures
- Targeted rehabilitation and revegetation to facilitate fauna movement and connectivity in the study area
- Implementation of relevant aspects of RMS' Biodiversity Guidelines.

Residual impacts that cannot be avoided or ameliorated will be further compensated through the acquisition and retirement of Bio Banking Credits.

Landform, geology and soils

The proposal has the potential to generate sediment during rainfall events due to ground disturbance during construction, including excavation and vegetation removal. A site-specific soil and water management plan would be prepared before construction, and include measures to mitigate erosion and sedimentation. Following revegetation of areas of land disturbed by construction, the potential for erosion to occur would be minimised.

Hydrology, hydraulics and water quality

During operation, only minor increases in downstream sheet flow levels are predicted and therefore flow changes are expected to have a negligible impact on watercourses. Measures to reduce the potential for scour have been provided for in the drainage design.

Stormwater flows into the local creek would be designed to mimic the existing flows to minimise the impacts on frog habitat areas.

Traffic and transport

The movement of construction and service vehicles along Mona Vale Road and access roads to carry construction materials would impact on traffic during construction. A traffic management plan would be prepared to address these impacts. Access to existing properties would be maintained throughout the construction phase.

Once complete, the proposal would reduce congestion and shorten travel times for general traffic, buses and freight vehicles.

The current road corridor (two lane undivided road) would not be able to satisfactorily cater for the forecast increases in peak period traffic with volume to capacity ratios greater than one and increasing over time. With the upgrade of Mona Vale Road to four lanes between Terrey Hills and Mona Vale, Mona Vale Road would have sufficient capacity to cater for forecast 2021, 2031 and 2036 morning and afternoon peak traffic demand. All the intersections within the study area are expected to perform adequately up to 2031.

Other operational benefits include:

- Safety and efficiency for B-double and other freight along Mona Vale Road would be improved
- The efficiency of public transport operations and travel time reliability along Mona Vale Road would be improved
- Safety for pedestrians and cyclists travelling along the corridor would be improved with the provision of an off-road multi-use path
- Improved access to the proposed Wirreanda Valley Precinct utilising the existing Harvey Road corridor to link with Mona Vale Road at Powder Works Road and Tumburra Street
- Provision of a central concrete median to safely separate east and west bound traffic.

Aboriginal heritage

A cluster of engravings on a rocky outcrop (having cultural heritage significance) and a second individual engraving are located close to the works area. These sites would not be directly affected by the proposal. Both sites are of high cultural and archaeological significance and would be protected during construction.

Historic heritage

There are two heritage items of local significance in the study area:

- Group of Monterey Pines (Mona Vale Road, Ingleside)
- Baha'i House of Worship (Mona Vale Road, Ingleside).

The proposal would require the removal of the Monterey Pines at the intersection of Baha'i Temple Way and Mona Vale Road due to the alignment and construction of the new local road connection. As part of the concept design, refinements in the road alignment have attempted to minimise the impact on the Baha'i House of Worship, a small impact remains on the curtilage of this site adjacent to Addison Road.

Urban design and visual amenity

An urban design strategy for the proposal has been developed which aims to integrate the widened Mona Vale Road sensitively into the Hawkesbury sandstone bush landscape.

Implementation of the proposed urban design strategy would successfully manage and mitigate the landscape character and visual impacts of the proposal. The urban design strategy and the range of mitigation measures may be extended and/or refined through the detailed design process and during consultation with affected landowners.

Noise and vibration

Noise impacts resulting from the proposal were determined at noise sensitive receivers along the length of the proposed works on Mona Vale Road, the Harvey Road extension, and on Powder Works Road. Operational noise modelling indicates that 11 residential receivers and three non-residential receivers (the Baha'i Temple and two other places of worship) would be impacted through increased noise levels following the completion of the upgrade.

During the detailed design stage of the proposal, further investigations of all feasible and reasonable mitigation options would be undertaken for affected receivers in accordance with the Road Noise Policy (DECCW, 2011) and RMS's *Environmental Noise Management Manual* (RTA, 2001). Mitigation options include the provision of noise reduction treatments of individual properties.

Construction of the proposal is expected to occur during and outside of standard hours. Construction outside of standard hours will be required as sections of the existing road will need to remain open to traffic during peak periods.

The assessment of construction noise impacts indicates that several residential receivers may experience noise levels in excess of the construction noise management levels, and in some cases would be highly noise affected for receivers closest to the works. In addition, maximum noise levels would be expected to exceed the sleep disturbance screening criteria when works are at their closest to receivers. Other sensitive land uses would also be expected to experience noise levels above

the construction noise management levels when works are at their closest to sensitive receivers.

A construction noise management plan will be developed to minimise construction noise impacts. The community would be notified of any out of hours work and mitigation measures would be implemented as per Roads and Maritime Services' *Noise Management Manual*. This includes consideration of night time noise respite periods.

An initial assessment of construction vibration indicates that three residential receivers may be impacted by vibration. A more detailed construction vibration study would be prepared prior to construction to manage potential impacts.

Socio-economic

The proposal would have an impact on the local community through the acquisition of land. This includes strip acquisition of 10 private properties and 11 properties owned by government agencies.

During construction, the community and road users are likely to experience temporary traffic delays, temporary construction impacts of minor noise, dust, visual and general amenity impacts. Measures have been proposed in the REF to minimise these impacts.

The construction phase of the proposal would create jobs. Once complete, improved connectivity and reduced travel times would contribute to business productivity improvements and enhance business opportunities in the area.

The proposal would permanently alter access to Tumburra Street and Addison Road. The former would be restricted to left in, left out while the latter would be closed to all but emergency vehicles. Alternative access would be available via the Harvey Road extension. The new arrangements would allow for safer vehicle movements and remove the potential unsafe turning movements (right turn in and out) across oncoming traffic in an 80 km/h zone.

The upgraded road would provide a safer road for motorists and pedestrians by the provision of overtaking lanes, a signalised intersection at Kimbriki Road and other road improvements, as well as a shared path for pedestrians and cyclists.

Other impacts

The REF has identified a number of other environmental impacts associated with:

- Air quality
- Climate change and greenhouse gases
- Waste management and resource use

Appropriate mitigation measures have been identified in the REF to manage these impacts and the impacts are not considered as being significant.

Justification and conclusion

This REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

The proposal as described in the REF best meets the project objectives but would still result in some impacts on native vegetation and fauna habitat. Other potential

impacts include construction noise, vibration and traffic delays during construction. Mitigation measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also reduce congestion, improve road safety and enhance connectivity and amenity for cyclists and pedestrians. On balance the proposal is considered justified.

Display of the review of environmental factors

This REF is on display for comment until Monday, 13 March 2017. Comments are to be provided by Monday, 13 March 2017. You can access the documents in the following ways:

Internet

The documents will be available as pdf files on the Roads and Maritime Services website at www.rms.nsw.gov.au/mvr.

Display

The review documents can be viewed at the following locations:

- Mona Vale Library, 1 Park Street, Mona Vale
- Northern Beaches Council, Dee Why
- Office of Environment and Heritage, Level 14, 59–61 Goulburn Street, Sydney.

How can I make a submission?

To make a submission on the proposal, please send your written comments to:

Mona Vale Road West Upgrade Project Team

Roads and Maritime Services

PO Box 973

PARRAMATTA NSW 2124

Or email: monavaleroad@rms.nsw.gov.au

Submissions must be received by Monday, 13 March 2017.

Privacy information

All information included in submissions is collected for the sole purpose of assisting in the assessment of this proposal. The information may be used during the environmental impact assessment process by relevant Roads and Maritime Services staff and its contractors.

Where the respondent indicates at the time of supply of information that their submission should be kept confidential, Roads and Maritime Services will attempt to keep it confidential. However there may be legislative or legal justification for the release of the information, for example under the *Government Information (Public Access) Act 2009* or under subpoena or statutory instrument.

The supply of this information is voluntary. Each respondent has free access at all times to the information provided by that respondent but not to any identifying information provided by other respondents if a respondent has indicated that the representation should be kept confidential.

Any respondent may make a correction to the information that they have provided by writing to the same address the submission was sent to.

The information will be held by the Roads and Maritime Services, 27-31 Argyle Street, Parramatta, NSW 2150.

What happens next?

Following the submissions period, Roads and Maritime Services will collate submissions. Acknowledgement letters will be sent to each respondent. The details of submission authors will be retained and authors will be subsequently advised when project information is released.

Roads and Maritime Services will prepare a Submissions Report that provides responses to submissions received. The Submissions Report will be made available on the Roads Maritime website.

After consideration of community comments, Roads and Maritime Services will determine whether the proposal should proceed as proposed, or whether any alterations to the proposal are necessary. The community will be kept informed regarding the Roads and Maritime Services determination.

Subject to project approval and funding, Roads and Maritime Services will proceed with final design and tenders will be invited for construction of the project.

If you have any queries, please contact the Roads and Maritime Services project manager on 1800 633 332.

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1 Introduction

1.1 Proposal identification

Mona Vale Road forms part of the Mona Vale to Macquarie Park Corridor, and is the main east–west link between the Pacific Highway at Pymble and Pittwater Road at Mona Vale totalling about 20 kilometres in length. Traffic surveys undertaken in December 2013 near the intersection of Mona Vale Road and Tumburra Street indicated the volume of traffic to be about 37,000 vehicles per day in both directions.

Roads and Maritime Services (Roads and Maritime) proposes to upgrade and widen about 3.4 kilometres of Mona Vale Road between McCarrs Creek Road, Terrey Hills and Powder Works Road, Ingleside (Mona Vale Road West upgrade) (the proposal). The upgrade would be from a two lane (one in each direction) undivided road to a four lane (two lanes in each direction) divided road.

The proposal is Stage Three of a broader upgrade of Mona Vale Road between Terrey Hills and Mona Vale. Stage One involved improving the Mona Vale Road/Ponderosa Parade/Samuel Street intersection at Mona Vale and was completed in late 2014. Stage Two, the Mona Vale Road East upgrade between Manor Road, Ingleside and Foley Street, Mona Vale, is the subject of a separate environmental impact assessment that was determined under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) by Roads and Maritime in December 2015.

The section of Mona Vale Road within the study area is primarily within a bushland setting with Ku-ring-gai Chase National Park adjacent to the road corridor to the north and Garigal National Park adjacent to the road corridor to the south. For the most part, this section of Mona Vale Road is situated along a ridgeline that separates the two national parks.

The Kimbriki Resource Recovery Centre is located to the south of Mona Vale Road near the western extent of the proposal and the Baha'i Temple is located to the north of the road near the eastern extent of the proposal. Other land uses in the vicinity of the study area include the Monash Country Club near the Powder Works Road intersection, the Ingleside Baptist Church located off Powder Works Road, residential development in Terrey Hills and also on the northern side of the road at Addison Road and commercial, business and residential development at Tumburra Street.

This section of Mona Vale Road is subject to traffic congestion especially during peak hours and road users frequently experience major traffic delays, both during and outside of peak periods. The congestion occurs for a variety of reasons including:

- High and increasing traffic volumes using this arterial road
- 'Bottlenecks' caused by traffic merging from two lanes into a single lane at both ends of the study area
- Heavy vehicles travelling below the posted speed as they climb or descend the steep hill within the study area, with no overtaking opportunities for other traffic
- Mona Vale Road is a classified B-double route and a bus route, with heavy vehicles making up about 10 per cent of the total traffic using the road.

The proposal would result in improved road safety, reduced congestion and would provide for future population and employment growth. It would also improve safety for cyclists by providing dedicated off-road shared path and improved on-road facilities.

The proposal generally comprises:

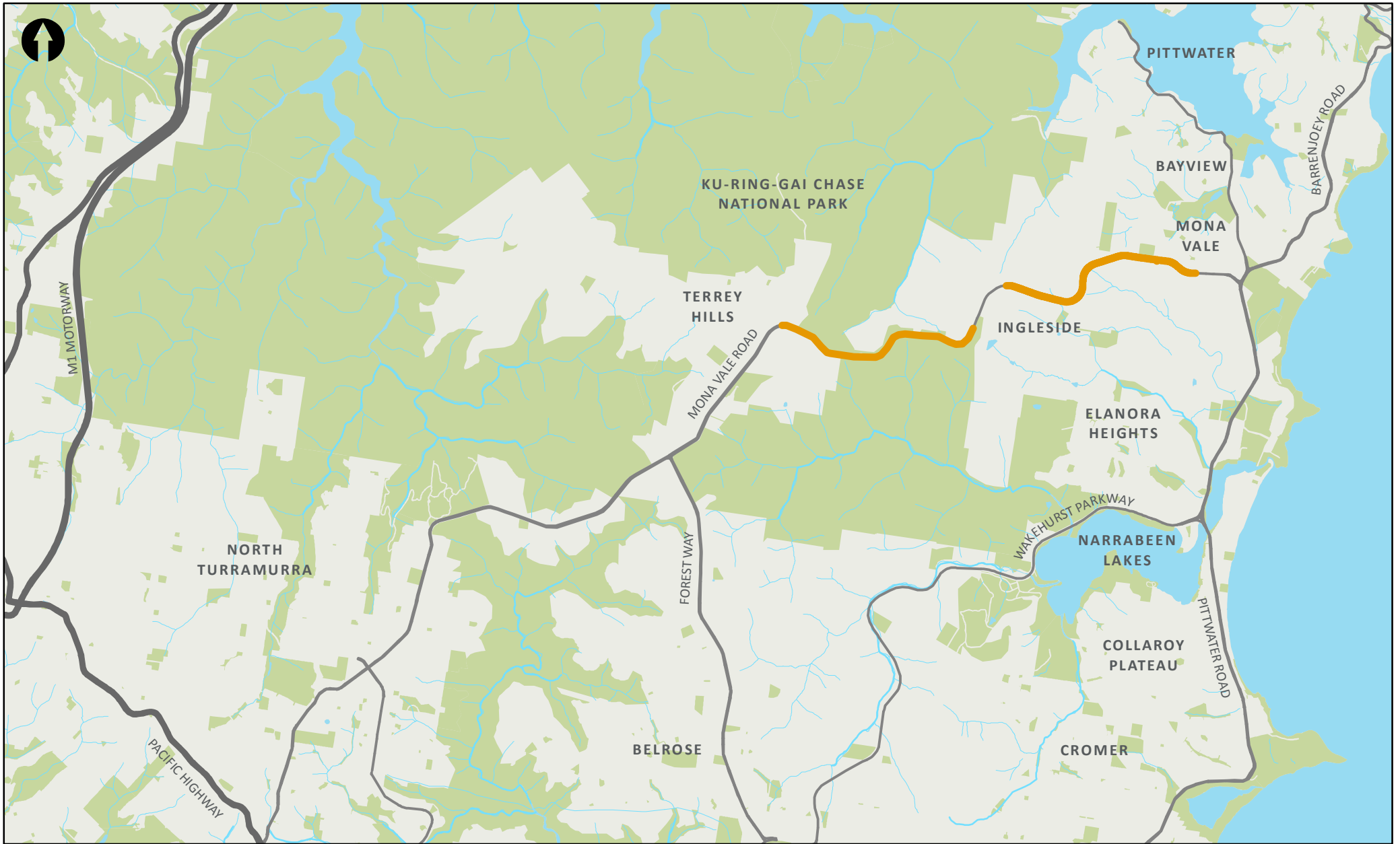
- Widening to provide four lanes (two in each direction) on Mona Vale Road between McCarrs Creek Road and Powder Works Road by:
 - Widening on the southern side of the existing carriageway between McCarrs Creek Road and Kimbriki Road
 - Deviation of the entire four lane road from the current road to the north of a rock outcrop having cultural heritage significance between Kimbriki Road and Tumburra Street
 - Widening on the northern side of the existing carriageway from about 700 metres west of Tumburra Street to Addison Road
 - Widening on both sides of the existing carriageway between Addison Road and Powder Works Road.
- Provision of a new traffic signal intersection at Kimbriki Road including additional dedicated turning lanes and a truck climbing lane
- Restricting traffic movements at the intersection of Mona Vale Road and Tumburra Street to left-in and left-out only
- Relocating the Mona Vale Road and Tumburra Street intersection to the west by about 40 metres to improve the existing steep grade on Tumburra Street
- Providing a new local road connection between Bungendore Street and Powder Works Road using the existing Harvey Road corridor and extending the new local road east of Addison Road to meet with the intersection of Mona Vale Road and Powder Works Road
- Removing bus stops on either side of the intersection at Tumburra Street and re-directing bus services along the new local road connection and Tumburra Street to serve existing and future land uses
- Relocating the existing access to the National Baha'i Centre by about 120 metres west along the new local road
- Improving fauna connectivity across Mona Vale Road between Ku-ring-gai Chase National Park and Garigal National Park by:
 - Providing a 40 metre wide fauna bridge over Mona Vale Road, east of Kimbriki Road
 - Providing a fauna underpass of Mona Vale Road to the west of the intersection with Tumburra Street
 - Providing a fauna underpass between Bungendore Street and Addison Road
- Closing the existing intersection at Mona Vale Road and Addison Road to general traffic and restricting future access at this intersection to emergency vehicles only
- Minor widening of Powder Works Road for a distance of about 160 metres east from the intersection with Mona Vale Road
- Constructing retaining walls and/or sandstone cuttings at various locations along the alignment

- Providing 3.0 metre wide outer shoulders in each direction to allow for on-road cyclists and vehicle breakdowns
- Constructing a shared use path on the northern side of Mona Vale Road from Kanangra Avenue to around 300 metres west of Mona Vale Road and Powder Works Road intersection before transitioning to a 1.5 metre wide footpath along the frontage of the Baha'i Temple
- Constructing a shared use path on the northern side of the new local road between Addison Road and Powder Works Road intersection
- Relocating and and/or adjusting underground and above ground utilities where required including the upgrade of street lighting
- Upgrading of the existing pavement and cross drainage structures including the construction, reconstruction and extension of pavement drainage lines
- Landscaping over the length of the proposal
- Installing traffic monitoring cameras at all signalised intersections to assist with traffic management.

The eastern portion of the proposal is located within the former Pittwater Local Government Area (LGA) and the western portion is located in the former Warringah LGA. Following the LGA amalgamation that occurred in May 2016 the entirety of the study area is now located within the Northern Beaches LGA and is within the Roads and Maritime Sydney Region.

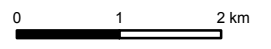
Construction of the proposal is expected to be funded by the NSW Government. Construction would take about 30 months to complete, weather permitting. At the time of preparation of this REF, funding for construction of the project is yet to be confirmed and identification of a specific commencement date is therefore not possible. However, construction is expected to follow after the Mona Vale Road East Upgrade which could commence construction in 2018, subject to funding.

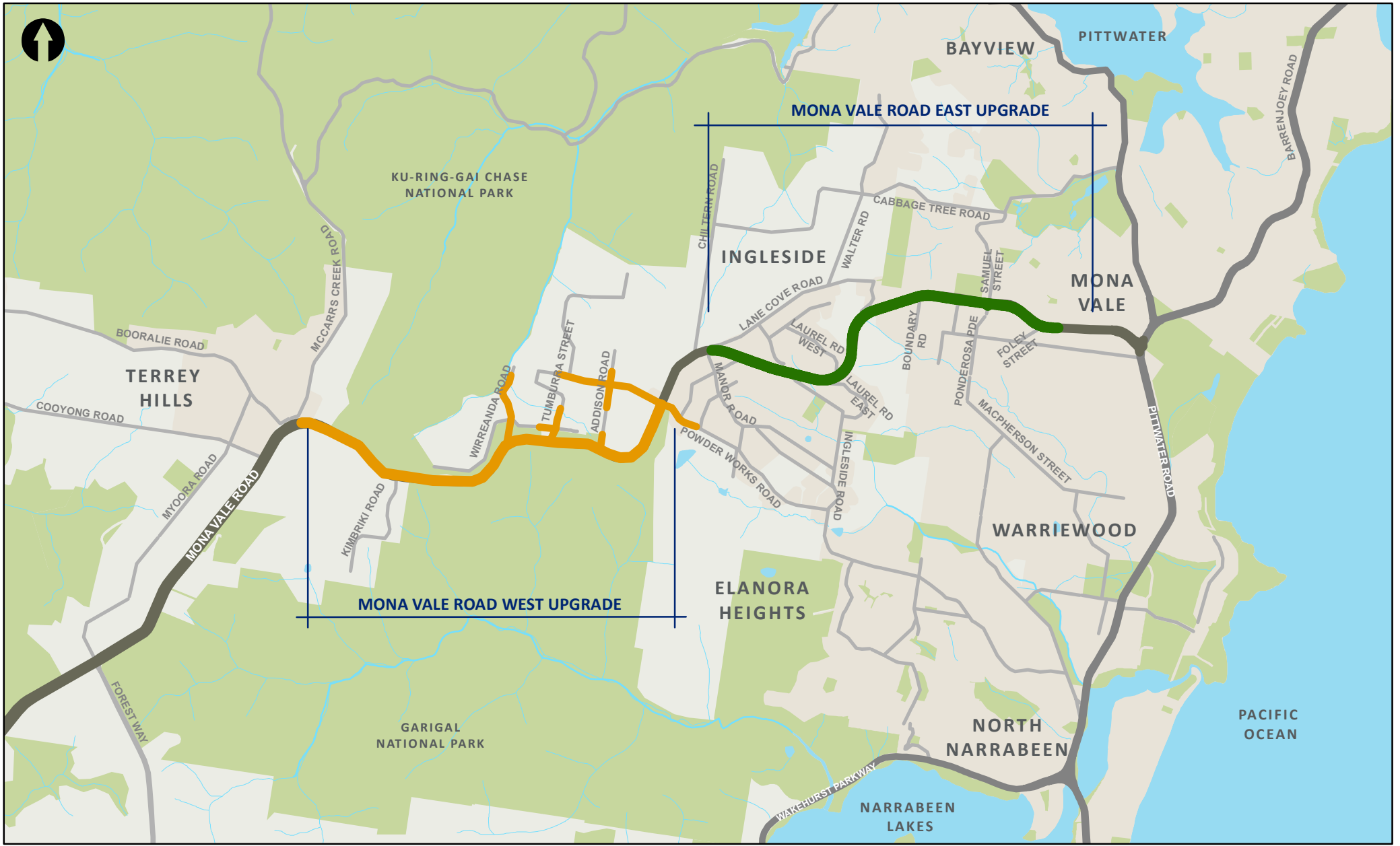
Figure 1-1 shows the regional context while Figure 1-2 shows the location of the proposal.



- MONA VALE ROAD - UPGRADES
- MOTORWAY/HIGHWAY
- ARTERIAL ROADS
- CREEK
- WATER BODY
- NATIONAL PARKS

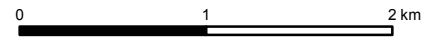
Regional context of the proposal Figure 1-1





- MONA VALE ROAD - UPGRADED TO 4 LANES
- MONA VALE ROAD UPGRADE - WESTERN SECTION
- MONA VALE ROAD UPGRADE - EASTERN SECTION
- ARTERIAL ROADS
- LOCAL ROADS
- WATER BODY
- NATIONAL PARKS
- CREEK

Location of the proposal Figure 1-2



1.2 Purpose of the report

This REF has been prepared by SMEC Australia on behalf of Roads and Maritime, Sydney Region. For the purposes of these works, Roads and Maritime is the proponent and the determining authority under Part 5 of the 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 protective measures to be implemented.

The description of the proposed works and associated environmental impacts have been undertaken in context of clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act), and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, the REF helps to fulfil the requirements of section 111 of the EP&A Act, that Roads and Maritime examines and takes into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Part 5.1 of the EP&A Act
- The significance of any impact on threatened species as defined by the TSC Act and/or FM Act, in section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement.
- The potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of the Environment and Energy for a decision by the Commonwealth Minister for the Environment and Energy on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

2.1 Strategic need for the proposal

Mona Vale Road is a key arterial road servicing Sydney's northern beaches and Pittwater region. The section between McCarrs Creek Road and Powder Works Road has two narrow lanes, steep grades on a curved alignment and has a speed limit of 70 kilometres per hour (km/h). Traffic volumes are increasing steadily with congestion, and slow travel times are experienced, particularly during the AM and PM peaks. There is also a history of crashes on this section of road, and there is limited provision for the safe movement of pedestrians and cyclists.

The proposal would result in improved road safety, reduced congestion and would provide for future population and employment growth. It would also improve safety for cyclists by providing dedicated off-road paths and improved on-road facilities.

2.1.1 Strategic planning and policy context

NSW 2021: A plan to make NSW Number One

NSW 2021: A plan to make NSW Number One (NSW 2021) (NSW Government, 2011) sets the NSW Government's agenda for change in NSW. The 10 year plan establishes strategies and goals to rebuild the economy, return quality services, renovate infrastructure, restore accountability to government, and strengthen local environments and communities.

NSW 2021 places emphasis on investing in and delivering an efficient and effective transport system including delivering road infrastructure that would relieve congestion, improve travel times, improve road safety and enhance and expand capacity on road corridors.

The five core strategies are supported by 32 goals. The proposal contributes directly to seven of these goals as follows:

- *Goal 1: Improve the performance of the NSW economy* – the proposal would improve the efficiency of the road network in the Northern Beaches region. This supports the economy by assisting the movement of people and goods
- *Goal 7: Reduce travel times* – the proposal would reduce congestion by upgrading the two-lane two-way section between McCarrs Creek Road and Powder Works Road, to a four lane dual divided carriageway. This additional capacity would improve traffic flow and reduce travel times
- *Goal 9: Improve customer experience with transport services* – the proposal would support this goal by improving bus stop and road crossing facilities in a way that integrates with the future development of Ingleside for easy access to public transport
- *Goal 10: Improve road safety* – the proposal would improve road safety by providing a divided dual carriageway that meets current design standards and practices. The proposal includes a suitable barrier to separate directional traffic flows. Safety for cyclists would be improved by the provision of dedicated off-road paths and improved on-road facilities
- *Goal 27: Enhance cultural, creative, sporting and recreation opportunities* – the proposal would support this goal by providing a path connecting Ingleside to

Mona Vale for use by recreational users, walkers and cyclists. There would also be improved on-road provision for cyclists.

Rebuilding NSW: State Infrastructure Strategy 2014

In November 2014 the Government released *Rebuilding NSW: State Infrastructure Strategy 2014* (NSW Government, 2014) which adopts the recommendations from Infrastructure NSW that are set out in the *State Infrastructure Strategy Update 2014* (Infrastructure NSW, 2014).

Rebuilding NSW recognises the costs of congestion and includes an allocation of \$1.3 billion to address congestion on Sydney's roads. The proposal is consistent with the emphasis on congestion reduction, delivering improved traffic flow and reduced travel times.

NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (Transport for NSW, 2012) establishes the framework to deliver an integrated, modern transport system by identifying NSW's transport actions and investment priorities over the next 20 years to cater for Sydney's projected population increase from 4.3 million to 5.6 million. By 2031, the number of trips made around the city each day will increase by 31 per cent from 16 million to 21 million trips, placing greater demands on road, rail and bus networks. Road congestion is currently estimated to have a cost of about \$5.1 billion (or nearly \$1,100 for every person living in Sydney) each year. By 2020, the costs of congestion are expected to rise to \$8.8 billion annually.

The plan proposes a coordinated and integrated approach to meeting these transport challenges. Actions outlined in the plan include a program of work to expand capacity on Sydney's most congested corridors and a medium to long-term action to deliver targeted investment and efficiency improvements on the arterial road network.

The plan states that the AM peak inbound average travel speed on the Mona Vale Road corridor is between 40 to 50 kilometres per hour. Forecast for strong growth in car traffic over the next 20 years means that road congestion will get worse unless action is taken. The proposal is consistent with the *NSW Long Term Transport Master Plan* by facilitating improved traffic flow along a strategic transport corridor.

A Plan for Growing Sydney

A Plan for Growing Sydney (Department of Planning and Environment, 2014a) establishes the NSW Government's vision for Sydney as 'a strong global city, a great place to live.' To achieve this vision, the plan sets the following four goals:

- Goal 1 – a competitive economy with world-class services and transport
- Goal 2 – a city of housing choice with homes that meet our needs and lifestyles
- Goal 3 – a great place to live with communities that are strong, healthy and well connected
- Goal 4 – a sustainable and resilient city that protects the natural environment and has a balanced approach to the use of land and resources.

The proposal supports Goal 1 and Goal 3 by delivering improvements to traffic flow and road safety. Consistent with Goal 4, the proposal would be delivered in a way that minimises environmental impacts and maintains fauna habitat connectivity.

A Plan for Growing Sydney also establishes a framework and priorities for subregional planning that will link growth in population and housing to the infrastructure that supports communities, such as schools, health services, transport, electricity and water projects. Mona Vale Road is within the 'North' subregion. The proposal would contribute to improving connections to a Global Sydney and to the Global Economic Corridor, which is a stated priority for the North subregion.

NSW Freight and Ports Strategy

The *NSW Freight and Ports Strategy* (Transport for NSW, 2013a) is a core component of the NSW Government's overall strategic planning framework. It is consistent with the *NSW Long Term Transport Master Plan* and supports the goals identified in *NSW 2021 – A Plan to Make NSW Number One* (NSW Government, 2011).

While the study area is remote from the dominant Sydney freight network and carries only moderate number of heavy vehicles, it is still classified as a tertiary freight route. The *NSW Freight and Ports Strategy* is therefore considered relevant to the proposal.

Objectives of the *NSW Freight and Ports Strategy* relevant to the proposal include:

- Delivery of a freight network that efficiently supports the projected growth of the NSW economy
- Balancing freight needs with those of the broader community and the environment.

Actions of the strategy and task actions relevant to the proposal include:

- Action 1D – Improve productivity of the road freight network
 - Task 1D-2 Provide necessary infrastructure to support High Productivity Vehicle access
 - Task 1D-3 Improve access for High Productivity Vehicles on State and local roads
- Action 2B – Develop and maintain capacity for freight on the road network
 - Task 2B-2 Prioritise road infrastructure investments
- Action 3B – Manage congestion, noise and emission impacts of freight transport
 - Task 3B-1 Recognise costs of congestion
 - Task 3B-2 Mitigate noise from freight operations
 - Task 3B-3 Mitigate emissions from freight operations
- Action 3C – Prioritise safety of freight transport
 - Task 3C-2 Improve heavy vehicle safety.

The proposal is considered consistent with the objectives, actions and tasks referenced above. It would reduce congestion on a tertiary freight route and includes design features that would better accommodate heavy vehicles and which would enhance safety for all road users.

Sydney's Cycling Future: Cycling for everyday transport

Sydney's Cycling Future: Cycling for everyday transport (Transport for NSW, 2013b) identifies a safe and connected network of bicycle paths as an important part of Sydney's integrated transport system. It reflects the NSW Government's intention to

make bike riding a convenient and enjoyable option that benefits everyone – by improving access to towns and centres, reducing congestion and increasing capacity on the public transport system. The objective is to make cycling a safe, convenient and enjoyable transport option for short trips (< 30 minutes).

Sydney's Cycling Future outlines how the NSW Government will coordinate planning and investment to improve the bicycle network and build the needs of bike riders into the planning of new transport and infrastructure projects.

The provision of broad cycle-safe shoulders as part of the proposal and shared path adjacent to the corridor is strongly aligned with two of the 'three pillars' of *Sydney's Cycling Future*:

- Pillar 1 – Safe connected networks.
- Pillar 3 – Partner with councils to target missing links and problem intersections in local bicycle networks. The proposed off-road shared path and road shoulders on Mona Vale Road would complement existing and proposed facilities in the Pittwater local government area.

Northern Beaches Regional Action Plan

The *Northern Beaches Regional Action Plan* (Department of Premier and Cabinet, 2012) outlines the initiatives and strategies to be pursued by the NSW Government to meet its election commitments. It requires agencies to plan for and facilitate connectivity to, from and across the region so that people spend less time in their cars commuting to work.

The plan states that '*residents of the Northern Beaches region rely heavily on private vehicles and public buses to commute to work and for travel to retail and recreation places. The geography of the region presents a challenge to solving the congestion issues faced by the Northern Beaches community on major transport routes*'.

The proposal is consistent with the *Northern Beaches Regional Action Plan* as it would provide additional road capacity in a currently congested area and improve travel times on Mona Vale Road for both private vehicles and public transport.

Northern Beaches Transport Action Plan

The NSW Government is investing in a number of transport improvements as part of the *Northern Beaches Transport Action Plan* (Transport for NSW, 2014b) *to address existing issues and the future growth of the area*.

The Action Plan specifically references the proposal and notes that planning is underway to improve safety on Mona Vale Road by upgrading to four lanes between McCarrs Creek Road at Terrey Hills and Powder Works Road at Ingleside.

Shaping Our Future

Shaping Our Future (Shore Region of Councils, 2010) is the overarching integrated strategy for the Shore Region of Councils geographical region. Adopted in 2010, it outlines the infrastructure and policy priorities so that member councils can lobby with a united voice for investment, as well as bring together projects that are more effectively or efficiently delivered in partnership by the councils.

Shaping Our Future outlines how the Shore Region of Councils will work together with other levels of government, business and the community to address critical challenges for the region, now and into the future.

The strategy identifies key priorities to address congestion and cut travel times in the region, one of which is the upgrade of Mona Vale Road. The proposal responds to this priority while at the same time improving road safety.

Mona Vale to Macquarie Park Corridor Strategy

The *Mona Vale to Macquarie Park Corridor Strategy* (Roads and Traffic Authority, 2009) provides an overview of the road transport system between Mona Vale and the De Burghs Bridge at Macquarie Park. The strategy addresses road safety, transport efficiency and asset maintenance issues, and sets out a 25 year framework for the management of the corridor.

This corridor forms part of a key arterial ring road extending from Mona Vale in the north to the Princes Highway at Hurstville in the south via Mona Vale Road, Ryde Road, Lane Cove Road, Homebush Bay Drive, Centenary Drive, Roberts Road and King Georges Road.

The strategy notes that many of the people who live within the corridor also work within the corridor. Those residents who do work outside the area predominantly drive to work, with only about five per cent travelling to work by bus or train. Annual average weekday traffic in 2007 at the eastern extent of Mona Vale Road was 19,000 vehicles with regular congestion, particularly at Ingleside. The strategy notes that the forecast population and employment growth along the corridor, 13 per cent and 19 per cent respectively, are higher than Sydney averages and will further affect congestion, particularly given the relatively high levels of car dependency.

The strategy identifies short-term and long-term priorities. In its list of longer term priorities (beyond 2014), it identified the need to:

- Monitor the adequacy of the capacity for the single lane sections between Mona Vale and Ingleside and, if appropriate, consider options for enhancing this capacity (LT3)
- Monitor and assess intersections reaching capacity, including the roundabout at Ponderosa Parade (LT2)
- Monitor and continue to address locations with higher crash rates using a 'safe systems' approach, including measures to address driver behaviour and the road environment (LT6)
- With the Department of Planning and Pittwater Council, encourage public transport, walking and cycling in the development of Ingleside, and secure developer contributions to deliver this infrastructure (LT7).

In its list of short term priorities (2009–2014), it identified the need to:

- Continue to plan for the corridor's role as a Strategic Bus Corridor, including the identification of appropriate bus facilities and priority measures in line with demand (ST6).

The proposal directly responds to both the long-term and short-term strategy priorities. It would increase capacity, improve intersection operation, improve road safety, provide for bus priority and enhance facilities for cyclists and pedestrians. The

proposal is therefore considered consistent with both the strategy and the long-term and short-term priorities.

Metropolitan Road Freight Hierarchy on the State Road Network

The *Metropolitan Road Freight Hierarchy on the State Road Network Practice Note* (Department of Transport, 2011) defines an urban road freight hierarchy for the State Road network in Newcastle-Sydney-Wollongong.

The objectives of the hierarchy include:

- To support the pattern of industrial lands and activities that lead to varying freight flows on the road network by providing suitable road infrastructure
- To provide for the specific needs of freight vehicles in operating the road network as a safe, sustainable and efficient road transport system for all road users.

The practice note classifies Mona Vale Road as a tertiary freight route. The proposal would deliver improved traffic flow for freight vehicles using the route. The design development process has proceeded in recognition of the tertiary freight route status with considerations including gradients, curvature, intersection design, lanes widths, vertical clearances and pavement design.

2.1.2 Urban growth

Mona Vale Road is a major east / west link between the Pacific Highway at Pymble and Pittwater Road at Mona Vale. Mona Vale Road is about 20 kilometres in length, serves a population of about 80,000 people and provides access to about 34,000 jobs in the local area (Roads and Traffic Authority, 2009). These numbers are expected to grow as a result of development in the local area and the wider region.

Growth in the North Subregion

The Sydney metropolitan region is divided into six subregions to provide focus for subregional planning which will set out how *A Plan for Growing Sydney* (Department of Planning and Environment, 2014a) will apply to local areas. The North Subregion covers eleven local government areas including Hornsby, Ku-ring-gai, Manly, Pittwater and Warringah. While new subregional plans are currently being prepared, the current and target population, housing and employment forecasts for the North Subregion illustrate expected growth (refer to Table 2-1).

Table 2-1 Current and target population, housing and employment for the North Subregion

	Current	Target to 2021 (2011-2021)	Target to 2031 (2021-2031)
Population	529,000	573,000 (+44,000)	610,000 (+81,000)
Housing	204,000	223,000 (+19,000)	241,000 (+37,000)
Employment	186,000	208,000 (+22,000)	225,000 (+39,000)

Source: *Draft Metropolitan Strategy for Sydney to 2031* (NSW Government, 2013)

Forecast population and employment growth rates along the Mona Vale to Macquarie Park corridor, of 13 per cent and 19 per cent respectively over the next 20 years, are higher than Sydney average rates (RTA 2009). The Traffic and Transport

Assessment (refer to Appendix B) notes that the development of the North Subregion and the Northern Beaches area over the next 20-25 years will see Mona Vale Road transformed to a heavily trafficked urban corridor accommodating between 25,000 and 42,000 vehicles per day in 2031.

The forecast increase in population and employment in the North Subregion as well as surrounding subregions will increase the need to travel and put pressure on the existing road and transport networks that are fast approaching capacity, especially during the peak periods. Extra road network capacity and new public transport services will be needed to move people within and out of the North Subregion efficiently. As a key arterial road servicing Sydney's northern beaches and Pittwater region, Mona Vale Road is one of the roads that needs increased capacity to address population and employment growth.

Construction of the new Northern Beaches Hospital and associated transport network upgrades will occur prior to the completion of the proposal (at this stage all associated development related to the hospital is estimated to be completed by 2018). It is expected that some of the vehicles currently accessing Mona Vale Hospital will utilise Mona Vale Road and Forest Way to access the new Northern Beaches Hospital.

About seven per cent of all hospital staff are expected to utilise Forest Way (and Mona Vale Road) based on their existing residential addresses. Including visitors, it is estimated that about 70 hospital related trips will utilise Mona Vale Road during the AM peak period (GTA Consultants, 2014).

Brookvale-Dee Why Major Centre, with its projected 3,000 additional jobs by 2031, is also expected to generate additional traffic that will use Mona Vale Road.

Ingleside Precinct

The Department of Planning and Environment, UrbanGrowth NSW and Northern Beaches Council are currently working together to investigate development potential in Ingleside. The Ingleside Precinct Planning Project commenced in July 2013 with the aim of identifying opportunities for development in the area, taking into account the environment, economic viability, housing types, community consultation and infrastructure needs. The precinct comprises around 700 hectares of land (refer to Section 6.11 for further detail). Currently, an additional 3400 dwellings, a shopping village with a mix of retail and commercial businesses, a community centre and one or two schools are envisaged for the Ingleside precinct.

Mona Vale Road (which traverses the precinct) is expected to be the main access to the precinct and therefore additional trips on Mona Vale Road are expected as the precinct is progressively developed. The increased capacity on the proposal provides would help accommodate this growth. It is also noted that roads in the southern part of the precinct would be designed to encourage use of Mona Vale Road in preference to Powder Works Road.

2.1.3 Traffic congestion

As discussed in Section 1.1, the subject section of Mona Vale Road is currently affected by traffic congestion and road users frequently experience major traffic delays, both during and outside of peak periods. The congestion occurs for a variety of reasons including:

- High and increasing traffic volumes using this arterial road
- 'Bottlenecks' caused by traffic merging from two lanes into a single lane at both ends of the study area
- Heavy vehicles travelling below the posted speed as they climb or descend the steep hill within the study area
- Mona Vale Road is a classified B-double route and a bus route, with heavy vehicles making up about 10 per cent of the total traffic using the road.

These conditions cause congestion, particularly during peak periods when traffic volumes are high. Due to the narrowness of the carriageway, crashes and breakdowns are also difficult to clear resulting in further delays.

The Traffic and Transport Assessment (refer to Appendix B) notes that the development of the North Subregion and the Northern Beaches area over the next 20–25 years will see Mona Vale Road transformed to a heavily trafficked urban corridor accommodating between 25,000 and 42,000 vehicles per day in 2031. This projected growth, in conjunction with the existing standard of the road, will result in increased congestion on Mona Vale Road and will affect general traffic, freight vehicles and buses. Travel times on Mona Vale Road will increase as the level of congestion increases.

Under the Full Mona Vale Road Upgrade scenario, all intersections are expected to perform at acceptable level of service or better than the expected level of service under a Do Nothing scenario up to 2036, for both the AM and PM peak hours.

Without the proposal, long delays as a result of congestion would mean people would spend more time travelling by car or on buses, freight transport would be less efficient and there would be limitations to future growth due to restricted accessibility. Increased times could also reduce the attractiveness and viability of commercial businesses and housing proposed as part of the proposed Ingleside Precinct, and the region may suffer economically.

2.1.4 Road safety

Crash statistics for the seven year period between 2009 and 2015 show that there were a total of 29 crashes on Mona Vale Road between the McCarrs Creek Road and Powder Works Road intersections (inclusive). This included 22 injury crashes (no fatal crashes were recorded). The severity of recorded crashes was similar to the NSW average.

The proposal would reduce the risk of crashes by improving the alignment of the road, allowing opportunities to safely overtake slower vehicles and dividing directional traffic flows with a central barrier. Specific examples of road improvements that would improve road safety include restricting direct access to Mona Vale Road from Addison Road and signalling the Kimbriki Road intersection.

It is expected that the proposal would result in a 15 per cent average annual reduction in the number of crashes occurring between the McCarrs Creek Road and Powder Works Road intersections (inclusive). In addition, the cost of these crashes is expected to be reduced by 22 per cent.

2.1.5 Pedestrian and cyclist safety and connectivity

The existing road makes no provision for cyclists and pedestrians and there are no marked cycle lanes or separate shared path facilities extending the full length of the road. A short length of narrow off road path connects the Baha'i temple to Addison Road. There is no recreational connectivity between Terrey Hills and Ingleside along Mona Vale Road. Recreational users (walkers, horse riders and cyclists) currently use a combination of local roads, bush trails and narrow Mona Vale Road shoulders to gain access between the communities. This lack of connectivity discourages use of these modes for both commuting and recreational purposes.

The existing road shoulders are relatively narrow and provide poor amenity and safety for cyclists. Some short disconnected sections of suitable shoulder are marked for cyclist use.

On-road cyclists would have improved facilities as part of the proposal, with shoulders extended to provide a three metre width on both sides of the road for the majority of the length of the upgrade.

In addition to the provisions for on-road cyclists, the proposal would improve access and amenity for pedestrians and cyclists through the provision of a three metre wide off-road shared path from Kanangra Avenue to around 300 metres west of Mona Vale Road and Powder Works Road intersection before transitioning to a 1.5 metre wide footpath along the frontage of the Baha'i Temple.

2.2 Existing road and infrastructure

The Mona Vale Road West upgrade includes 3.4 kilometres of improvements along Mona Vale Road between McCarrs Creek Road, Terrey Hills to Powder Works Road, Ingleside. It is a key east-west arterial road providing access to Sydney's Northern Beach suburbs, including a range of residential, employment and industrial areas. The proposal specifically provides access to the suburbs of Terrey Hills, Ingleside, Warriewood, Elanora Heights, Bay View, Church Point and Mona Vale Road itself, via the Mona Vale Road East upgrade. The eastern end connects to the existing dual carriageway east of Manor Road and the western end ties into the existing dual carriageway, immediately east of McCarrs Creek Road.

2.2.1 Landscape and key features

The landscape context along Mona Vale Road has a reasonably consistent bushland setting, however the broader context takes in residential and rural land uses.

From west to east Mona Vale Road runs along the crest of a sandstone ridgeline that bisects Ku-ring-gai Chase National Park to the north of the alignment and Garigal National Park to the south. It crosses the upper levels of the catchments of Deep Creek and its tributaries that flow into Narrabeen Lakes to the south, and McCarrs and Wirreanda Creeks, which join Pittwater at Church Point in the north.

Topographically, the steep sided ridgeline presents physical constraints to the upgrade. The road has tight horizontal curves and a steep and undulating vertical alignment. From the highest point of the upgrade along the ridge close to Tumbledown Dick Hill at RL 217, the alignment follows the undulations of the ridgeline to RL 200, adjacent to the Baha'i Temple at the eastern end. The existing road provides views across the National Parks, views to the Baha'i Temple and the first view of the Pacific Ocean for those travelling east on Mona Vale Road.

The road is characterised by sandstone cuttings and a sense of enclosure by trees along the roadside. Overhead power lines are highly visible on a number of sections of the existing road.

The road corridor has areas of particular ecological value, as well as sites of Aboriginal and historic heritage, classified as being of local significance. A small number of residential properties occur adjacent to the road corridor but do not front onto Mona Vale Road, nor have access from it.

Land to the south of the road is dominated by the Garigal National Park while part of the study area to the north of the road contains land forming part of the Ku-ring-gai Chase National Park. Other small tracts of natural vegetation not forming part of the national parks are located along the northern side of the road. Horse trails are found set back from the Mona Vale Road corridor. These trails connect to trails within the national parks.

The location of the road adjacent to national parks, the road's high traffic volumes and the absence of fauna crossings or containment provisions between the adjoining national parks, result in a high prevalence of fauna road kill.

The existing road sides have fixed objects such as trees, utility poles, drainage structures and rocky outcrops within the clear zone.

Existing key structures and landscape elements within the study area include:

- High voltage overhead power lines
- Intersections at Kimbriki Road, Tumburra Street and Addison Road
- Steep gradients
- Aboriginal cultural heritage site near the western end of the study area
- The Baha'i Temple
- Views to the coastline and Pacific Ocean, and views across the National Parks
- Rugged bushland with sandstone cuttings, trees and under storey vegetation immediately adjacent to the road.

2.2.2 Existing road and intersections

Mona Vale Road is an important arterial road connector for north-eastern Sydney. The 20 kilometre route connects Pittwater Road at Mona Vale in the north east, to the Pacific Highway at Pymble. It is classified by Roads and Maritime as a Class 4 Urban Road, and an important State Road. The road has a posted speed limit of 70 km/h.

The existing road between McCarrs Creek Road, Terrey Hills and Powder Works Road, Ingleside is predominantly a two-lane single carriageway with sections that include overtaking lanes in steep terrain. Overtaking lanes are present for the westbound carriageway between Kimbriki Road and McCarrs Creek Road and for the eastbound carriageway between Tumburra Street and Powder Works Road. A four lane section of road exists on the western approach to McCarrs Creek Road where the proposed western limit of works ties into existing conditions.

Lane configuration along this section of Mona Vale Road varies from two lanes to six lanes. The existing lane configuration of Mona Vale Road in the study area is as follows:

- McCarrs Creek Road to Kimbriki Road: three lanes (one lane eastbound, two lanes westbound)
- Kimbriki Road to Tumburra Street: two lanes (one lane in each direction)
- Tumburra Street to Powder Works Road/Baha'i Temple Way: three lanes (two lanes eastbound, one lane westbound).

Within the study area there are three intersections between McCarrs Creek Road and Powder Works Road:

- Kimbriki Road – the existing layout of the Kimbriki Road and Mona Vale Road intersection is an unsignalised seagull treatment. Kimbriki Road is a two-lane, two-way road that drops off quite significantly from Mona Vale Road. It is characterised by steep grades (up to 20 per cent in some sections). The left turn out of Kimbriki Road joins a single lane before the commencement of a climbing lane up the steep grade of Tumbledown Dick Hill. Available gaps in traffic for turning movements (left out, right out and right in) are limited by high volumes and associated congestion on Mona Vale Road.

Kimbriki Road services about eight rural residential properties and connects onto an access track that services the Kimbriki Resource Recovery Centre. About 30 per cent of the intersection traffic is heavy vehicles.

There are plans currently underway to expand the Kimbriki Resource Recovery Centre and, to that end, Northern Beaches Council has proposed an upgrade of this connecting track from the site all the way to the intersection of Kimbriki Road with Mona Vale Road. A small section of this upgrade approaching the intersection would provide a temporary treatment, until the proposed signalised intersection of the Mona Vale Road upgrade project is constructed (subject to project approval).

- Tumburra Street – Tumburra Street provides access to a number of light industrial and rural residential properties and about 20 percent of the intersection traffic is heavy vehicles. It has a seagull type intersection. The left turn out of Tumburra Street does not have a dedicated lane, with an overtaking lane climbing the steep grades to Powder Works Road commencing 160 metres east of the intersection.
- Addison Road – Addison Road services mostly residential traffic. It is a no through road with no other connections. It has a channelised right turn intersection with a dedicated right turn in lane only. Available traffic gaps for turning movements (left out, right out and right in) are limited by high volumes and associated congestion on Mona Vale Road.

Roads located in the vicinity of the proposal include Kanangra Road, Kimbriki Road, Wirreanda Road, Tumburra Street, Addison Road, Baha'i Temple Way and Powder Works Road. .

The following slip or turning lanes exist within the study area:

- Left turn lane and acceleration lane from McCarrs Creek Road
- Right turn lane from Mona Vale Road westbound into McCarrs Creek Road

- Seagull intersection for movements into and out of Kimbriki Road from Mona Vale Road eastbound
- Left turn lane into Kimbriki Road from Mona Vale Road westbound and also an acceleration lane out of Kimbriki Road onto the westbound carriageway
- Seagull intersection for movements into and out of Tumburra Street from Mona Vale Road westbound
- Left turn lane from Mona Vale Road eastbound into Tumburra Street
- Right turn lane for movements from Mona Vale Road westbound into Addison Road
- Right turn lane for movements from Mona Vale Road eastbound into Powder Works Road.

Mona Vale Road is designated a B-Double route for trucks up to 26 metres in length with connections to other B-Double routes including Forest Way and Pittwater Road (also for trucks up to 26 metres in length), as well as Barrenjoey Road (for trucks up to 19 metres in length). The road carries heavy traffic at AM and PM peaks in a narrow corridor with a winding alignment and three intersections. Traffic volumes are increasing steadily and congestion and slow travel times are experienced along the proposal route.

The road does not meet current design standards, with lanes below the desired width of 3.5 metres. The shoulders are generally less than 1.5 metres and in some locations less than one metre. Due to the narrowness of the carriageway, crashes and breakdowns are difficult to clear and cause delays. There is insufficient room for use of road shoulders by cyclists.

Existing vertical grades are up to 10.4 per cent. While climbing lanes are provided for two of the three steep grade sections, heavy vehicle speeds are severely restricted by the steep climbs. There are no descent lanes or dual lanes provided for the downhill grades. With heavy vehicles required to descend slowly for safety reasons, this has a direct impact on general traffic speeds.

There is no dedicated bus lane or slipways for bus stops within the study area. There are rural style road side bus stops without shelters provided at Tumburra Street and Kimbriki Road. No formal pedestrian crossing facilities are provided.

2.3 Proposal objectives

Roads and Maritime has established seven objectives for the proposal as follows:

1. Provide a safe road environment that reduces the frequency and severity of crashes
2. Reduce congestion and delays on Mona Vale Road between McCarrs Creek Road and Powder Works Road during peak periods
3. Deliver infrastructure that provides effective network performance for at least the minimum term of 10 years after opening
4. Improve access to bus services. Strengthen integration between land use and all other modes of road use
5. Contribute to safe and effective pedestrian and cycling infrastructure, that supports local and State Government initiatives for active transport

6. Provide the best economic outcome and deliver a positive benefit-cost ratio
7. Minimise impacts to the local environment including adjacent bushland, whilst enhancing urban design and transport outcomes.

2.4 Alternatives and options considered

The proposal has been under development for a number of years as documented in the following key reports:

- Mona Vale to Macquarie Park Strategy (Roads and Traffic Authority, 2009)
- Mona Vale Road – Terrey Hills to Ingleside Preliminary Environmental Investigation (Roads and Maritime Services, 2012c) May 2012
- Mona Vale Road Upgrade: McCarrs Creek Road to Powder Works Road Options Report (Roads and Maritime Services, 2012d) October 2012
- Mona Vale Road Upgrade: McCarrs Creek Road to Powder Works Road Project Options Assessment – Value Management Workshop Report (ACVM, 2013) February 2013
- Mona Vale Road Upgrade: McCarrs Creek Road to Powder Works Road Preferred Option Report (Roads and Maritime Services, 2013c) August 2013.

2.4.1 Methodology for selection of preferred option

In developing route options and then selecting a preferred option, Roads and Maritime has sought to meet the project objectives, and to avoid major technical, social and environmental constraints where possible.

Roads and Maritime used an iterative process to develop the route options. This has involved a number of inputs, including field investigations, engineering designs, community consultation and feedback, internal and external stakeholder involvement, and technical workshops.

Three design options were placed on display in October 2012. Submissions from the public and stakeholders were collected and used to inform the refinement of the options.

A value management workshop was held in February 2013 to evaluate the options and to recommend a preferred alignment option. Attendees included technical specialists and project team members from Roads and Maritime, consultant specialists, representatives from Warringah Council and Pittwater Council, OEH and community representatives.

Assessment criteria were developed from the proposal objectives and other aspects considered important (of value) to the proposal stakeholders to support the evaluation of the options. These were as follows.

Technical/functional perspective

- Improve safety for end users
- Ease of investigation and construction, minimising worker risk and providing capacity for staging of works to minimise duration
- Minimise construction traffic and through traffic impacts

- Provide the best integration of public utilities with the transport solution
- Provide the best opportunity to accommodate public transport expansion into the future
- Provide the best ongoing operation and maintenance solution.

Natural and built environment perspective

- Minimise impacts on threatened ecological communities and threatened species
- Minimise impacts on the National Park (including acquisition)
- Provide opportunities for improved flora and fauna connectivity
- Minimise impacts on water quality.

Socio-economic perspective

- Minimise heritage/cultural impacts
- Minimise adverse impacts to the local amenity (access, noise, air quality, quality of life, etc except the connectivity extent)
- Minimise adverse impacts to view and fits best with the tourist route aesthetics
- Minimise adverse impacts to the adjacent community and businesses
- Provide the best opportunity for recreational access between communities and national parks (i.e. connectivity extent).

Relative weightings for the assessment criteria within each perspective were undertaken qualitatively by the whole group using a paired comparison technique. The opportunities and risks for each option were discussed and then each option was evaluated using the assessment criteria. The options were assessed relatively and on a qualitative basis of how each option met each criteria on a scale of one to five. The best performing option against each assessment criteria was given the highest rating and the other options were given a rating based on their performance against the criteria relative to the best performing option.

The relative strategic cost estimate for each option was then presented to obtain some comparison between options. A summary of the rankings of the options based on the qualitative assessment together with the relative strategic cost estimates was tabled in a value matrix so that the group could draw some conclusions as to which option provided best 'value for money'.

As a result of the work undertaken, recommendations as to the preferred option to be progressed were then made.

2.4.2 Identified options

Options identified and discussed in this section focus primarily on the alignment around the rock outcrop adjacent to Mona Vale Road and to the east of Kimbriki Road. The remainder of the alignment for each option generally follows the existing road alignment and are considered common to all route options. A constraint for the proposal is that the culturally significant rock outcrop cannot be removed, harmed or placed at risk of damage.

Broader alternatives such as upgrades to public transport services along the corridor were considered in the Mona Vale to Macquarie Park Strategy (Roads and Traffic Authority, 2009). The steep topography precludes any consideration of rail alternatives. The Mona Vale Road corridor has previously been identified as a bus strategic corridor (Roads and Traffic Authority, 2009) however the current configuration of a single lane in each direction and high traffic volumes experienced along this section of Mona Vale Road precludes any development of this approach until the capacity constraint has been addressed.

The identified options are illustrated in Figure 2-1 and are described as follows.

Do nothing option

In considering broader alternatives to the proposal, the do nothing option was examined. Under this option, Mona Vale Road between McCarrs Creek Road and Powder Works Road would not be upgraded from a single lane each way to two lanes each way with a divided median.

Widening within the existing corridor

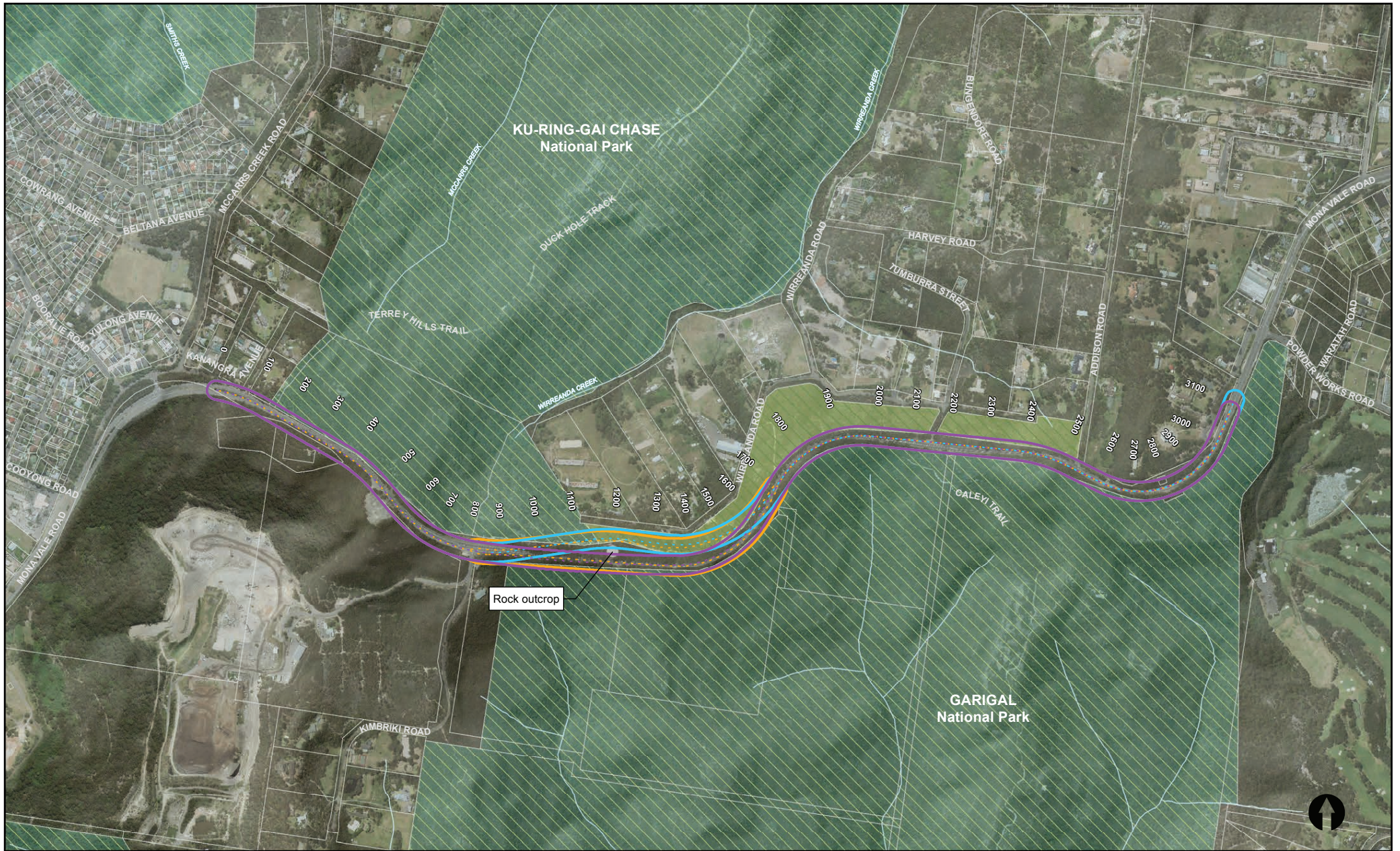
Widening within the existing corridor and bypassing the rocky outcrop to the south with a viaduct structure. This option would be predominantly located within the existing corridor, with road shoulders generally about 2.5 metres wide throughout. The alignment would seek to minimise impacts on the endangered Duffys Forest Ecological Community and Ku-ring-gai Chase National Park located to the north.

Northern alignment

Building a new road and bypassing the rocky outcrop on a northern alignment. This alignment would avoid impacts on the rocky outcrop and allow for the carriageway to be constructed without compromising the width of the road shoulders in the vicinity of the rocky outcrop. It would also allow a shared path along the northern side of Mona Vale Road for a majority of the length of the upgrade.

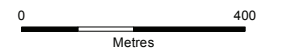
Split carriageway

Splitting the carriageway and running two lanes eastbound on a new road to the north of the rocky outcrop and upgrading the existing road for westbound traffic bypassing the rocky outcrop to the south. Similar to the northern alignment option, this would avoid impacts on the rocky outcrop while maintaining the 2.5 metre wide shoulder and the shared path along the northern side of the road for the full length of the upgrade.



- Option 1 corridor (50m)
- Centreline
- Option 2 corridor (50m)
- Centreline
- Option 3 corridor (50m)
- Centreline
- National Park
- Natural bushland (Crown land)

Options considered Figure 2.1



2.4.3 Analysis of options

Do nothing option

Forecast population and employment growth rates along the Mona Vale to Macquarie Park corridor, of 13 per cent and 19 per cent respectively over the next 20 years, are higher than Sydney average rates (Roads and Traffic Authority, 2009). The current road corridor (two lane undivided road) will not be able to cater for the significant amount of additional traffic.

Delays would be caused by local traffic conflicting with major through traffic movements along Mona Vale Road. Intersection delays currently experienced at McCarrs Creek Road and Powder Works Road / Baha'i Temple Way will continue to increase. Travel times on Mona Vale Road would increase as the level of congestion increases.

Long delays would result in social impacts as future residents spend more time travelling by car and impose limitations to future growth in the subregion due to its restricted accessibility via a constrained road network. Increased travel times on Mona Vale Road could also reduce the attractiveness and viability of commercial businesses/town centres and the region may suffer economically. Congestion on Mona Vale Road would also limit the accessibility to the proposed Ingleside land release, reducing the attractiveness of public transport for future residents. As such, the Do Nothing option would not meet Proposal Objectives 2 and 3 (reducing delays).

The potential for crashes is likely to increase with additional traffic, especially at major intersections along the route. More rear-end crashes would also be likely to occur as delays on Mona Vale Road continue to increase. Access to and from local and private roads are expected to be more difficult with increased volumes of traffic on Mona Vale Road. Motorists may take greater risks to turn onto Mona Vale Road as gaps in the flow of traffic would be less frequent. As such, the Do Nothing option would also not meet Proposal Objective 1 (providing a safe road environment that reduces the frequency and severity of crashes).

Given these factors, the do nothing option was not regarded as an acceptable solution as it would not satisfy Proposal Objectives 1, 2 or 3. The Do Nothing option was not considered further.

Widening within the existing corridor

This option would have the most geotechnical constraints and constructability issues which, in order to manage these issues during construction, would require a greater construction footprint. This option would also require strip acquisition of Garigal National Park, would have the least opportunities for fauna connectivity and the shared path would be located to the north of a rocky outcrop, leaving users isolated. As such, this option did not satisfy Proposal Objective 7 (to minimise impacts to the local environment including adjacent bushland), and marginally addresses Proposal Objective 5 (safe and effective pedestrian and cyclist infrastructure) as the option would leave the shared path isolated from Mona Vale Road and/or local roads.

This option would avoid the culturally sensitive area. This option would simplify the intersections and access points to future residential development which would seek to address the enhancing transport outcomes criteria of Proposal Objective 7. As this option only marginally addresses Proposal Objectives 6 and 7, it was not considered further.

Northern alignment

The northern alignment option would provide on and off ramps from the Mona Vale Road corridor to local streets of Tumburra Street and Wirreanda Road, improving efficiency for through traffic and improving safety to motorists accessing local streets, satisfying Proposal Objective 1 (providing a safe road environment that reduces frequency and severity of crashes) through the separation of through and entering/exiting traffic, Proposal Objective 2 (reducing congestion) through improving through traffic, and Proposal Objective 3 (delivering effective network performance) through improving through traffic.

The northern alignment would allow for the provision of a shared path along a large majority of the length of the upgrade meeting Proposal Objective 5 (safe and effective pedestrian and cyclist infrastructure).

It would require acquisition of part of Ku-ring-gai Chase National Park however it would consolidate a fragmented piece of bushland to the north of the road into a more contiguous area of Garigal National Park. In consolidating the area of Garigal National Park, this option would avoid a culturally sensitive area and return an area and its cultural significance to a national park. It would provide improved fauna connectivity opportunities and is the only option with the opportunity for a fauna overpass between the two national parks, minimising potential impacts of further fragmentation (which would occur with options that created increased ground distance between the national parks through provision of additional lanes, with negligible opportunity to mitigate) and improving fauna connectivity between the national parks.

Environmental benefits created through this option address Proposal Objective 7 (minimising impacts to the local environment including adjacent bushland) through both minimising impacts and providing a positive environmental outcomes for cultural items and fauna connectivity.

Split carriageway

This option would require acquisition of part of Ku-ring-gai Chase National Park and the shared path would be adjacent to the corridor. The fauna connectivity opportunities would rely on fencing of the central median area or extended culverts between the two national parks and would further fragment the vegetation and create an additional barrier for wildlife movement. This option would result in the culturally sensitive area being isolated and it would impact on unlisted non-Aboriginal heritage items to the south of the road corridor. As such, this option did not satisfy Proposal Objective 7 (to minimise impacts to the local environment including adjacent bushland), and was not further considered.

The three build options considered during the options development stage were considered to each impact similar areas of Duffys Forest Ecological Community and would potentially impact on one dwelling (about 0.1 hectare of private property).

2.5 Preferred option

The preferred option (Northern alignment option) would address strategic planning objectives including congestion and safety by increasing capacity for the movement of freight and general traffic in the Mona Vale Road corridor.

The preferred option directly addresses the NSW Government's strategic goals, priorities and actions as outlined in *NSW 2021: A plan to make NSW number one* (NSW Government, 2011), the *NSW Long Term Transport Master Plan* (Transport for NSW, 2012), the *Mona Vale to Macquarie Park Corridor Strategy* (Roads and Traffic Authority, 2009) and other related plans and strategies.

The preferred option would best meet the proposal objectives by:

- Providing two additional lanes and a central concrete barrier. When compared to other options this would most effectively reduce the incidence of dangerous overtaking of slower heavy vehicles (both descending and climbing) and the associated likelihood of head on crashes (Proposal Objective 1)
- Providing two additional lanes. This would increase capacity to a greater extent than other options and allow the passing of both descending and climbing heavy vehicles. This avoids the need for merges, would reduce current traffic congestion and would improve travel times for both commuters and the movement of freight (Proposal Objective 2, Proposal Objective 3, Proposal Objective 4)
- Providing for an 80 km/h posted speed limit (rather than 70 km/h for other options), consistent with other nearby parts of the road network (Proposal Objective 4)
- Providing 3.0 metre wide sealed shoulders to improve safety and amenity for cyclists (Proposal Objective 5).

The northern option was chosen as the preferred route because it:

- Ranks well with community feedback received on the three route options
- Provides the most flexibility to design around potential constructability issues
- Minimises the amount of national park land acquisition required
- Allows for the old road to be consolidated into Garigal National Park
- Avoids impact to the culturally sensitive area
- Provides the best opportunities for fauna connectivity between the national parks
- Provides simpler traffic staging during construction, minimising inconvenience to road users
- Provides two lanes in each direction for motorists, as well as wider shoulders for on-road cyclists.

2.6 Design refinements

The preferred option was based on strategic designs completed by Roads and Maritime. These were 'high level' designs that showed a typical arrangement for the proposed upgrade. As the project development process continued, Roads and Maritime further refined the design to improve or optimise its functionality, environmental and social outcomes, urban design outcomes and cost benefits.

The preferred option design refinements for key elements of the proposal subsequently investigated during concept design development included the Tumburra Street interchange, Kimbriki Road intersection and a shared path. Refinements adopted as a result of subsequent investigations are detailed here.

The proposal is subject to detailed design. During detailed design, further investigation may result in changes to the proposal.

2.6.1 Tumburra Street

As part of the initial design process, Roads and Maritime investigated intersection options for the Tumburra Street intersection including:

- Traffic lights similar to McCarrs Creek Road and Mona Vale Road with an eastbound truck climbing lane
- Eastbound and westbound entry and exit ramps along Wirreanda Road
- Grade separation with Mona Vale Road crossing over the top of Tumburra Street.

The original interchange treatments for both the eastbound and westbound entry and exit ramps were by way of two separate roundabouts situated on Wirreanda Road. Besides the Mona Vale Road traffic movements, the two roundabouts were also proposed to cater for local Wirreanda Road traffic as well as a proposed road linking Tumburra Street and Addison Road. One consequence of this option was that the eastbound exit ramp would be constructed in a very deep cut slot which, at its deepest point, would have reached about 13.5 metres in height.

The underpass option at Tumburra Street would be difficult to construct as it would require excavation of a sizeable portion of the existing Mona Vale Road pavement under traffic. The main reasons, however, relate to the significant level difference between Mona Vale Road and Wirreanda Road, which lies at the bottom of a steep hill. Attempts to grade various options to connect the two roads were impracticable as they introduced substandard vertical alignment elements.

Subsequent refinements considered, but not preferred, for Tumburra Street and Wirreanda Road interchange included:

- Constructing a multi-span bridge with battered abutments to take Mona Vale Road over Tumburra Street. As part of options investigations it became apparent that due to the steep downgrade of Tumburra Street, almost 18 per cent, it would be possible to move the Mona Vale Road alignment to the north just enough to achieve the required vertical clearance over Tumburra Street without affecting Tumburra Street itself.
- Westbound entry and exit ramp treatments. The original proposal included an underpass at Tumburra Street. To make this underpass option feasible, the Mona Vale Road alignment was moved approximately 10 metres to the north to accommodate the future westbound entry and exit ramps on the existing Mona Vale Road alignment.
- Removal of a roundabout treatment at the intersection of Tumburra Street and Wirreanda Road
- Realignment of a proposed road connecting Tumburra Street with Addison Road (also superseded by the revised intersection design described below).

Subsequent to the initial round of design development, a second round took place in consultation with the Department of Planning and Environment with regard to the access strategy for the Ingleside Land Release. As detailed in Section 2.6.3, the design refinement process resulted in development of the proposal (refined preferred option) which included primary access to the Wirreanda Valley and proposed

Ingleside Land Release provided through a new signalised intersection at the upgraded intersection of Mona Vale Road, Powder Works Road and a new local road being the extension of Harvey Road.

A left-in, left-out only turning movement was maintained under the design refinement option at the Mona Vale Road and Tumburra Street intersection. The location of the existing intersection has been shifted to the west by about 40 metres to improve the existing steep grade on Tumburra Street. The previously proposed local road connecting Tumburra Street to Addison Road has been removed.

2.6.2 Kimbriki Road intersection

Two layouts for the proposed signalised intersection of Kimbriki Road and Mona Vale Road were investigated, these comprising:

- A high angle treatment on Kimbriki Road in combination with a left and through lane along Mona Vale Road, on the westbound approach to Kimbriki Road
- A slip lane on Kimbriki Road in combination with a left turn only lane along Mona Vale Road, on the westbound approach to Kimbriki Road.

Roads and Maritime commissioned a traffic analysis of the two options. The analysis indicated that the slip lane option with an exclusive left turn lane would be a comparatively safer option. The proposed intersection configuration therefore consists of three westbound through lanes on the westbound approach and departure sides of the intersection while the left turn movement out of Kimbriki Road would be signal controlled.

Due to the heavy Mona Vale Road traffic volumes during peak hours in the westbound direction, the proposal provides an additional lane at the stop line. Considering the 10 per cent upgrade on the westbound departure side of the intersection, an additional through/climbing lane on the westbound approach to the intersection was considered necessary to cater for left turning heavy vehicles out of Kimbriki Road. The proposal was further refined to include a bus stop (westbound) located on the departure side of the proposed signalised intersection. This would replace an existing bus stop located about 50 metres to the east of the current intersection.

Initially, the design provided for the proposed Mona Vale Road widening to occur on the southern side of the existing alignment (refer to) to avoid impacting on an area containing the endangered Angus's Onion Orchid (*Microtis angusii*). The consequence of this was a substantial level difference over the existing steep Kimbriki Road alignment and potential property impacts to Lot No 1/DP 381755.

In order to mitigate impacts on the property access, the proposed Kimbriki Road alignment was moved about seven metres to the west. This allowed for property access via the existing Kimbriki Road pavement which would no longer be used by general traffic. This would have also allowed a substantial amount of the ultimate Kimbriki Road intersection configuration to be built off-line, thereby minimising traffic disruptions during construction.

Subsequent ecological investigations in the area indicated that the Angus's Onion Orchid is more generally widespread and not limited to the area immediately north of the Kimbriki Road intersection as originally thought. In view of this, the design of the intersection was refined further, being shifted about 10 metres to the north. The principal advantage of this is a significant reduction in the length of retaining walls

required on the southern side of Mona Vale Road, particularly to the west of Kimbriki Road. This design refinement also resulted in an extended storage platform for heavy vehicles at the intersection.

2.6.3 Local connecting road between Mona Vale Road and Harvey Road

As discussed in Section 2.6.1, subsequent to the initial round of design development, a second round took place in consultation with the Department of Planning and Environment with regard to the access strategy for the Ingleside Land Release. This round of design refinement included an investigation of options for access from Mona Vale Road to both the Wirreanda Valley and Ingleside Land Release area.

During design development, it was recognised that there was an opportunity to provide improved local connectivity through construction of a new road along the route of an existing 'paper road' located between Harvey Road and Addison Road.

The process identified three preferred options which generally followed the Harvey Road alignment east of the intersection of Harvey Road and Bungendore Street, up to the intersection with Addison Road, before continuing east through privately owned parcels of land to meet with the intersection of Mona Vale Road and Powder Works Road.

The three options considered were as follows:

- Option 1 – extension of Baha'i Temple Way
- Option 2 – five leg signalised intersection of Baha'i Temple Way
- Option 3 – left in, left out of Baha'i Temple Way.

The three options are shown in Figure 2-2, Figure 2-3 and Figure 2-4 respectively.

All three options share a common alignment from Harvey Road through to Baha'i Temple Way, the principal difference being the configuration of the connection to Mona Vale Road. Option 1 is preferred as it would provide the best outcome in terms of traffic safety.

The new road connection would provide an alternate access for Mona Vale Road from the Wirreanda Valley and the Ingleside Land Release area, catering for both current and future land-uses, and reducing demand on the Tumburra Street and Addison Road intersections. As a result of the reduced demand at these intersections, a left-in and left-out only was maintained under this option at the Mona Vale Road and Tumburra Street intersection.

The benefits of the design refinement and update to the preferred option include:

- A minimised the design footprint on Mona Vale Road through a simplified design comprising a T-intersection (left in left out) at Tumburra Street, and left in emergency vehicles access only at Addison Road
- Improved traffic flows on Mona Vale Road by removing the proposed signalised intersection (under the preferred option) at Tumburra Street
- Upgrade to the signalised intersection at Mona Vale Road and Powder Works Road to provide connection to the proposed Harvey Road extension
- Provision for access and connectivity to the Wirreanda Valley and the Ingleside Land Release area through the Harvey Road extension

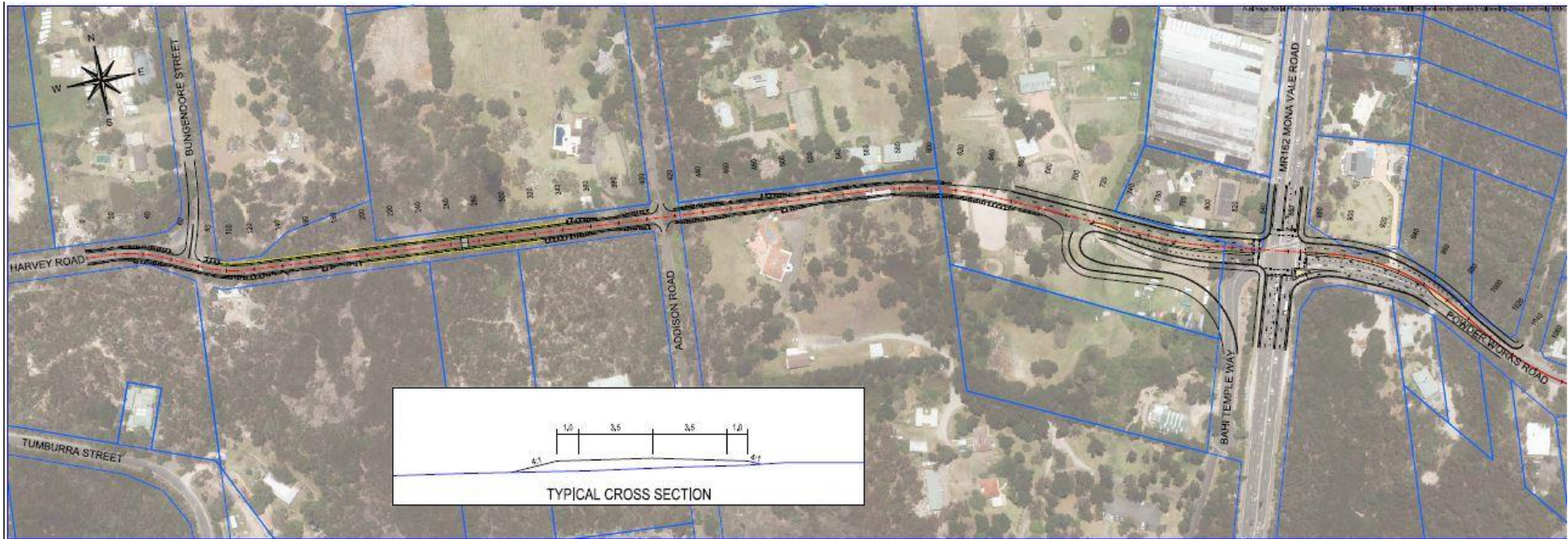


Figure 2-2 Harvey Road extension – Option 1

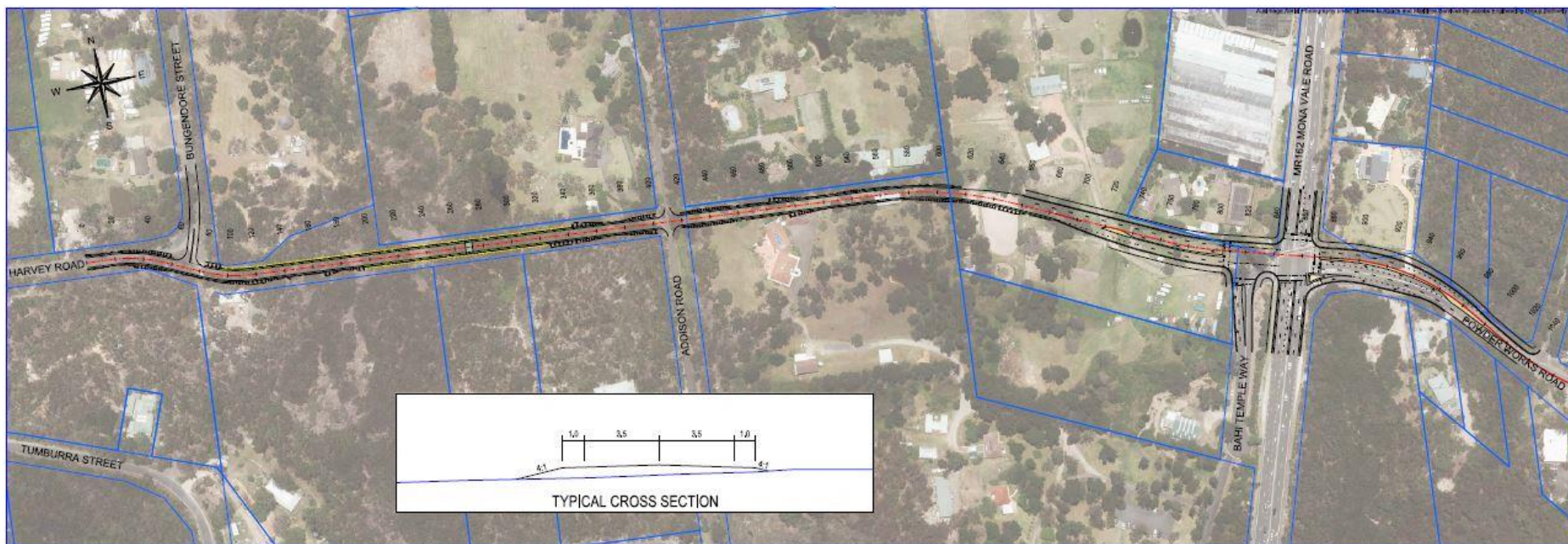


Figure 2-3 Harvey Road extension – Option 2

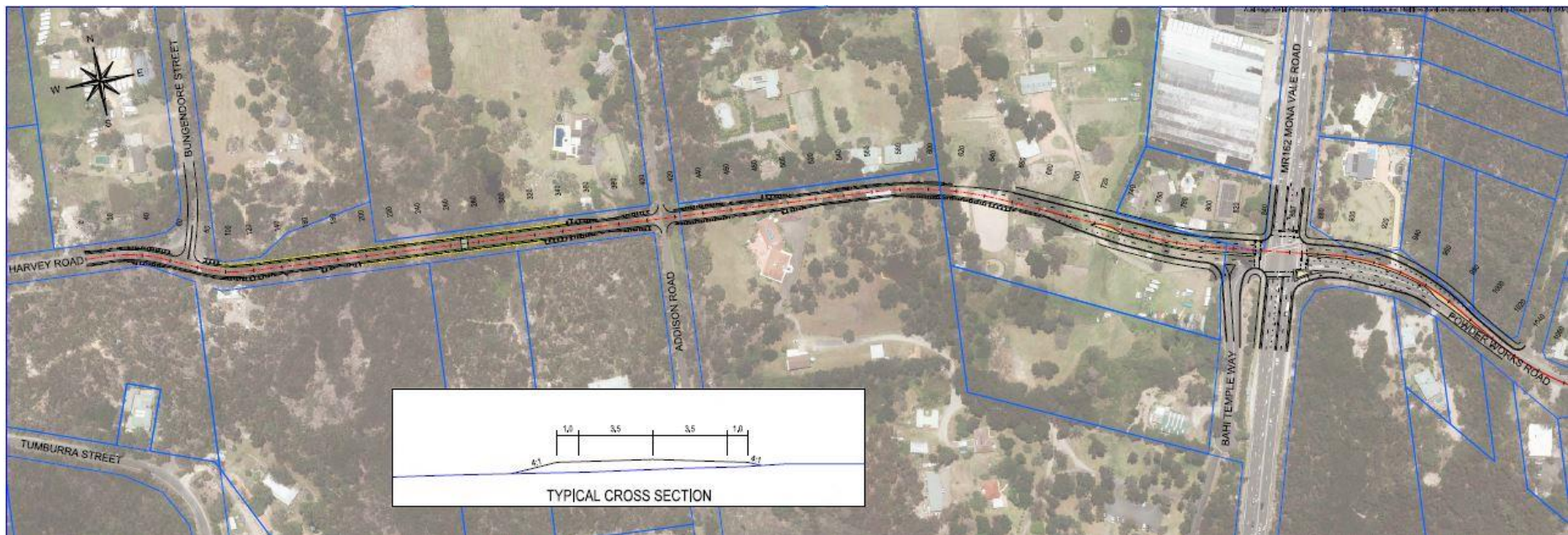


Figure 2-4 Harvey Road extension – Option 3

3 Description of the proposal

3.1 The proposal

The proposal involves a 3.4 kilometre upgrade of Mona Vale Road between McCarrs Creek Road, Terrey Hills and Powder Works Road, Ingleside. The upgrade would be from a two lane (one in each direction) undivided road to a four lane (two lanes in each direction) divided road on Mona Vale Road, and would include local road connections and upgrades on Wirreanda Road, Addison Road and Tumburra Street. The proposal is needed to reduce congestion and improve road safety. In addition, the concept design provides for anticipated future growth in the region.

Mona Vale Road is the main east-west link between the Pacific Highway, Pymble and Pittwater Road at Mona Vale totalling about 20 kilometres in length. Traffic surveys undertaken in December 2013 near the intersection of Mona Vale Road and Tumburra Street indicated the volume of traffic to be about 37,000 vehicles per day in both directions.

The proposal generally comprises:

- Widening to provide four lanes (two in each direction) on Mona Vale Road between McCarrs Creek Road and Powder Works Road by:
 - Widening on the southern side of the existing carriageway between McCarrs Creek Road and Kimbriki Road
 - Deviation of the entire four lane road from the current road to the north of a rock outcrop having cultural heritage significance between Kimbriki Road and Tumburra Street
 - Widening on the northern side of the existing carriageway from about 700 metres west of Tumburra Street to Addison Road
 - Widening on both sides of the existing carriageway between Addison Road and Powder Works Road.
- Provision of a new traffic signal intersection at Kimbriki Road including additional dedicated turning lanes and a truck climbing lane
- Restricting traffic movements at the intersection of Mona Vale Road and Tumburra Street to left-in and left-out only
- Relocating the Mona Vale Road and Tumburra Street intersection to the west by about 40 metres to improve the existing steep grade on Tumburra Street
- Providing a new local road connection between Bungendore Street and Powder Works Road using the existing Harvey Road corridor and extending the new local road east of Addison Road to meet with the intersection of Mona Vale Road and Powder Works Road
- Removing bus stops on either side of the intersection at Tumburra Street and re-directing bus services along the new local road connection and Tumburra Street to serve existing and future land uses
- Relocating the existing access to the National Baha'i Centre by about 120 metres west along the new local road

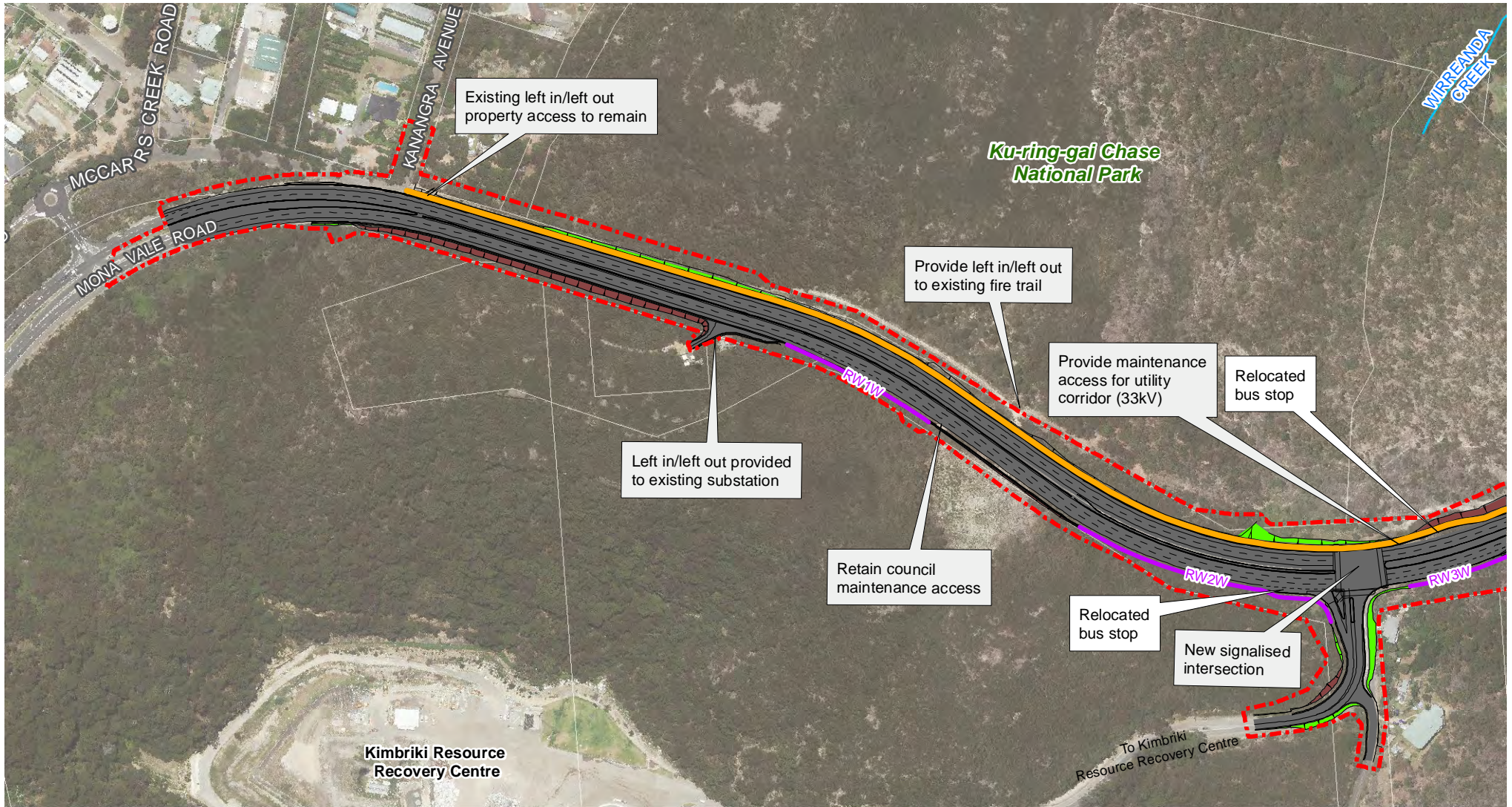
- Improving fauna connectivity across Mona Vale Road between Ku-ring-gai Chase National Park and Garigal National Park by:
 - Providing a 40 metre wide fauna bridge over Mona Vale Road, east of Kimbriki Road
 - Providing a fauna underpass of Mona Vale Road to the west of the intersection with Tumburra Street
 - Providing a fauna underpass between Bungendore Street and Addison Road
- Closing the existing intersection at Mona Vale Road and Addison Road to general traffic and restricting future access at this intersection to emergency vehicles only
- Minor widening of Powder Works Road for a distance of about 160 metres east from the intersection with Mona Vale Road
- Constructing retaining walls and/or sandstone cuttings at various locations along the alignment
- Providing 3.0 metre wide outer shoulders in each direction to allow for on-road cyclists and vehicle breakdowns
- Constructing a shared use path on the northern side of Mona Vale Road from Kanangra Avenue to around 300 metres west of Mona Vale Road and Powder Works Road intersection before transitioning to a 1.5 metre wide footpath along the frontage of the Baha'i Temple
- Constructing a shared use path on the northern side of the new local road between Addison Road and Powder Works Road intersection
- Relocating and and/or adjusting underground and above ground utilities where required including the upgrade of street lighting
- Upgrading of the existing pavement and cross drainage structures including the construction, reconstruction and extension of pavement drainage lines
- Landscaping over the length of the proposal
- Installing traffic monitoring cameras at all signalised intersections to assist with traffic management.

The proposal would be funded by the NSW Government. Subject to approval and funding, construction works are expected to commence in the first half of 2019, and construction is expected to take a minimum of 2.5 years to complete (including preliminary works).

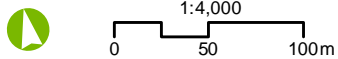
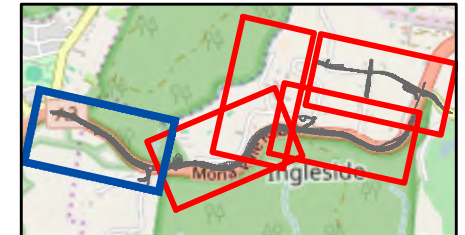
Figures 3-1 to 3-5 show the concept design and illustrate the key features of the proposal. Figures 3-6 to 3-9 show typical cross sections along the proposal.

The proposal is subject to detailed design. During detailed design further investigation may result in changes to the proposal.

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- | | |
|-----------------------|------------------------------|
| Construction boundary | Proposed drainage connection |
| Pavement | Fauna culvert crossing |
| Retaining wall | Earthworks - cutting |
| Pedestrian path | Earthworks - fill batter |
| Shared path | |

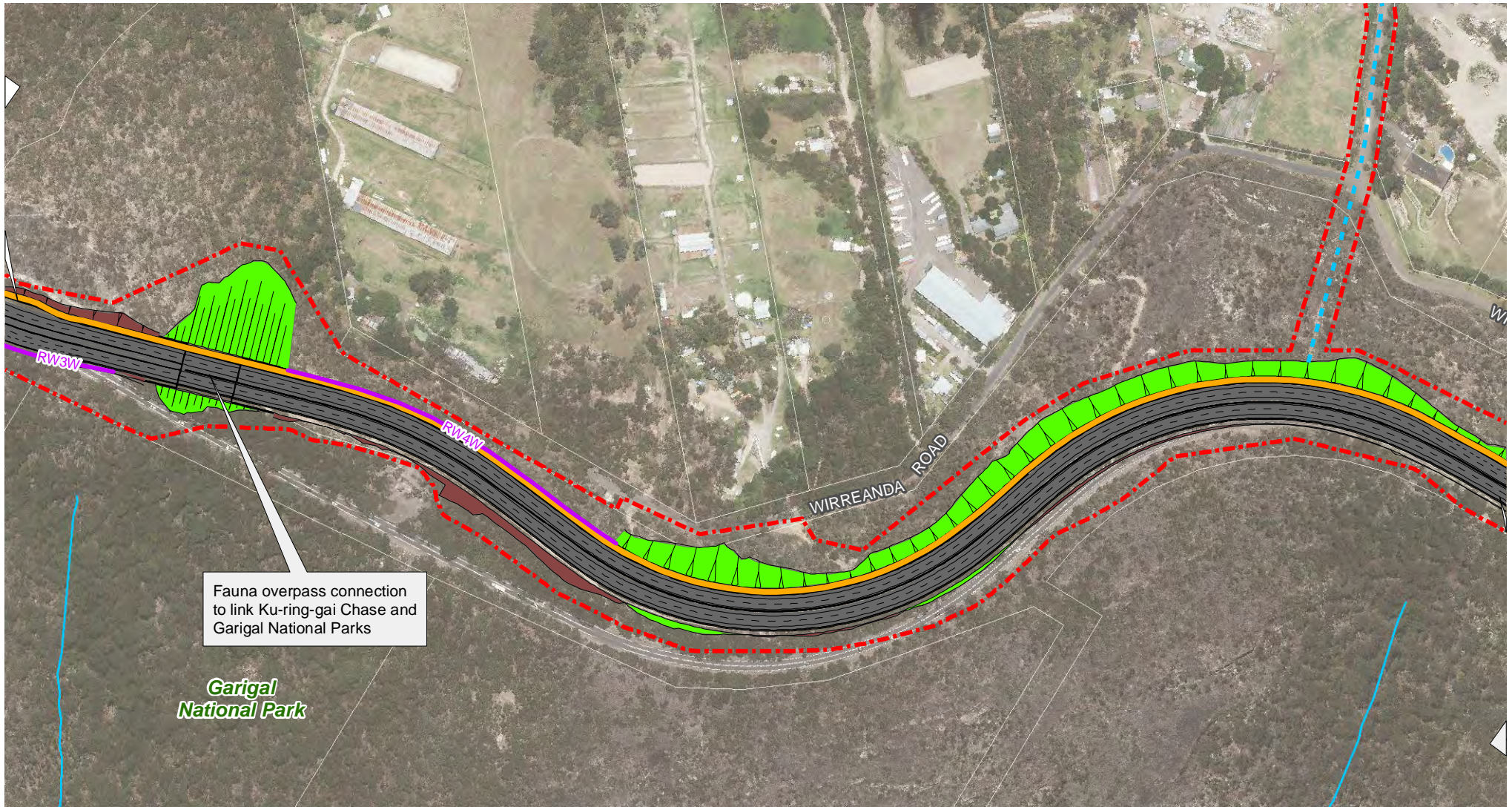


Source: Aurecon, RMS, LPI
 Projection: GDA 1994 MGA Zone 56

Mona Vale Road West Upgrade (Stage 3) **Key features of the proposal**

Figure 3.1

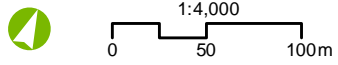
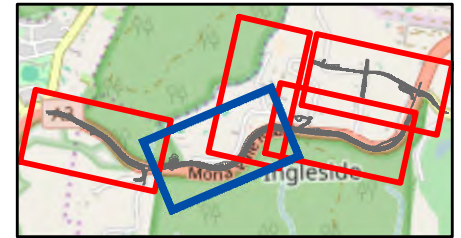
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Fauna overpass connection to link Ku-ring-gai Chase and Garigal National Parks

Garigal National Park

- Construction boundary
- Pavement
- Retaining wall
- Pedestrian path
- Shared path
- Proposed drainage connection
- Fauna culvert crossing
- Earthworks - cutting
- Earthworks - fill batter

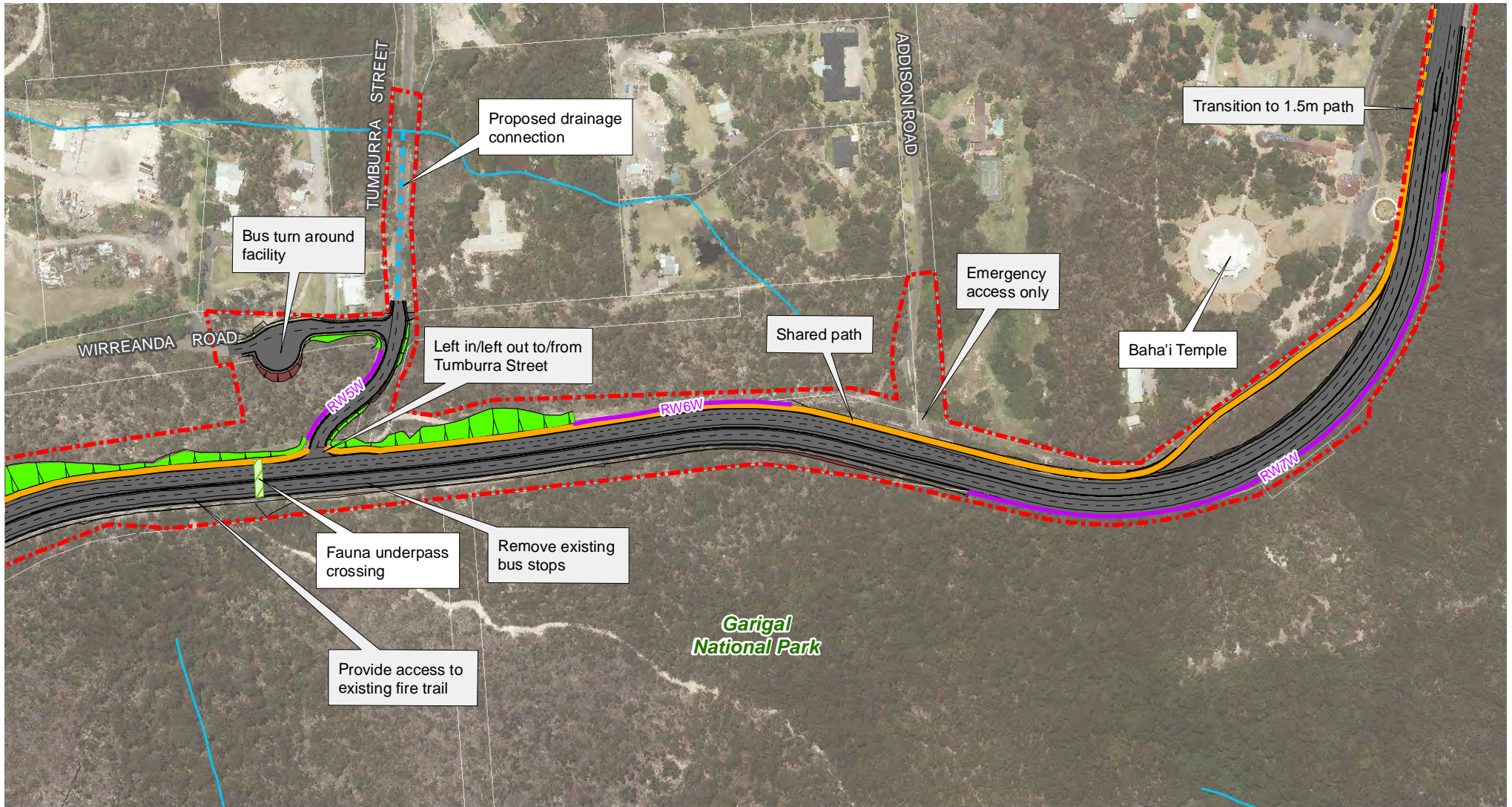


Source: Aurecon, RMS, LPI
Projection: GDA 1994 MGA Zone 56

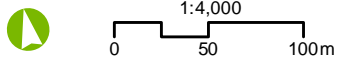
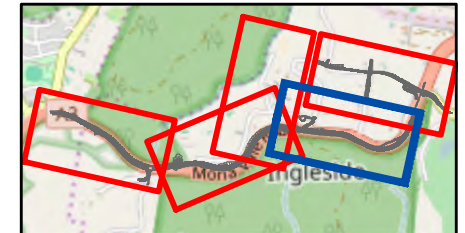
Mona Vale Road West Upgrade (Stage 3) **Key features of the proposal**

Figure 3.2

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- Construction boundary
- Proposed drainage connection
- Pavement
- Fauna culvert crossing
- Retaining wall
- Earthworks - cutting
- Pedestrian path
- Earthworks - fill batter
- Shared path

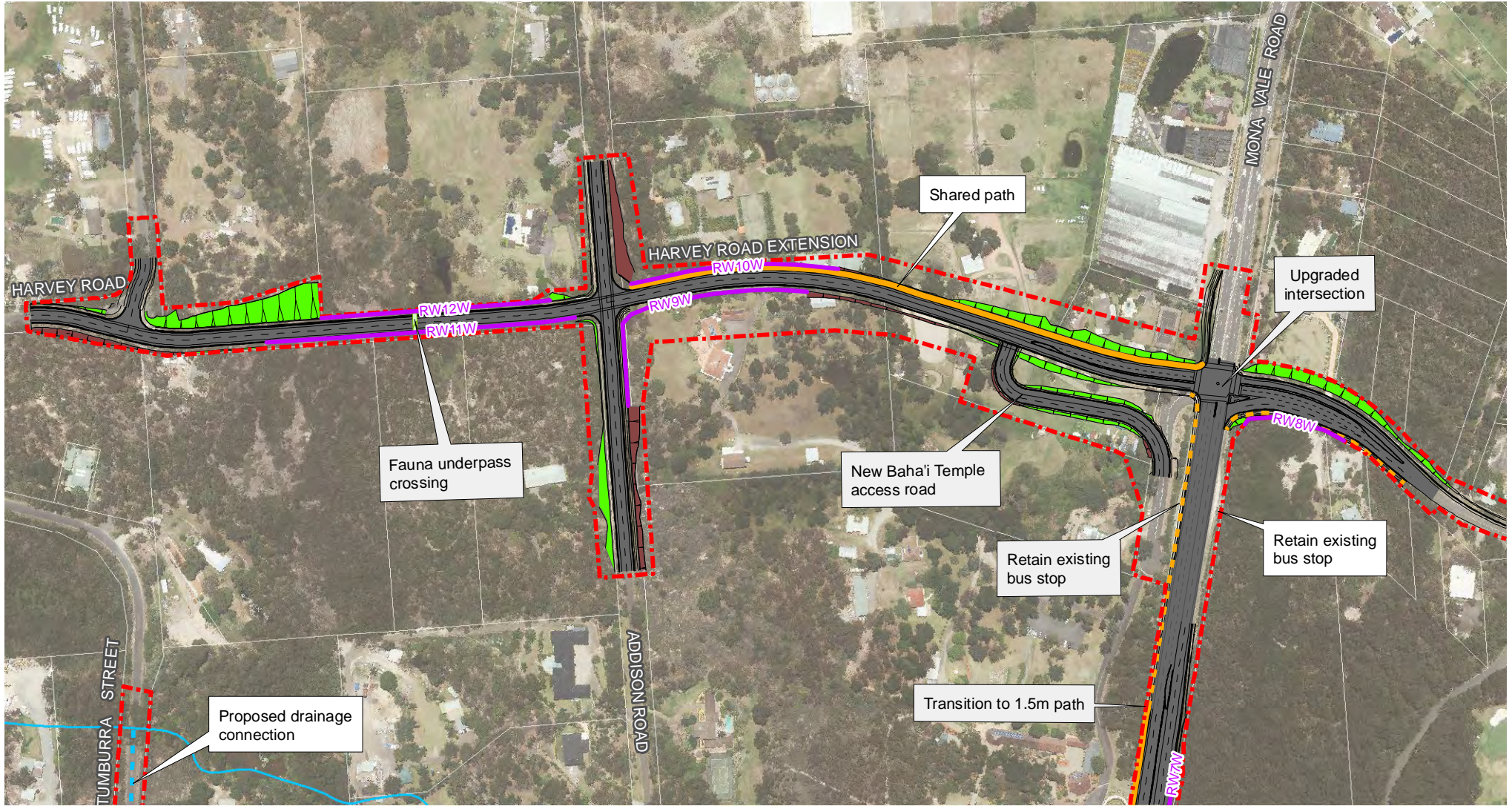


Source: Aurecon, RMS, LPI
 Projection: GDA 1994 MGA Zone 56

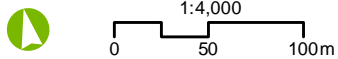
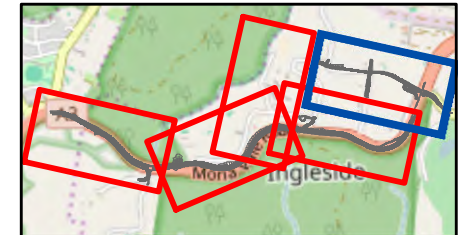
Mona Vale Road West Upgrade (Stage 3) **Key features of the proposal**

Figure 3.3

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- Construction boundary
- Proposed drainage connection
- Pavement
- Fauna culvert crossing
- Retaining wall
- Earthworks - cutting
- Pedestrian path
- Earthworks - fill batter
- Shared path

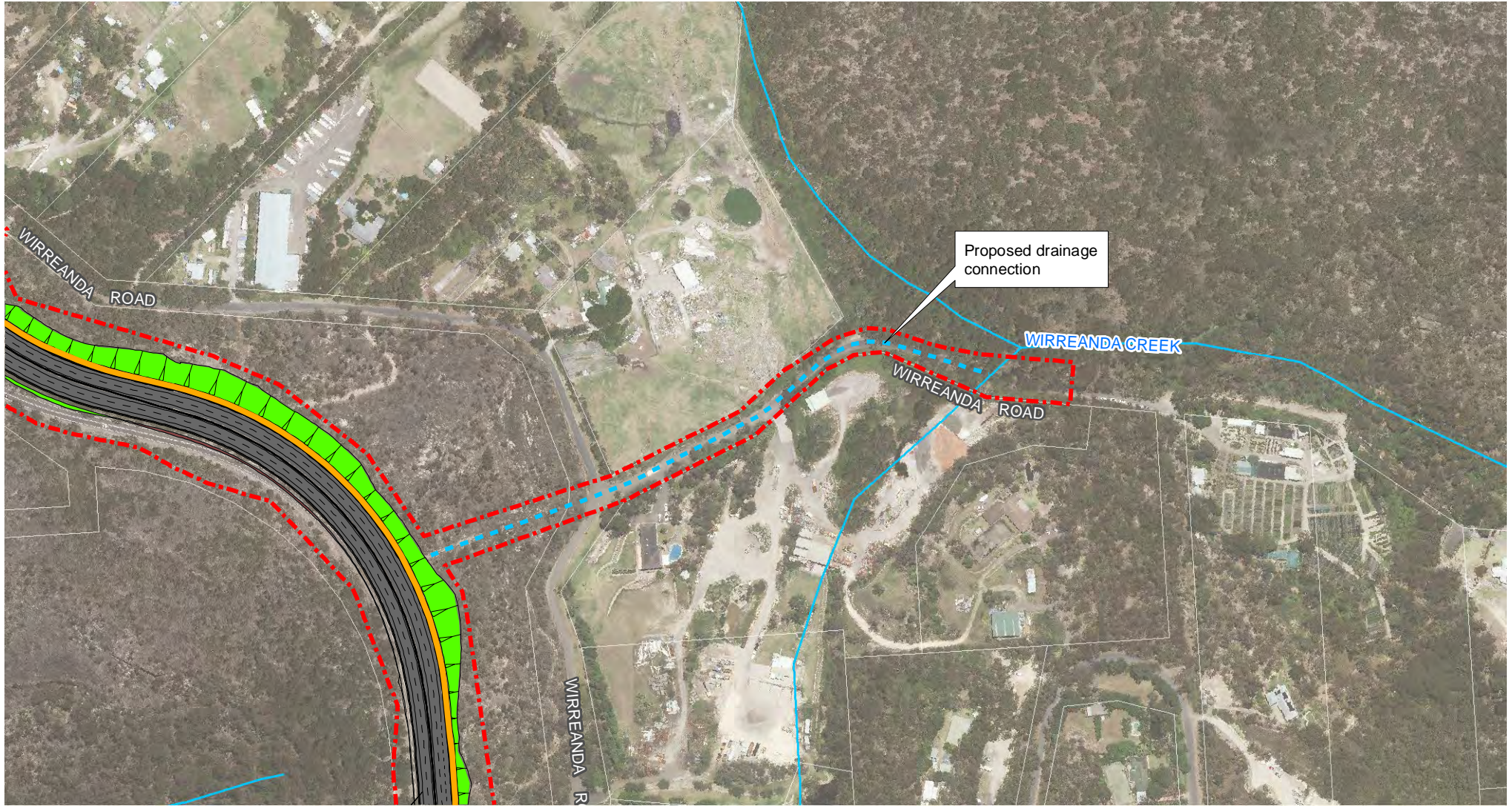











Source: Aurecon, RMS, LPI
 Projection: GDA 1994 MGA Zone 56

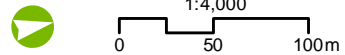
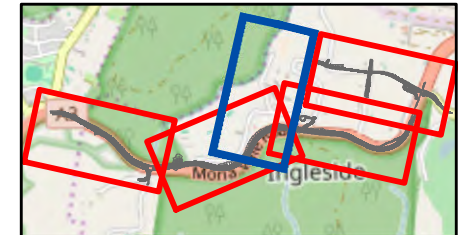
Mona Vale Road West Upgrade (Stage 3) **Key features of the proposal**

Figure 3.4

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-  Construction boundary
-  Proposed drainage connection
-  Pavement
-  Fauna culvert crossing
-  Retaining wall
-  Earthworks - cutting
-  Pedestrian path
-  Earthworks - fill batter
-  Shared path



Source: Aurecon, RMS, LPI
 Projection: GDA 1994 MGA Zone 56

Mona Vale Road West Upgrade (Stage 3) **Key features of the proposal**

Figure 3.5

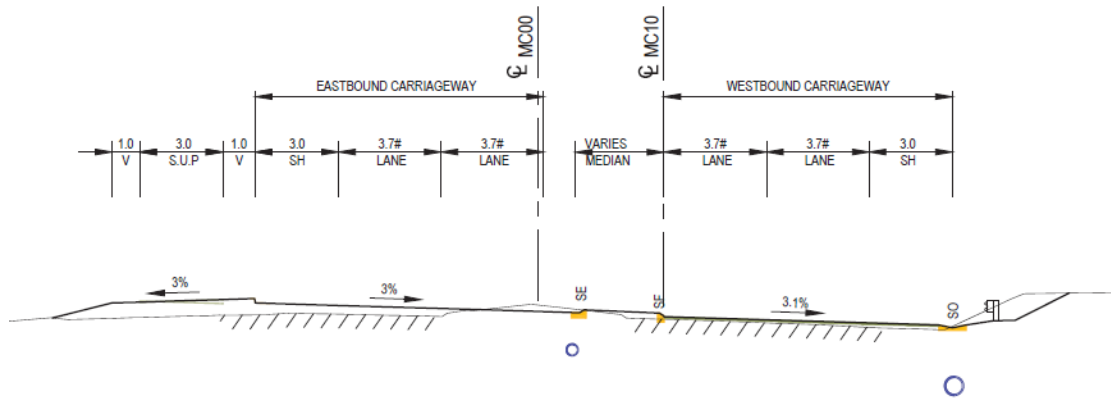


Figure 3-6 Cross section near western limit of works

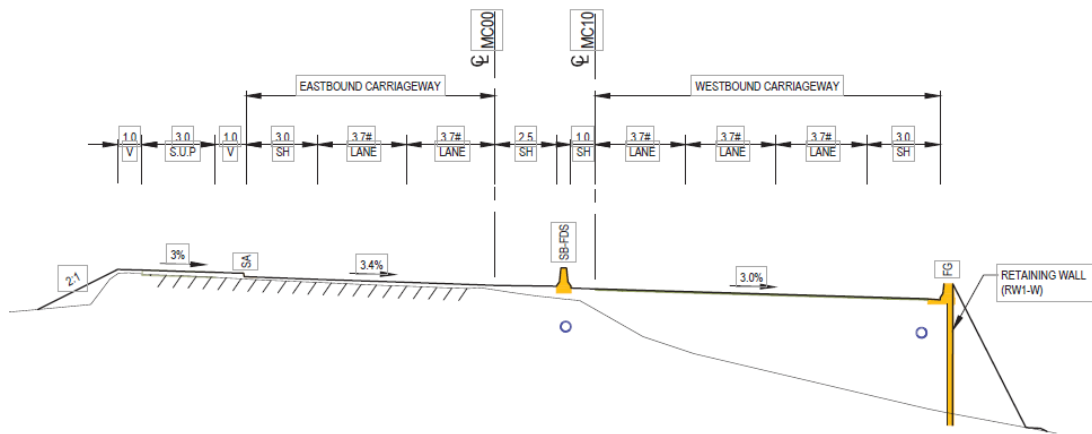


Figure 3-7 Cross section near Kimbriki Road

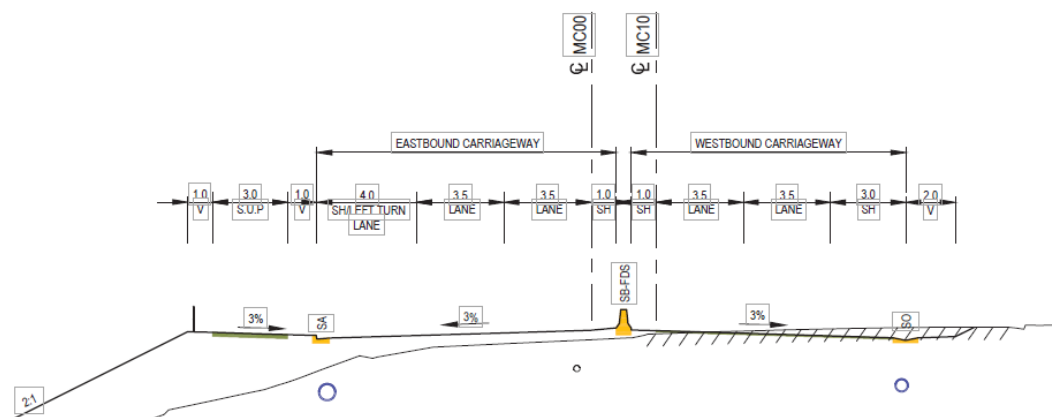


Figure 3-8 Cross section near Tumburra Street

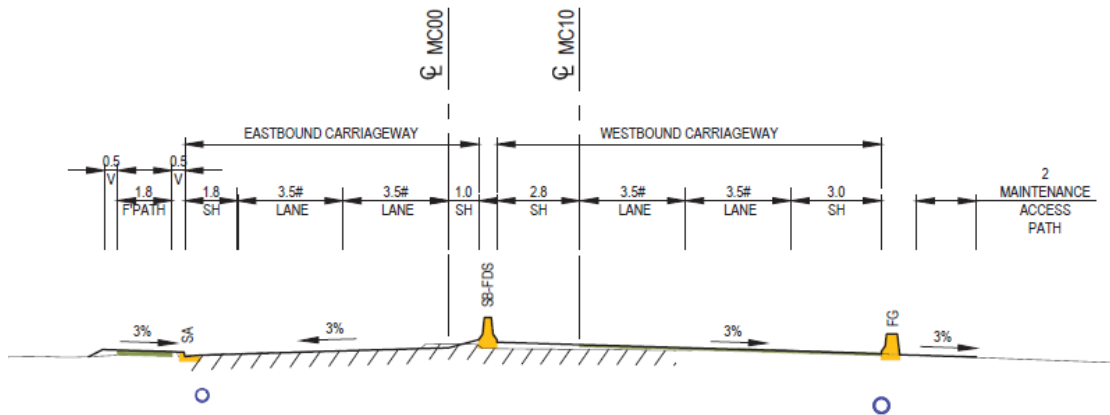


Figure 3-9 Cross section near Baha'i Temple

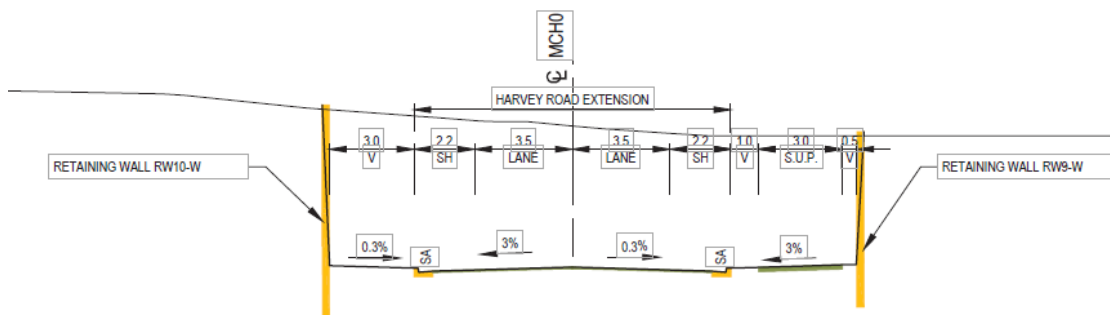


Figure 3-10 Cross section (in cut), Harvey Road extension

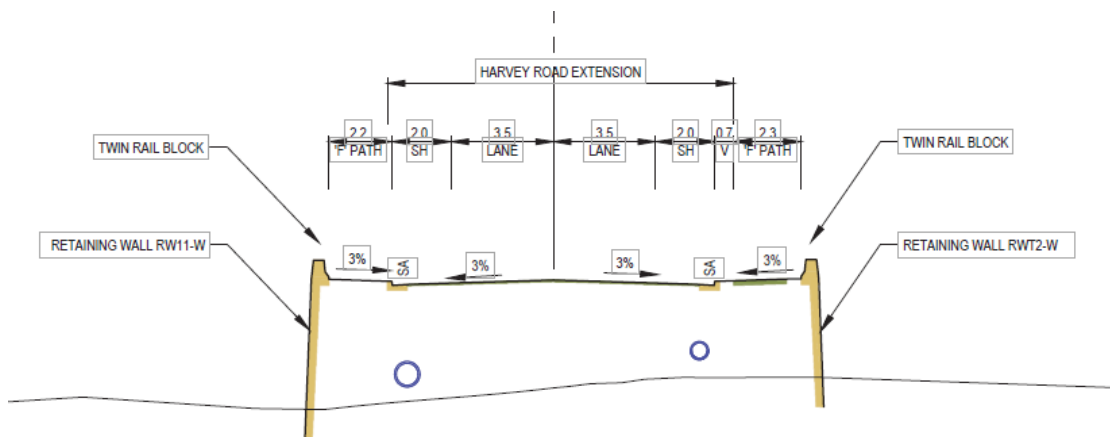


Figure 3-11 Cross section (on fill), Harvey Road extension

3.2 Design

Design criteria

The proposal was designed to be consistent with Roads and Maritime design criteria and other specifications including requirements of this document. Key reference documentation is the Roads and Maritime updates issued for use in conjunction with the *Guide to Road Design* (Austroads, 2009).

The principal design criteria for the proposal are identified in Table 3-1.

Table 3-1 Design criteria for the proposal

Criterion	Requirement
Posted speed	80 km/h
Number of lanes	Two lanes in each direction
Stopping sight distances	Reaction time 1.5 seconds
Grade	Desirable maximum 7 per cent
Lane width	3.5 metres
Shoulder width	Variable. 2.5 metre sealed kerbside shoulders (3.0 metres where adjacent to type F barriers)
Median width	Variable; generally 2.6 metres
Shared path	3.0 metres
Design vehicle	5.0 metre car 26 metre B-Double
Hydraulic standard (pavement)	Minimum 10 year Annual Recurrence Interval (ARI)

3.2.1 Engineering constraints

The proposal presents a number of engineering constraints including:

- Access and constructability is constrained by site topography, geology and the proximity to the national parks
- There is a need to cater for bushfire management and emergency services access
- Geotechnical risks associated with constructability (rock workability, slope stability), costs and worker safety
- Steep grade of Mona Vale Road and local roads
- Aboriginal cultural heritage site near the western end of the study area and an Aboriginal land claim near the eastern end of the study area
- Proximity to national parks
- Presence of threatened ecological community (Duffys Forest EC), threatened species (Caley's Grevillea and Angus's Onion Orchid), and fauna movement corridors.

3.2.2 Urban design and landscape

A Landscape Character/Visual Impact Assessment and Urban Design Study has been prepared for the proposal and is provided in Appendix C. Urban design objectives were developed to guide the design of the proposal and improve the urban design outcomes for the community and road users. The urban design objectives

ensure the proposal fits into the natural, built and community settings, improves the travelling experience for road users, and minimises adverse visual impacts. The urban design objectives are:

- Objective 1: reinforce the roads role as an arterial road within the Northern Beaches region connecting Mona Vale, Warriewood and Elanora Heights to Ingleside, Terrey Hills and west to Pymble and the Pacific Highway
- Objective 2: maintain and improve the character of the Mona Vale Road corridor and reinforce the distinct character and identity that the alignment has created traversing the ridgeline and escarpment down into Mona Vale
- Objective 3: protect, maintain and enhance views, heritage, cultural and roadside landmarks and values
- Objective 4: provide a simple and unified suite of road and roadside elements and details that contribute to and do not detract from the existing character of Mona Vale Road
- Objective 5: Ensure due care and consideration is given to Safety in Design and Crime Prevention Through Environmental Design (CPTED) including natural surveillance and natural territorial reinforcement.

In addition to the above objectives, design principles for bus stops, retaining walls, fauna connectivity, noise barriers, and shared paths were also developed (refer to Appendix C).

3.2.3 Mona Vale Road

Mona Vale Road would be widened between McCarrs Creek Road and Powder Works Road to provide two lanes in each direction generally following the existing alignment. The typical cross section for the Mona Vale Road Upgrade (West) consists of four 3.5 metre wide lanes (two lanes in each direction), with a 2.6 metre wide central median and 3.0 metre wide outer shoulders in each direction to allow for on-road cyclists and vehicle breakdowns. The proposed alignment deviates to the north around a significant cultural heritage item.

The proposal includes a number of retaining walls (refer to Section 3.2.13) along Mona Vale Road due to the natural topography and proximity of the existing alignment along a ridgeline.

3.2.4 Kimbriki Road

A new signalised intersection is proposed at Kimbriki Road and Mona Vale Road (refer Figure 3-12). At this location, Mona Vale Road would be widened to the south of the existing road alignment to accommodate three westbound through lanes on the westbound approach and departure sides of the intersection.

Kimbriki Road would be upgraded for about 140 metres, including embankments and retaining walls, with the right turn movement out of Kimbriki Road onto Mona Vale Road being signal controlled and left turn movement facilitated by a left turn lane.

Due to the heavy Mona Vale Road traffic volumes during peak hours for the westbound direction, an additional lane would be provided at the stop line. The westbound departure side of the intersection has a 10 per cent upgrade, an additional through/climbing lane on the westbound approach to the intersection would be provided for left turning heavy vehicles out of Kimbriki Road.

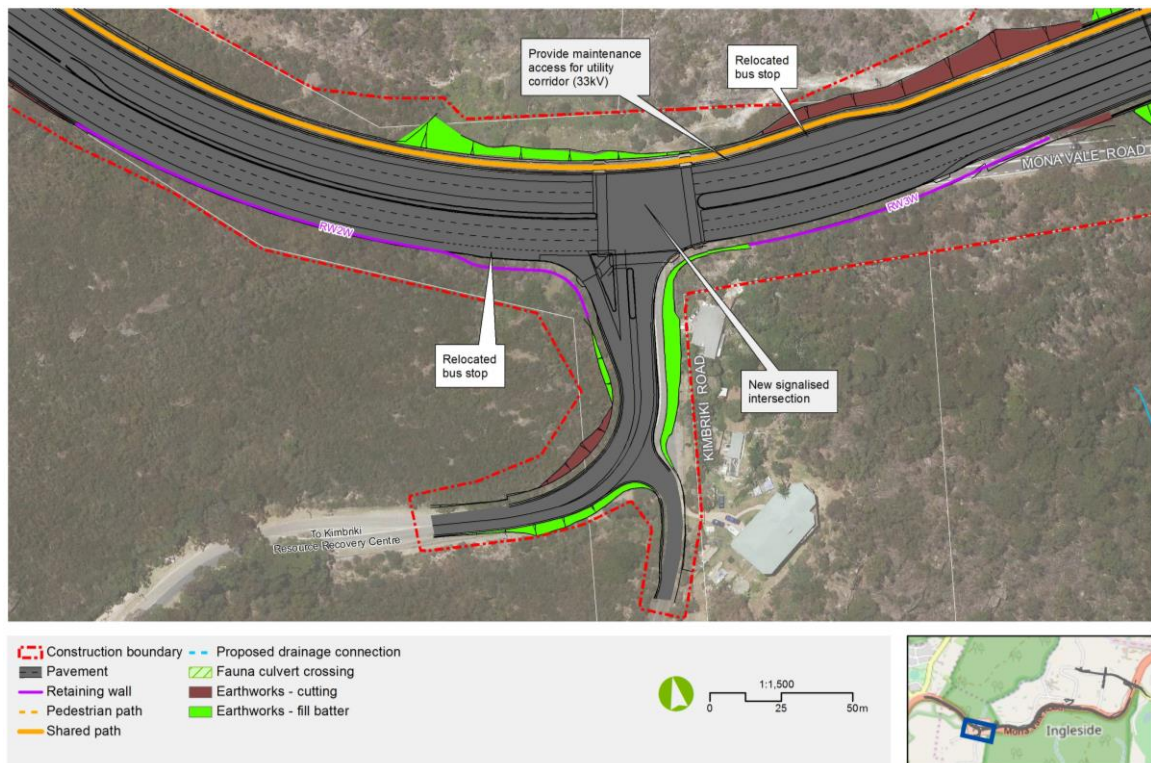


Figure 3-12 Kimbriki Road intersection upgrade detail

A bus stop would be provided (westbound) on the departure side of the proposed signalised intersection. This would replace an existing bus stop located about 50 metres to the east of the current intersection. The eastbound bust stop would be also moved slightly to accommodate the intersection works.

3.2.5 Tumburra Street

Tumburra Street is currently a seagull intersection providing for all vehicle movements. The left turn out of Tumburra Street does not have a dedicated lane, The immediate section of Tumburra Street has a steep grade dropping away from Mona Vale Road.

The location of the existing intersection has been shifted to the west by about 40 metres to improve the existing steep grade on Tumburra Street. The design comprises a simple T-intersection with access to be restricted to left in, left out only (refer Figure 3-13).

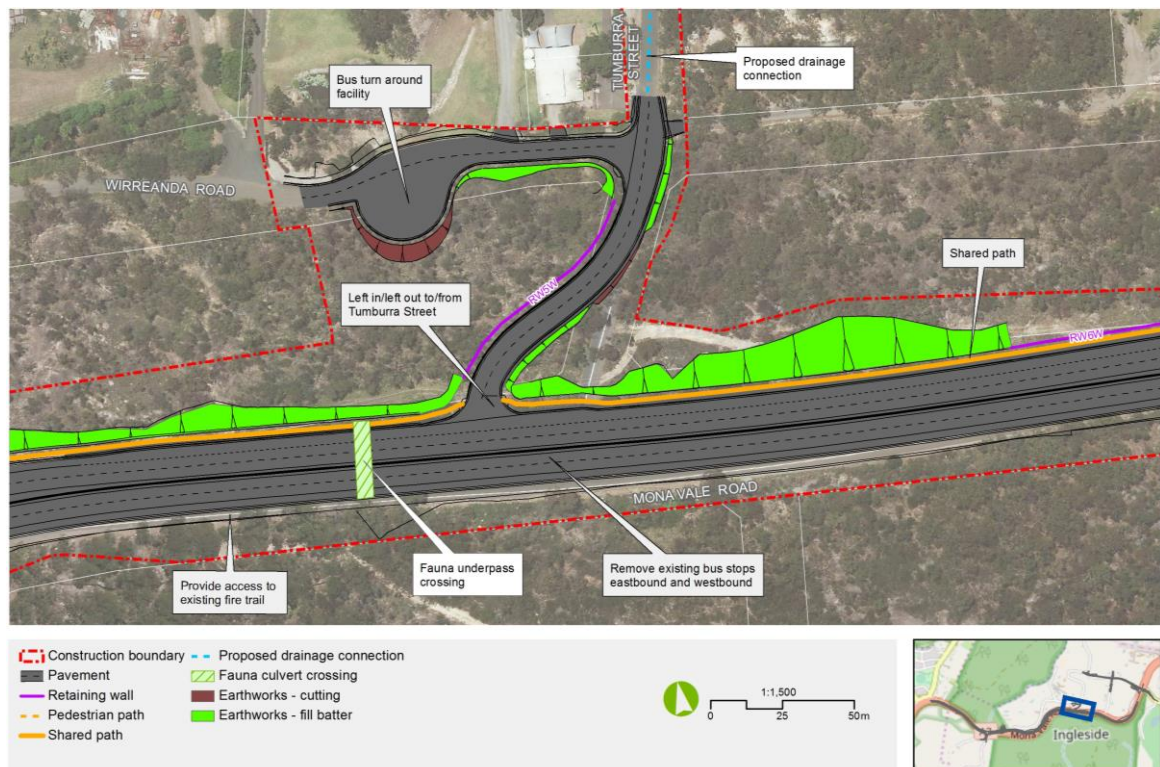


Figure 3-13 Tumburra Street intersection upgrade detail

3.2.6 Addison Road

Addison Road is an existing channelised right turn intersection with a dedicated right turn in lane only. Under the proposal, access to and from Addison Road would be limited to emergency vehicles only.

Alternative access to Addison Road for westbound vehicles would be available via the new connecting road between Powder Works Road and Harvey Road.

3.2.7 Harvey Road extension (Mona Vale Road to Harvey Road)

Roads and Maritime proposes to construct a new local connecting road (Harvey Road extension) aligned along the existing 'paper road' located between Bungendore Road and Addison Road, then continuing east to connect to Mona Vale Road at the Powder Works Road intersection (refer Figure 3-4).

The proposed local connecting road (Harvey Road extension) would provide improved connectivity to the Wirreanda Valley and proposed Ingleside Land Release, also allowing for the reconfiguration of the Tumburra Street intersection to left in left out and the conversion of the Addison Road to use by emergency vehicles only.

The proposed Harvey Road extension would include the following:

- Two lane road, one lane in each direction, provided between Mona Vale Road connecting to the existing Harvey Road at Bungendore Street
- A right turn lane would be provided at the intersection with Mona Vale Road for right turn movements onto Mona Vale Road westbound
- One combined through lane/left turn lane (for left turn movements onto Mona Vale Road eastbound) would be provided at the intersection with Mona Vale Road

- The existing Baha'i Temple access road would be relocated about 120 metres west of the Mona Vale Road intersection to allow safe entry and exit movements
- All movements would be provided for at the intersection of Harvey Road extension and Addison Road
- Tie-in work would be undertaken at the local connection with Bungendore Street.

A fauna underpass is proposed to cross Harvey Road about 130 metres west of Addison Road. Final location and sizing would be confirmed during detailed design.

Through the detailed design process, affected property owners would be consulted in relation to the design of the Harvey Road extension. A wider construction impact area has been provided in Figure 3-4 to accommodate potential changes to the horizontal alignment. Once the alignment has been finalised during detailed design, the construction impact area would be refined to a three metre buffer from the edge of pavement.

3.2.8 Powder Works Road

Powder Works Road would be upgraded through widening and lane marking at the intersection with Mona Vale Road. The works would also comprise an upgrade of the northbound lanes to provide:

- One through lane onto Harvey Road (extension)
- Two left turn lanes onto Mona Vale Road
- A right turn lane onto Mona Vale Road.

These works are shown in Figure 3-14.

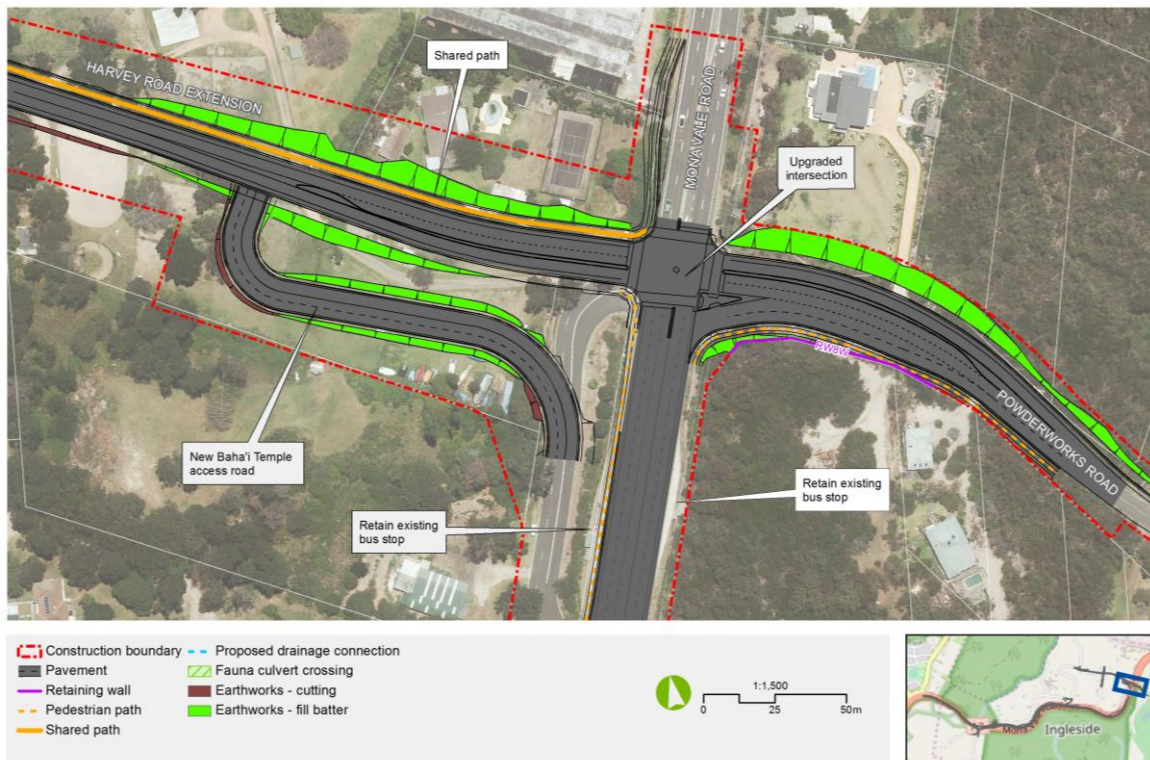


Figure 3-14 Powder Works Road intersection upgrade detail

3.2.9 Property adjustments

A number of properties would be affected through minor driveway adjustments to allow access to driveways to and from the new road works. The number and locations of property accesses requiring adjustments would be finalised in consultation with landowners during detailed design.

3.2.10 Bus facilities

The proposal would involve changing the ingress and egress functions at junctions with adjoining roads. As such, some bus routes would need to be modified both during and after construction.

Bus stop facilities would be provided/retained at the following locations (refer Figures 3-1, 3-3 and 3-4):

- Relocation of the westbound bus stop to the western side of the Kimbriki Road/Mona Vale Road signalised intersection
- Minor relocation of the existing eastbound bus stop at the Kimbriki Road/Mona Vale Road intersection to accommodate the proposed signalised intersection
- Provision of a new bus stop on Wirreanda Road at the proposed bus turn around bay
- Retain existing bus stops on Mona Vale Road about 50 metres west of the Powder Works Road intersection (both eastbound and westbound bus stops).

The existing bus stops at Tumburra Street would be removed. The proposed Harvey Road extension would allow bus services to access the local road network to the north of Mona Vale Road.

3.2.11 Fauna connectivity

The proposal would provide for fauna connectivity across the upgraded Mona Vale Road and the Harvey Road extension as follows:

- A fauna crossing over Mona Vale Road) comprising a 40 metre wide bridge structure, about 160 metres east of Kimbriki Road (refer Figure 3-1)
- Fauna exclusion fencing along both sides of the upgraded section of Mona Vale Road to restrict access to the roadway and to direct fauna to the overpass
- A fauna underpass on Mona Vale Road, about 25 metres west of Tumburra Street (refer Figure 3-3)
- A fauna underpass on the proposed Harvey Road extension about 100 metres west of Addison Road (refer Figure 3-4).

The fauna crossing over Mona Vale Road (refer Figure 3-15) would be the first of its kind in Sydney. The bridge structure would provide improved and safer connectivity for fauna moving between Ku-ring-gai Chase National Park and Garigal National Park.



Figure 3-15 Proposed fauna crossing on Mona Vale Road

Source: KI Studio (Nov 2016).

3.2.12 Shared path

On-road cyclists would have improved facilities as part of the proposal, with shoulders extended to provide a consistent three metre width on both sides of the road throughout the length of the upgrade. This would act to increase safety for cyclists along Mona Vale Road as a regional cycle route.

In addition to three metre wide shoulders which could be used by cyclists, the proposal would improve access and amenity for pedestrians and cyclists through the provision of a three metre wide shared path between Terrey Hills and Ingleside along Mona Vale Road and along the proposed Harvey Road extension to Addison Road (refer Figures 3-1 to 3-4).

Beginning at Kanangra Road at the western end of the proposal, the shared path would run along the northern side of Mona Vale Road directly adjacent to the main carriageway before transitioning to a 1.5 metre width at the existing footway, fronting the Baha'i Temple property.

In addition, a 3.0 metre wide shared path would be provided on the northern side of the local access road between Addison Road and Powder Works Road.

RMS will be working closely with the Northern Beaches Local Council and the Department of Planning and Environment to ensure that connectivity is achieved between Mona Vale Road and the local access road.

The shared path would also provide for the off-road installation of utilities.

Pedestrian and cyclists infrastructure proposed as part of the upgrade addresses the network deficiency in the existing active travel network as identified in the *Warringah Bike Plan 2010-2015*.

3.2.13 Retaining walls

Due to site topography a large proportion of the upgrade would include retaining walls to reduce the project footprint and impacts to adjacent environmentally sensitive areas, including the National Parks. The proposal includes the construction of retaining walls ranging from 2.8 metres to 11.6 metres in height.

All retaining walls would be in fill situations, and most would face bushland and would not be visible from the road. While the type and form of retaining walls is yet to be finalised, given their height the majority of retaining walls would be of reinforced earth construction and would include straps or grids that extend under the road pavement.

Four types of retaining walls would be considered depending on local conditions:

- Option 1 – reinforced soil wall
- Option 2 – geofoam structure
- Option 3 – reinforced concrete wall on rock socket
- Option 4 – reinforced concrete wall on shallow base support.

These four retaining wall options are shown in Figures 3-11 to 3-14 inclusive.

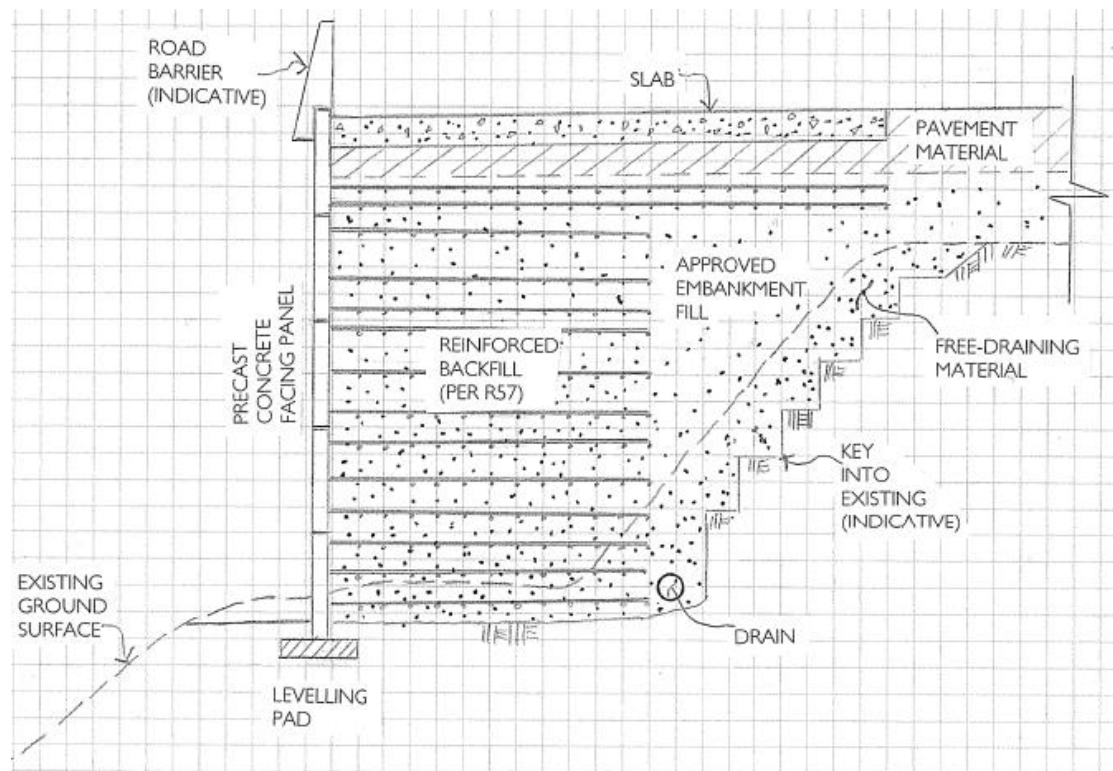


Figure 3-16 Retaining wall option 1

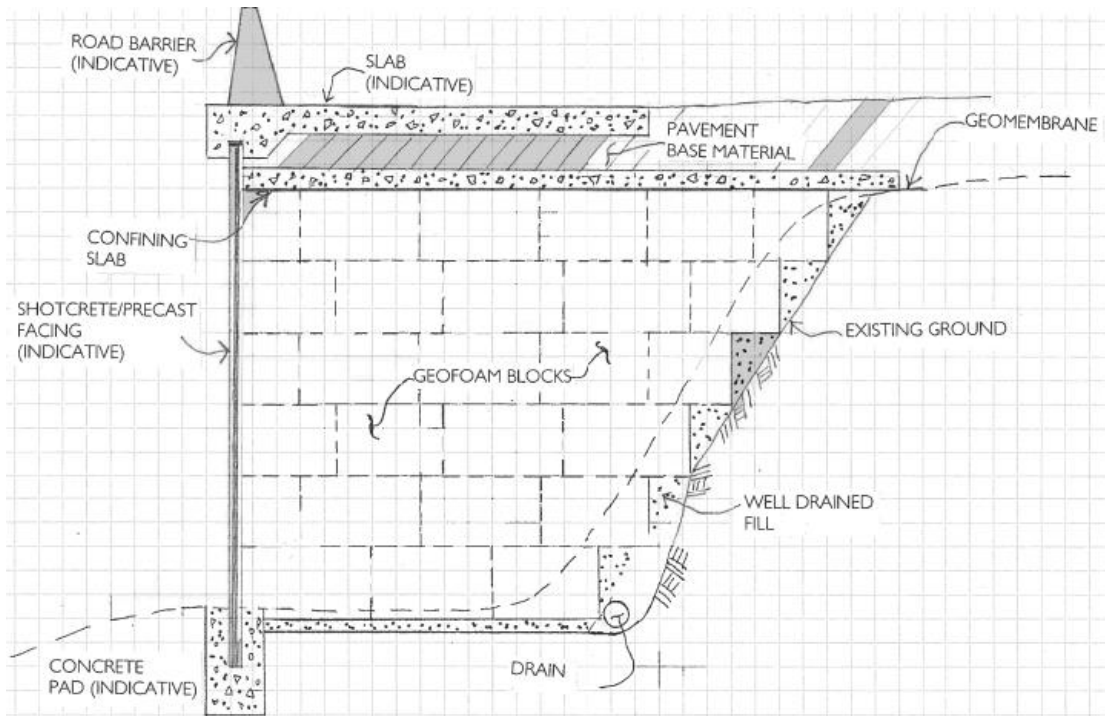


Figure 3-17 Retaining wall option 2

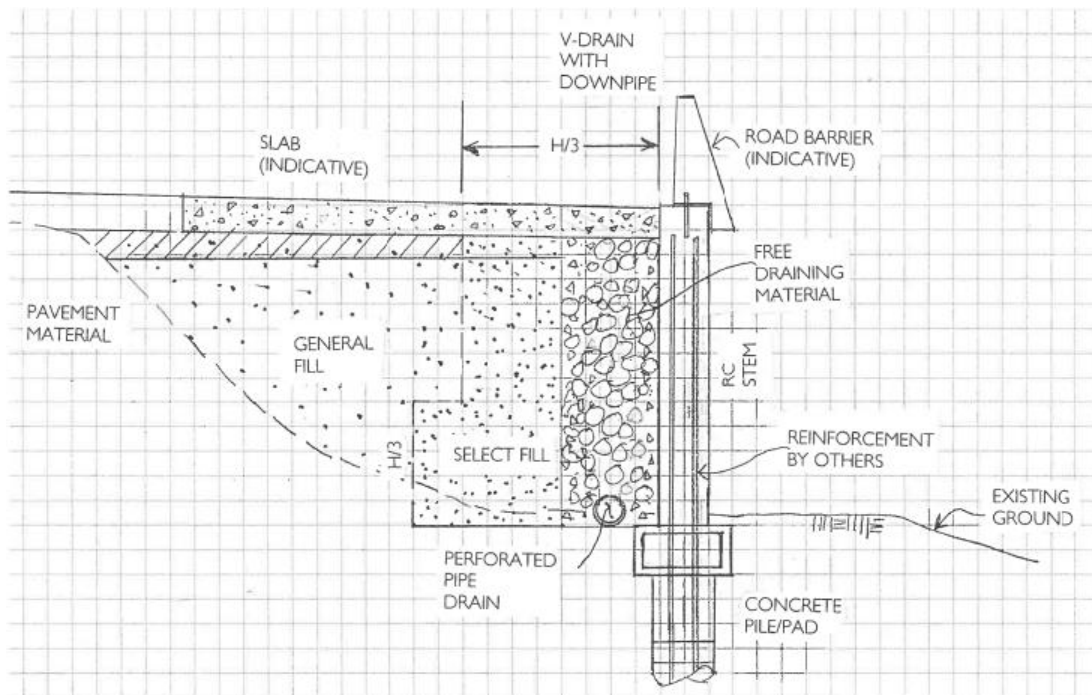


Figure 3-18 Retaining wall option 3

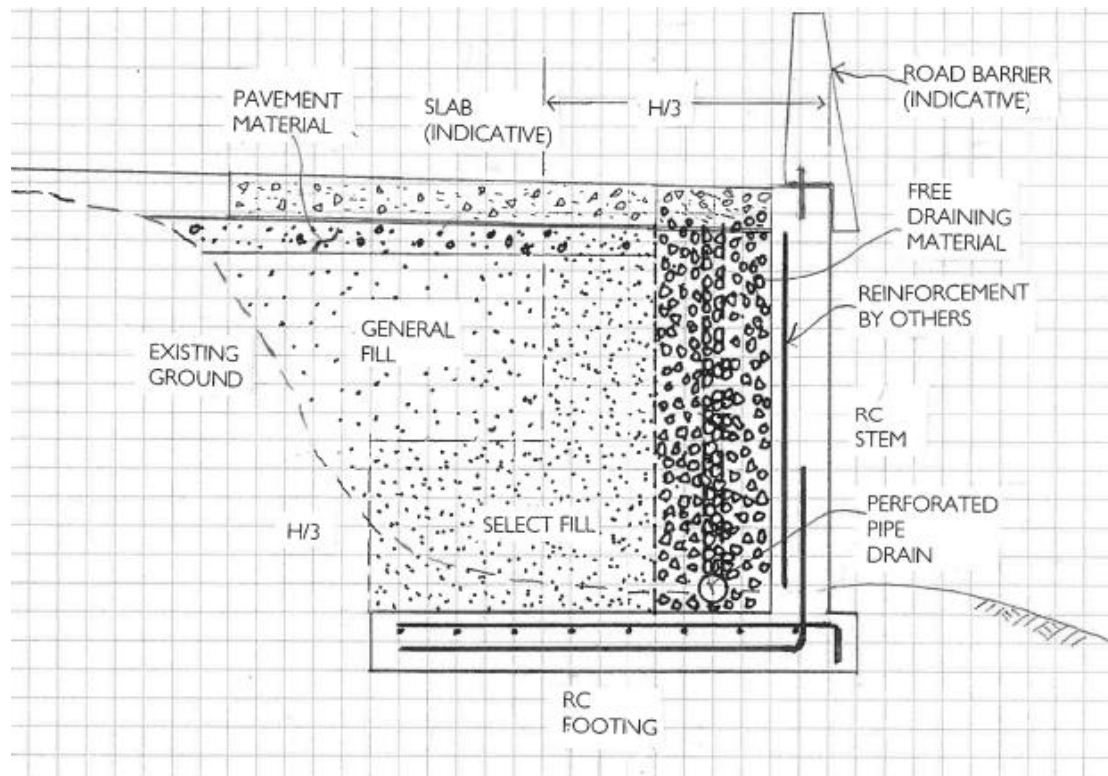


Figure 3-19 Retaining wall option 4

The following design criteria would apply to retaining walls:

- Utilise precast concrete facing panels with a strong pattern and texture to discourage graffiti
- Utilise a pattern with a combination of smooth and rough surface textures to discourage graffiti and reduce the visual scale of the wall
- Utilise a dark colour to assist in reducing the visual impact by blending the wall into its landscape context and preventing unnecessary glare from the northern sunlight
- Wall terminations are to appear to disappear into the ground. Ensure the wall is designed to extend as far as is required to achieve this
- Ensure fixings are concealed and discreet
- Where retaining walls are located adjacent to the shared path, provide an open, transparent fence to maintain openness and views for shared path users
- Provide planting in front of the wall to soften its appearance and reduce the visual impact
- Use a consistent retaining wall design finish across both the east and west upgrades
- Minimise construction footprint especially near environmentally sensitive areas such as National Parks.

The locations and approximate lengths of the retaining walls are provided in Table 3-2.

Table 3-2 Locations and lengths of retaining walls

ID	General location	Approximate length (m)
RW1W	Located immediately to the east of the substation access adjacent to the westbound carriageway.	120
RW2W	Extend westwards from the Kimbriki Road intersection adjacent to the westbound carriageway.	195
RW3W	Extends eastwards from about 70 metres from the Kimbriki Road intersection adjacent to the westbound carriageway.	80
RW4W	Located immediately to the east of the proposed fauna overpass connection adjacent to the eastbound carriageway.	260
RW5W	On Tumburra Street between Mona Vale Road and bus turnaround facility	85
RW6W	About 90 metres west of Addison Road adjacent to the eastbound carriageway.	170
RW7W	Located just to the east of Addison Road adjacent to the westbound carriageway, and terminating about 250 metres from Powder Works Road.	480
RW8W	On southern side of Powder Works Road at Mona Vale Road intersection.	55
RW9W	Adjacent to southbound lane on Addison Road south of the intersection and adjacent to the westbound lane on the Harvey Road extension east of the intersection.	220
RW10W	Adjacent to eastbound lane to the immediately to the east of Addison Road.	155
RW11W	On new Harvey Road extension adjacent to the westbound lane.	225
RW12W	On new Harvey Road extension adjacent to the eastbound lane.	200

3.2.14 Rock cuttings

Due to the natural topography and location of the proposed upgraded road alignment, rock wall cuts are required to minimise impacts on vegetated areas and threatened species and heritage items. These range from long cut sections on Mona Vale Road to small cuttings on local roads and are summarised in Table 3-3.

Table 3-3 Proposed rock cuttings

ID	Start chainage	Length (m)	Max height (m)
1-W	200	310	2.5
2-W	640	120	4.0
3-W	680	90	5.1
4-W	70	60	2.3
5-W	1010	130	5.3
6-W	1120	120	6.1
7-W	1280 1368	90 140	3.9 5.7
8-W	1850	230	2.1
9-W	2170	30	3.1
11-W	2500	250	9.0
12-W	2820	20	1.0
13A-W	2870	20	1.7
13B-W	2890	110	3.2

3.2.15 Drainage and water quality

Pavement drainage

The section of Mona Vale Road in the study area contains limited formal drainage infrastructure. Runoff from the existing roadway drains in a diffuse manner into the adjacent roadside areas.

Design development for the pavement drainage system was undertaken with regard to the following key considerations:

- Limit pavement drainage outlets into drainage systems that run through the rural residential area around Wirreanda Road and Tumburra Street
- Divert pavement drainage discharge to locations within Ku-ring-Gai National Park and Garigal National Park where flow changes can be more readily accommodated
- Maintain existing flow regimes where possible around sensitive receivers such as Red-crowned Toadlet and Giant Burrowing Frog habitat downslope from Mona Vale Road, and the area of Angus's Onion Orchid identified to the north of the Kimbriki Road intersection.

The pavement drainage would be designed to provide 100 year Average Recurrence Interval (ARI) flood immunity for the upgraded section of Mona Vale Road. A similar level of flood immunity would be provided for the Harvey Road extension.

The proposed pavement drainage system would consist of gutters, pits, pipes and channels to collect, convey and discharge stormwater from the road pavement.

Subsurface drainage

Subsoil drainage would be provided in the lower road pavement levels and would discharge to the pavement drainage network.

Subsoil drainage would also be provided behind retaining walls. Retaining wall subsoil drainage would generally be located below the pavement drainage network and would discharge at regular intervals through the face of the retaining walls to the downstream catchment.

Cross drainage

As for the pavement drainage, the general design strategy for cross drainage is to mimic the existing drainage regime as closely as possible to avoid impacts on sensitive areas such as Red-crowned Toadlet and Giant Burrowing Frog habitat, and Angus's Onion Orchid habitat.

Water quality management

Design development with regard to operational water quality has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC version 6). A full description of this is provided in Section 7 of the Surface Water Strategy Hydrology and Hydraulics Report (Appendix D).

The steep topography constrains opportunities to install water quality basins. However, the design provides for grassed drainage swales adjacent to the westbound carriageway in the vicinity of Tumburra Street for the following three pavement drainage outlets:

- Outlet W2040 – about 70 metres in length
- Outlet W2140 – about 15 metres in length
- Outlet W2400 – about 55 metres in length.

In addition to these three swales, the pavement drainage design includes the provision of oil and grit separators at each outlet discharging upstream of the frog habitats to manage the risk of oil spills and to reduce the pollutant loads entering the habitats.

3.3 Construction activities

Figures 3-19 to 3-23 show the construction impact area for the proposal. The figures illustrate the proposed construction area for the road widening as well as the construction area for utilities and the shared path. This is the area that is expected to be disturbed by vegetation removal, general road construction, operation of machinery and construction of access.

The construction impact areas would be revegetated when works are completed.