Transport for NSW

Jervis Bay Road Intersection Upgrade

Preferred Strategic Options Report

November 2020 | Version: v1

Contents

Executive Summary

Transport for NSW (Transport) is progressing with plans for a proposed Jervis Bay Road and Princes Highway intersection upgrade and has identified a preferred option.

Since 2011, the Australian and NSW Governments have invested $2.5 billion to upgrading the Princes Highway. This has transformed and better connected communities, employed thousands of locals, improved safety, eased traffic congestion, and grown regional economies. The Australian and NSW Governments have now committed a further $1.5 billion to upgrade the Princes Highway between Jervis Bay Road at Falls Creek and the Victorian border.

An upgraded intersection at Jervis Bay Road is a priority project and part of a 20 year plan to deliver a safe, reliable, efficient and connected transport network. The 20 year plan is built on five goals:

- Safety - A safer corridor for all customers and communities including local traffic, freight, tourists, and public and active transport users.
- Resilience - a corridor that can be efficiently managed and maintained while adapting to changing social, environmental and economic factors including the ability to quickly recover from natural disasters and respond to changing land use and technologies.
- Liveability - a corridor that supports communities by connecting and contributing to providing attractive and healthy places to live, work and play.
- Sustainability - a corridor that is socially, environmentally and economically sustainable and unlocks a wide range benefits for communities and other customers.
- Connectivity and Accessibility - a corridor that has good physical and digital connectivity and accessibility, for access to opportunity and services.

The proposed intersection upgrade would:

- Improve safety for all transport users
- Support pedestrian, cyclists and public transport users
- Grow regional economies including tourism and freight
- Improve resilience of the transport network
- Reduce congestion
- Improve access to local roads

This report

The purpose of this report is to document the process followed for the development and assessment of intersection options and the identification of a recommended preferred option.

Preferred option selection process

Following community feedback provided during March and April 2020, an extensive option investigation and assessment process was carried out to better understand the factors that may influence the feasibility of different intersection options.

26 potential intersection options were considered including types of roundabout and grade separated options.

Four shortlisted options were further investigated and developed to enable a comparative assessment of the options during a value management workshop. All shortlisted options included a type of grade separation. They included:

- Option 1004 – At-grade roundabout with right turn flyover
- Option 1005 – At-grade roundabout with right turn underpass
- Option 2005 – Grade separated highway over an at-grade roundabout
- Option 2009 – Grade separated highway, with roundabouts on either side of the highway.

A Value Management Workshop was held on 15 September 2020 and brought together project team members, technical specialists, and key stakeholders from local and state government agencies to assess the shortlisted options for the project. Participants of the workshop agreed to project objectives, identified broad community issues, assessed technical information and considered features of each design option before a recommendation for a preferred option was made.

Preferred option

Option 2009, a grade separated highway with roundabouts on either side, has been identified as the preferred option.

The selected type of grade separation would be the safest and most reliable option. It provides the most reduced congestion and most improved connectivity for all transport users compared to other shortlisted options. Features of the preferred option would include:

- Four lanes for highway traffic, two in each direction.
- A bridge for highway traffic would cross Jervis Bay Road to allow transport users on Jervis Bay Road to travel north on the Princes Highway without being held up by southbound highway traffic.
- Roundabouts are proposed on either side of the intersection to further reduce the likelihood of accidents and improve connectivity for all transport users with local roads and the highway entry and exit lanes
- Based on expected traffic flow at each roundabout, motorists travelling from Jervis Bay Road north onto the Princes Highway, and from the Princes Highway east onto Jervis Bay Road, would have reliable and congestion-free access.
- Longer entry and exit lanes on and off the highway would improve safety and efficiency and reduce congestion.
- The new highway corridor would be east of the existing highway to provide space for the western entry and exit lanes and the roundabout connecting to the Old Princes Highway. This would also make construction easier and reduce traffic impacts while it's being built.

Next Steps

The preferred option will be placed on public display until Sunday 20 December 2020 to provide the community and stakeholders an opportunity to review the preferred option and provide feedback.

Transport will consider community and stakeholder feedback as we further develop and refine the design and prepare an environmental assessment. The environmental assessment will explain the potential impacts of the project and provide more detail on the proposed features of the intersection upgrade. The environmental assessment for the project will be on display for community feedback in 2021.

1. Introduction

1.1 Background

The Princes Highway is critical to a thriving South Coast NSW.

It helps drive the State's third largest regional economy, is relied upon by over 500,000 local residents and welcomes almost four million tourists each year.

It connects regional centres and essential services and is the main transport corridor for freight to the region.

Since 2011, the Australian and NSW Governments have invested $2.5 billion upgrading the Princes Highway. This has transformed and better connected communities, employed thousands of locals, improved safety, eased traffic congestion and grown regional economies.

The focus is now on the future, with the Australian and NSW Governments committing $1.5 billion to upgrade the Princes Highway between Jervis Bay Road at Falls Creek and the Victorian border.

Five priority projects have progressed to the design phase including the Jervis Bay Road and Princes Highway intersection, Jervis Bay Road to Sussex Inlet Road upgrade, Milton Ulladulla bypass, Burrill Lake to Batemans Bay upgrade and Moruya bypass.

1.2 Princes Highway upgrade roadmap

Transport for NSW has developed a strategic roadmap for the Princes Highway upgrade. It is Transport's plan for the highway over the next 20 years and identifies what needs to be done in the short, medium and long term to deliver a vision for the Princes Highway as a safe, reliable, efficient and connected network.

It would be a highway that enables the movement of people and goods and supports sustainable growth of the local economy, employment opportunities and population.

It would contribute to the character of the places it serves and be resilient to adapt to natural hazards and climate change, respond to changing land use, and support new technologies, industries and economic trends.

The roadmap is built on five goals:

- **Safety**: A safer corridor for all customers and communities including local traffic, freight, tourists, and public and active transport users.
- **Resilience**: A corridor that can be efficiently managed and maintained while adapting to changing social, environmental and economic factors including the ability to quickly recover from natural disasters and respond to changing land use and technologies.
- **Liveability**: A corridor that supports communities by connecting and contributing to providing attractive and healthy places to live, work and play.
- **Sustainability**: A corridor that is socially, environmentally and economically sustainable and unlocks a wide range benefits for communities and other customers.
- **Connectivity and Accessibility**: A corridor that has good physical and digital connectivity and accessibility, for access to opportunity and services.

The roadmap aligns with the *Future Transport 2056 Strategy* and the *Regional NSW Services and Infrastructure Plan*. This will ensure the future of the Princes Highway delivers the key outcomes and priorities for regional transport throughout the state.

1.3 Proposal overview

The Jervis Bay Road and Princes Highway intersection is located about 12 kilometres south of Nowra and 170 kilometres south of Sydney (Figure 1-1.

Jervis Bay Road provides the main link to the coastal villages of Huskisson, Vincentia, Hyams Beach and Jervis Bay (ACT).

The intersection has one of the highest volume of vehicle movements on the highway between Nowra and the border with Victoria and has been the location of 15 crashes in the five years to 31 December 2018, resulting in six serious and 11 minor injuries.

The Proposal aims to provide a safer and more reliable intersection which is consistent with planned upgrades of the Princes Highway further south.

1.4 Study area

The study area is located in Falls Creek in the Shoalhaven local government area and covers an area of about 31 hectares. The study area extends about one kilometre north or the existing Jervis Bay Road and Princes Highway intersection along the Princes Highway and south about 600 metres, and extends about 600 metres east along Jervis Bay Road.

Figure 1-2 illustrates the study area, as outlined by the red perimeter.

1.5 Purpose of this report

The purpose of this report is to describe how the preferred option for the Jervis Bay Road and Princes Highway intersection was selected.

The report identifies the need for the Proposal, examines issues and constraints, describes the assessment of options and identifies a preferred option to be taken forward for further development, community consultation and environmental investigation.

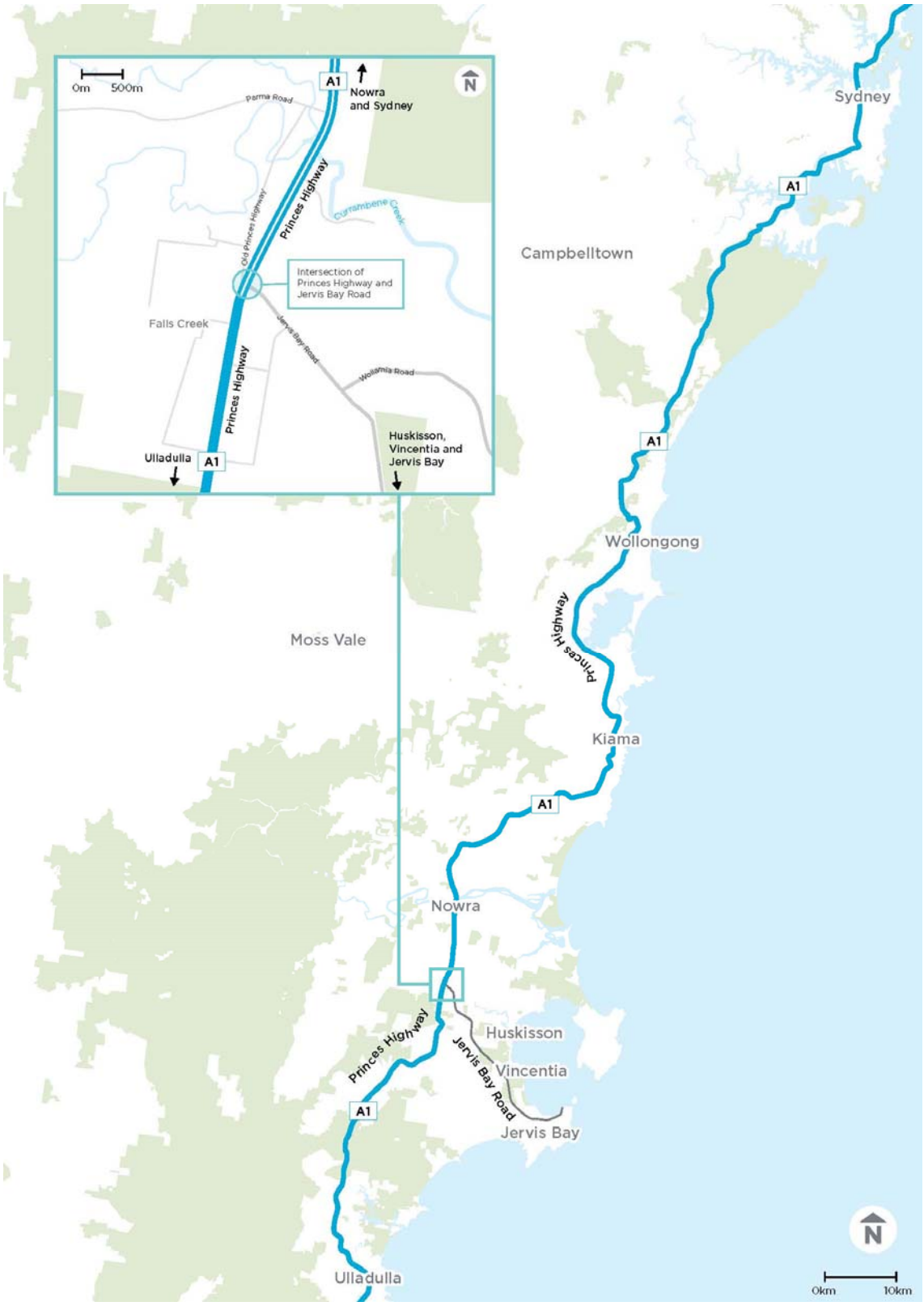


Figure 1-1 Location map of the Jervis Bay Road and Princes Highway intersection at Falls Creek

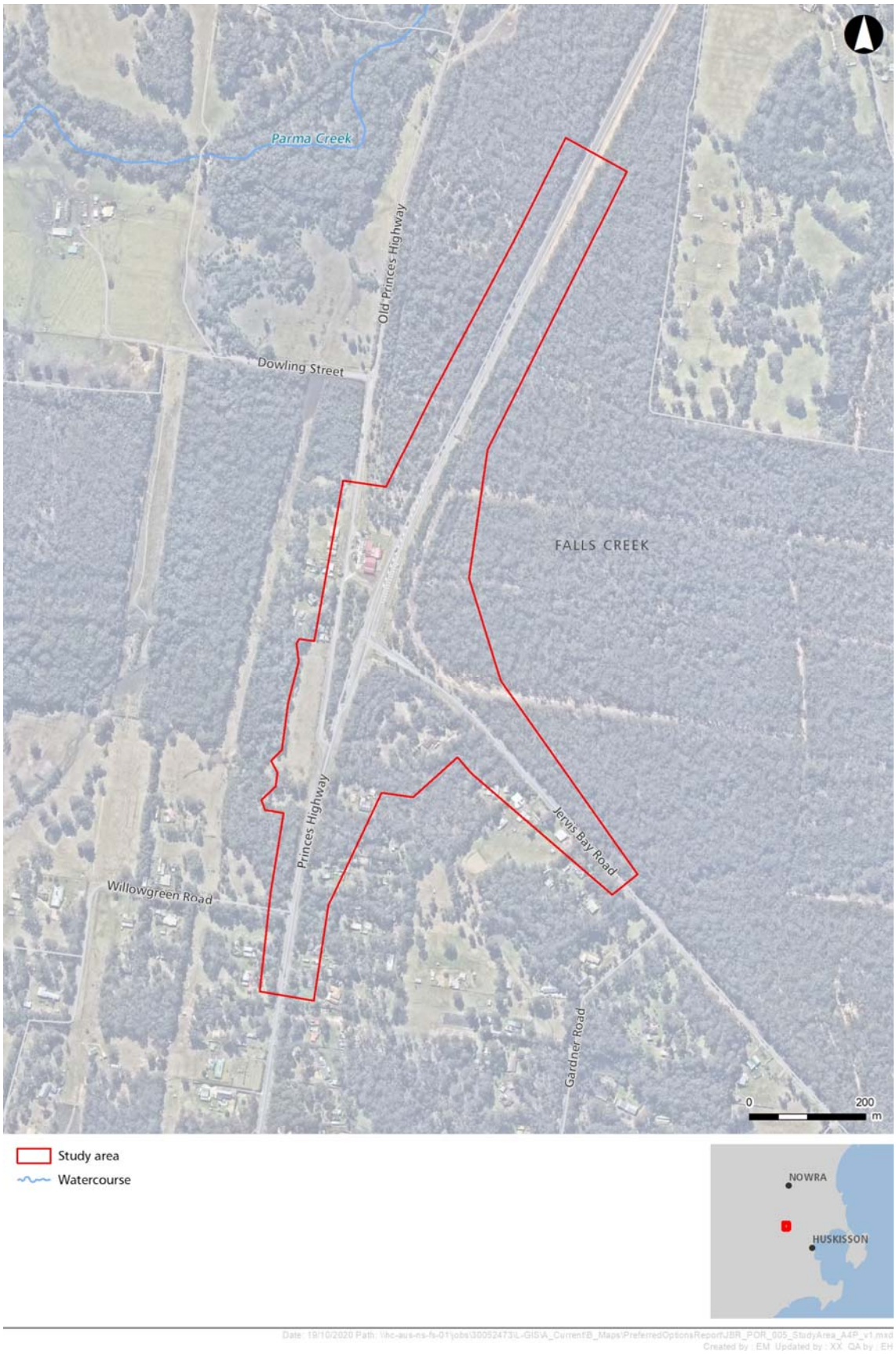


Figure 1-2 Study area

2. Need for the proposal

2.1 Service need / problem statement

The purpose of the proposal is to improve safety, reduce queuing and delay on Jervis Bay Road at the intersection with the Princes Highway.

2.1.1 Safety

Improving road safety is one of the key initiatives for this section of the Princes Highway. The section of the Princes Highway at the intersection performs poorly when considered against the Australian Road Assessment Program (AusRAP) road safety risk analysis, scoring two out of a possible five stars (five stars being the safest roads).

The intersection has a history of crashes, with 15 crashes recorded in the five year period up to 31 December 2018, resulting in zero fatalities, six serious and 11 minor injuries.

The majority of crashes at the intersection are associated with vehicles exiting Jervis Bay Road and being struck by vehicles travelling on the Princes Highway.

2.1.2 Traffic

The Jervis Bay Road and Princes Highway intersection experiences some of the highest vehicles movements on the NSW south coast, south of Nowra, with about 23,000 vehicles using the Princes Highway at this location on an average day. About 9,000 vehicles use Jervis Bay Road on an average day.

The intersection performs poorly during both weekday peak and holiday peak periods with delays and queuing experienced on Jervis Bay Road. Traffic movements out of Jervis Bay Road are typically lower during peak holiday periods however higher traffic volumes on the Princes Highway reduce the number of safe opportunities to turn right, resulting in increased delays.

2.1.3 Access

The Jervis Bay Road and Princes Highway intersection forms a key part of the transport network within changing residential, tourism, defence and industrial areas within the Shoalhaven. It also facilitates access to the regional centre of Vincentia and coastal villages of Huskisson, Hyams Beach and Jervis Bay.

The intersection of Island Point Road and the Princes Highway is located about 10 kilometres south of the Jervis Bay Road intersection. Island Point Road also provides connectivity to Vincentia, Hyams Beach and Jervis Bay, however this access route increases travel distance and would not appropriately support desired user demand for access to this coastal area.

The high traffic volumes on Jervis Bay Road, and high demand at the intersection of Jervis Bay Road and the Princes Highway, is due to the proximity of the intersection to Nowra and recognises that Jervis Bay Road provides an important access route between Vincentia and surrounding coastal villages with Nowra, Wollongong and Greater Sydney to the north.

Tourism and tourism-related activity is a major driver of economic activity, land use and transport demands at, and around the intersection. Residential development and initiatives to increase the number of visitors will continue to increase demand at the intersection.

2.2 Customer types and needs

The Jervis Bay Road and the Princes Highway intersection caters for a broad range of customers with specific needs and priorities, many of which could be better provided for by a major upgrade of the existing intersection arrangement.

Road users with local knowledge (residents, commuters, freight)

People using the road network with light and heavy vehicles need a safe intersection arrangement that can accommodate the high amount of traffic without causing delays now and in the future.

Road users without local knowledge (visitors, tourists and freight)

Further to the needs of road users with local knowledge, road users who do not know the intersection are more reliant on a layout that is easy to understand and navigate and is well signposted. Additionally, safe and efficient movement from Jervis Bay Road to the Princes Highway is essential at all times, particularly during peak and holiday periods.

Local community and residents

The local community of Falls Creek need this intersection to provide safe and efficient access to and across the Princes Highway using any mode of transport. Limiting visual impacts, increase in noise and air pollution are also important.

The Princes Highway currently creates a barrier through Falls Creek.

Local businesses

Local businesses need good connectivity to, from and across the Princes Highway for their customers and suppliers.

Pedestrians and cyclists

Pedestrians and cyclists need safe provisions along and across the intersection. This is particularly important as the majority of existing pedestrians are students accessing the bus stops to commute to school. Safe provisions include a minimum width of shoulders for cyclists along the Princes Highway, dedicated paths throughout the intersection and safe, formalised crossing points.

While the number of cyclists and pedestrians is currently relatively low in the vicinity of this intersection, these upgraded facilities have the potential to encourage a shift to active and public transport modes in the future and will greatly improve the safety of these most vulnerable users.

Public transport users

Public transport users need safe access to bus stop locations and safe provisions for bus services to stop. This includes, as a minimum, shared paths connecting to the bus stops.

To encourage a further shift to public transport, safe drop off locations (kiss and ride) need to be considered, bicycle parking and a potential centralised bus terminal near the intersection.

Emergency services

Emergency services rely on being able to safely and reliably reach emergencies at and past the intersection regardless of traffic conditions.

2.3 Proposal objectives

The objectives of the Proposal are listed and described in Table 2-1. Proposal objectives are intended to apply throughout all stages of proposal development, from route selection through to construction. Minor refinements may be considered to take into account future government strategies.

Table 2-1 Proposal objectives

Objective	Description
1. Improve safety at the intersection	Provide an intersection that allows for safe access to and from Jervis Bay Road for all transport users. Provide an intersection that reduces the incidence of fatal and serious injury crashes on the network.
2. Improve transport network efficiency and connectivity to support regional economic development, tourism and freight	Provide an intersection that caters for short, local trips and regional, long distance trips, improving efficiency and connectivity that supports a range of transport options for all transport users including public transport, motorists and freight.
3. Improve transport network resilience	Improve network reliability and safe access during emergencies including bushfire and flood. Deliver a futureproofed interchange that responds to unexpected changes in traffic demand, evolving technologies and changes in climate.
4. Support an increase in active transport (walking and cycling) and use of public transport	Provide integrated active transport options such as pedestrian and cycleways, as well as accommodation of safe and efficient public transport access that enables integration with a potential future multi modal interchange at the intersection.
Strategic Priority 4 from the TfNSW Corporate Plan 2018-2021: Respect our community and the environment	Minimise impacts to areas of environmental sensitivity, as well as to the existing communities surrounding the proposed intersection.
Strategic Priority 1 from the TfNSW Corporate Plan 2018-2021: Increase customer value	Provide the best value for money across the life of the proposal with consideration of the other proposal objectives and wider economic benefits.

2.4 Strategic alignment

The proposal is consistent with relevant strategic planning documents, as described in Table 2-2.

Table 2-2 Strategic alignment of the proposal

Strategic plans	Strategic alignment of the proposal
Future Transport 2056	The proposal contributes to achieving several of the key objectives including: • Supporting the hub and spoke transport network for the Regional City of Wollongong, as well as the strategic centres of Nowra, Vincentia, Ulladulla and Batemans Bay • Adopting a Safe System approach to the delivery of road safety improvements to contribute to achieving the 'Towards Zero' target.
Future Transport 2056 – Regional NSW Services and Infrastructure Plan	For Regional NSW, Future Transport 2056 is supplemented by the Regional NSW Services and Infrastructure Plan which describes the necessary initiatives required in the short, medium and long term to meet customer needs now and into the future. The proposal contributes to the commitment of investigating duplication of the Princes Highway between Jervis Bay Road and Moruya. The proposal also contributes to achieving the target to increase public and active transport active transport use in Regional NSW.
Connecting to the future – Our 10 Year Blueprint	The proposal contributes to achieving several of the key outcomes including: • Safe, seamless journeys for people and goods • Transport Investments and solutions that service the people of NSW • Quality assets and efficient networks, managed at the right price
NSW Road Safety Strategy 2021	The proposal contributes to the commitment of reducing fatal and serious injury crashes on rural roads by targeting an identified crash cluster and applying a Safe System approach to intersection design.
NSW Freight and Ports Plan 2018 – 2023	The proposal supports the plan by: • Enhancing productivity • Increasing use of safer and more productive vehicles • Enabling regional growth • Reducing fatalities and serious injuries from crashes involving heavy vehicles or light trucks

Strategic plans	Strategic alignment of the proposal
Illawarra Shoalhaven Regional Plan	The proposal will support the five goals set in the Regional Plan for the Illawarra-Shoalhaven region including: • A connected and prosperous economy • A variety of housing choices, with homes that meet needs and lifestyles • A region with communities that are strong, health and well connected • A region that make appropriate use of agricultural and resource lands • A region that protects and enhances the nature environment.
Tourism and Transport Plan	The proposal supports the plan by: • Providing greater access to more of NSW • Making transport the attraction • A seamless experience.
NSW South Coast Marine Tourism Strategy	The proposal aligns with Strategic Direction 4: Tourism Activation of the Marine Environment by improving accessibility to the South Coast from Sydney

3. Proposal considerations and constraints

Preliminary investigations carried out by Transport for NSW identified key issues and constraints which have assisted in the development of potential options for an upgrade of the Jervis Bay Road intersection. The key considerations informing the options development are described below.

3.1 Statutory and planning framework

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

3.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the main piece of legislation regulating land use planning and development in NSW. The planning pathway for development under the EP&A Act is generally dependent on the development's size, environmental impact and capital cost, as well as relevant planning provisions under other pieces of NSW legislation.

The proposal would be assessed under Division 5.1 of the EP&A Act. A review of environmental factors (REF) would be prepared to document the environmental assessment process. Transport would be the proponent and determining authority. If the environmental assessment indicates the proposal may significantly affect the environment, an environmental impact statement (EIS) would be prepared in accordance with the provisions of the EP&A Act.

3.1.2 State Environmental Planning Policies

The Proposal would require consideration of the State Environmental Planning Policies (SEPPs) described below.

State Environmental Planning Policy (Infrastructure) 2007

The *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) aims to facilitate the effective delivery of infrastructure across the state, including for roads and road infrastructure facilities. Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

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

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

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

State Environmental Planning Policy (Koala Habitat Protection) 2019

The *State Environmental Planning Policy (Koala Habitat Protection) 2019* (Koala SEPP) aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. The SEPP applies to a range of Local Government Areas, including Shoalhaven.

Part 2 of the SEPP regulates impact on koala habitats. While the SEPP does not affect the permissibility of the Proposal as a Division 5.1 or 5.2 assessment, consideration would be required regarding the Proposal's impact on koala habitat.

3.1.3 Other relevant legislation and environmental planning instruments

Shoalhaven Local Environmental Plan 2014

The study area is within the Shoalhaven LGA. Land use and development within the Shoalhaven LGA is primarily regulated by the *Shoalhaven Local Environmental Plan 2014* (Shoalhaven LEP). The Shoalhaven LEP identifies land use zones in the study area, includes zone objectives and lists permissible and prohibited development within zones.

The study area includes the following zones under the Shoalhaven LEP:

- RU2 Rural Landscape
- R5 Large Lot Residential
- SP2 Infrastructure.

Under the Shoalhaven LEP, the Proposal would be permitted with consent in all affected zones. However, it is expected the Proposal would be carried out by, or on behalf of, Transport for NSW without development consent under the ISEPP. Under that circumstance, the requirement under the Shoalhaven LEP to obtain consent would not apply. Transport for NSW would still consider the objectives of the local land use zonings during future assessments.

Roads Act 1993

The *Roads Act 1993* (Roads Act) provides for the classification of roads and the declaration of Transport for NSW and other public authorities as roads authorities for both classified and unclassified roads. It also regulates the carrying out of various activities in, on and over public roads.

Under the Roads Act, the relevant roads authority must issue a licence to carry out work in, on or over a road (refer to Section 138 of the Roads Act). Any work proposed by Transport for NSW on local roads would require the approval of Shoalhaven City Council.

Protection of Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) focuses on protecting, restoring and enhancing the environment within NSW, and reducing potential risks to human health and the environment. It aims to provide opportunity for increased public involvement and access to information regarding environmental protection.

The POEO Act has provisions related to water, air and land pollution, as well as waste management requirements, that would be considered during the environmental assessment for the proposal.

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) sets out the environmental impact assessment framework for threatened species and threatened ecological for activities subject to assessment under Part 5 of the EP&A Act (amongst other types of development).

Based on preliminary investigations, there are threatened ecological communities and threatened fauna species listed by the BC Act are known or are likely to occur within and near the study area. The potential for the Proposal to impact on threatened species listed under the BC Act would be considered during the environmental assessment for the proposal.

Crown Lands Management Act 2016

The *Crowns Land Management Act 2016* (Crown Lands Management Act) provides the legislative framework for the administration of land that is vested in the Crown in NSW. Ministerial approval is required to grant a 'lease, licence, permit, easement or right of way over a Crown Reserve'.

Based on preliminary investigations, there are multiple parcels of Crown land within the study area. If Crown land is identified as being affected by the Proposal, the relevant requirements of the *Crown Lands Management Act 2016* and Commonwealth *Native Title Act 1993* would need to be implemented.

Aboriginal Land Rights Act 1983

Through the *Aboriginal Land Rights Act 1983*, vacant Crown land not lawfully used or occupied or required for an essential purpose or for residential land, is returned to Aboriginal people (and vested in Aboriginal Land Councils).

A search of the Aboriginal Land Claims Register should be conducted to confirm the existence of any Aboriginal land claims over the potentially affected land parcels of identified Crown land. In accordance with Section 42B of the *Aboriginal Land Rights Act 1983*, land vested in an Aboriginal Land Council can only be acquired by Transport for NSW through an Act of Parliament.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides the basis for legal protection and management of National Parks estate and Aboriginal sites and objects in NSW.

Section 86 lists offences relating to harming or desecrating Aboriginal objects. Under Section 90 of the NPW Act, where harm to an Aboriginal object or Aboriginal place cannot be avoided, an Aboriginal Heritage Impact Permit (AHIP) is required.

There are known Aboriginal heritage sites within and adjacent to the study area. The potential for the proposal to impact on Aboriginal heritage would be considered during the environmental assessment for the Pproposal.

Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) provides a flexible and responsive statutory framework to safeguard the economy, environment and community from a variety of biosecurity

risks including animals and plant pests and diseases, weeds and contaminants. Under Part 3 of the Biosecurity Act, any person who deals with biosecurity matters has the duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated and minimised.

The presence of any invasive flora or fauna species would be considered during the environmental assessment of the Pproposal and managed during construction as required.

Water Management Act 2000

The study area is covered by the Water Sharing Plan for the Clyde River Unregulated and Alluvial Water Sources 2016. It is subject to the provisions of the *Water Management Act 2000* (WM Act).

Under Schedule 4 of the *Water Management (General) Regulation 2018*, a roads authority does not need to obtain an access licence when water is required for road construction and road maintenance. However, potential impacts on groundwater would need to be considered during the detailed environmental assessment phase of the proposal. If any dewatering is required a Crown exemption under Section 112 of the *Water Act 1912* would be expected to apply.

Controlled activities under the WM Act apply to 'waterfront land' defined as all land within 40 metres of the highest bank of any river, lake or estuary. This would include carrying out work to build crossings of waterways within the study area. However, under Clause 38 of the *Water Management (General) Regulation 2011* public authorities do not need to obtain a controlled activity approval under the WM Act. Impacts on the riparian zone of watercourse within the study area should be considered as part of the environmental assessment.

Contaminated Land Management Act 1997

The Contaminated Land Management Act 1997 (CLM Act) establishes a process for investigating, managing and remediating contaminated land. Where contamination is known to be present but does not pose an unacceptable risk to the current or approved land use, management of the contamination and identification of remediation requirements may be dealt with by the local council under the planning and development framework of the EP&A Act.

If contaminated land is identified during the development of the proposal, it would be managed in accordance with the requirements of the Act.

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects matters of national environmental significance (MNES) (as defined under the Act) and the environment of Commonwealth land.

Under the EPBC Act a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on MNES or the environment of Commonwealth land.

A referral is not required for proposed road activities assessed under Division 5.1 of the EP&A Act that may affect nationally listed threatened species, threatened ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Native Title Act 1993

The *Native Title Act 1993* provides the legislative framework that:

- recognises and protects native title
- establishes ways in which future dealings affecting native title may proceed, and to set standards for those dealings, including providing certain procedural rights for registered native title claimants and native title holders in relation to acts which affect native title
- establishes the National Native Title Tribunal.

The Native Title Claim NC2017/003 – South Coast People (entered on Register 31/01/2018) affects the study area.

3.2 Transport considerations

The following sections describe the key transport considerations for developing the intersection upgrade design options.

3.2.1 Roads

The key road categories within the study area and their functions are outlined in Table 3-1.

Table 3-1 Road hierarchy classification guidelines

Road classification	Road types	Function
State Roads	Freeways/ motorways and primary arterials	Forming connections between urban centres such as Sydney, Newcastle, Wollongong and the Central Coast, running through major regional towns
Regional Roads	Secondary or sub arterials	Provide the main connections between smaller regional towns and districts with the main State Road network
Local Roads	Collector and local access roads	Roads providing local access to residential properties, as well as connections to arterial roads

Source: Transport's classified roads map 2017

The Princes Highway is a major State Road and, running north to south, links Sydney and the Illawarra Region with the NSW South Coast and beyond to the Gippsland region of Victoria. Jervis Bay Road is a Regional road that functions as the main east-west link to the regional centre of Vincentia and coastal villages of Huskisson, Hyams Beach and Jervis Bay and joins the Princes Highway at Falls Creek. Figure 3-1 shows the road hierarchy of the study area.

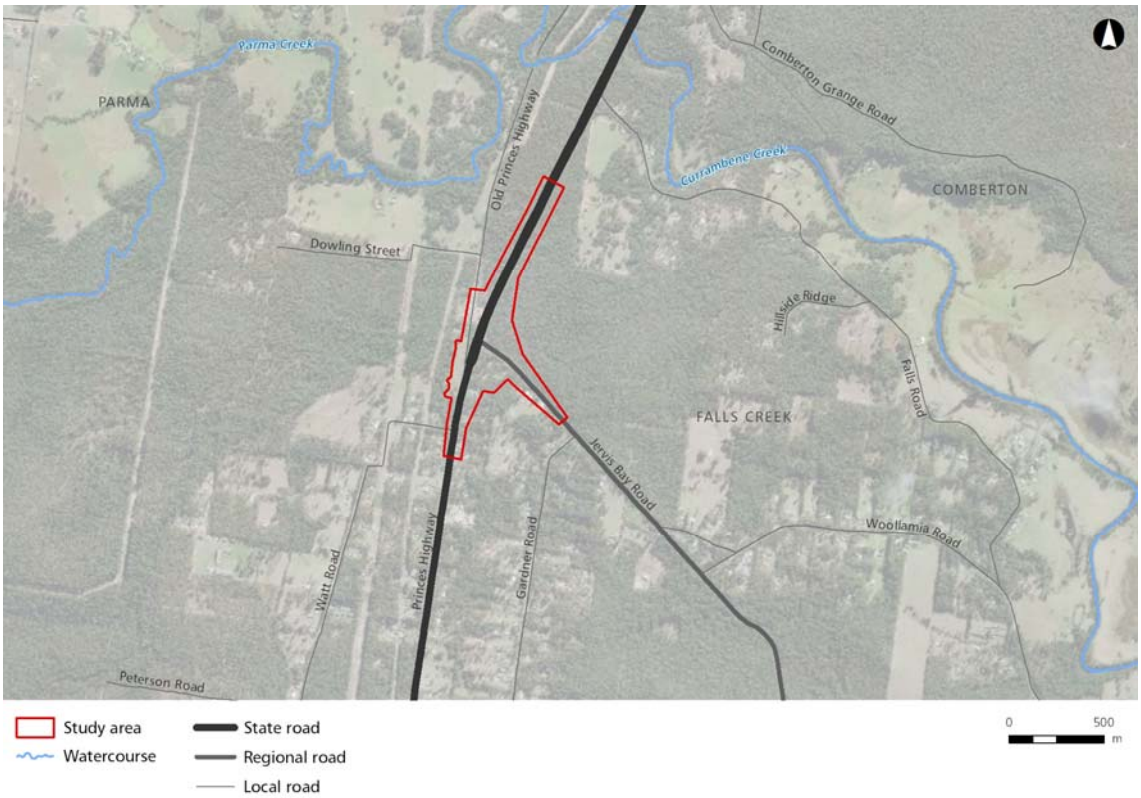


Figure 3-1 Road hierarchy

3.2.2 Freight routes

The Princes Highway is important for freight movements, including by heavy vehicles and oversized vehicles. Major towns such as Vincentia and Huskisson provide a range of services that require freight requirements, with Jervis Bay Road providing the primary freight connection between these towns and the Princes Highway.

Current approved heavy vehicle routes in and around the study area are shown in

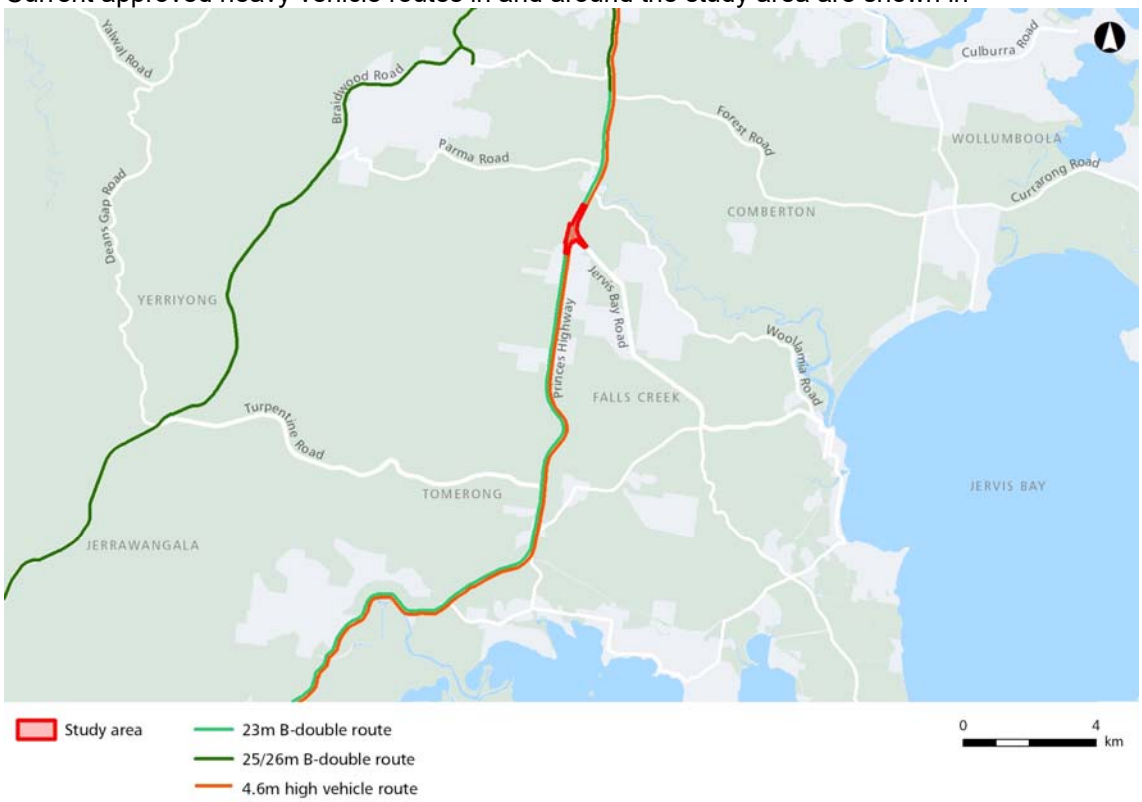


Figure 3-2. While the Princes Highway south of Nowra doesn't form part of the current approved 25/26m B-double route, the Princes Highway Upgrade, including Jervis Bay Road intersection, would be designed to cater for a potential future extension of the heavy vehicle route and improve freight connectivity with Jervis Bay Road.

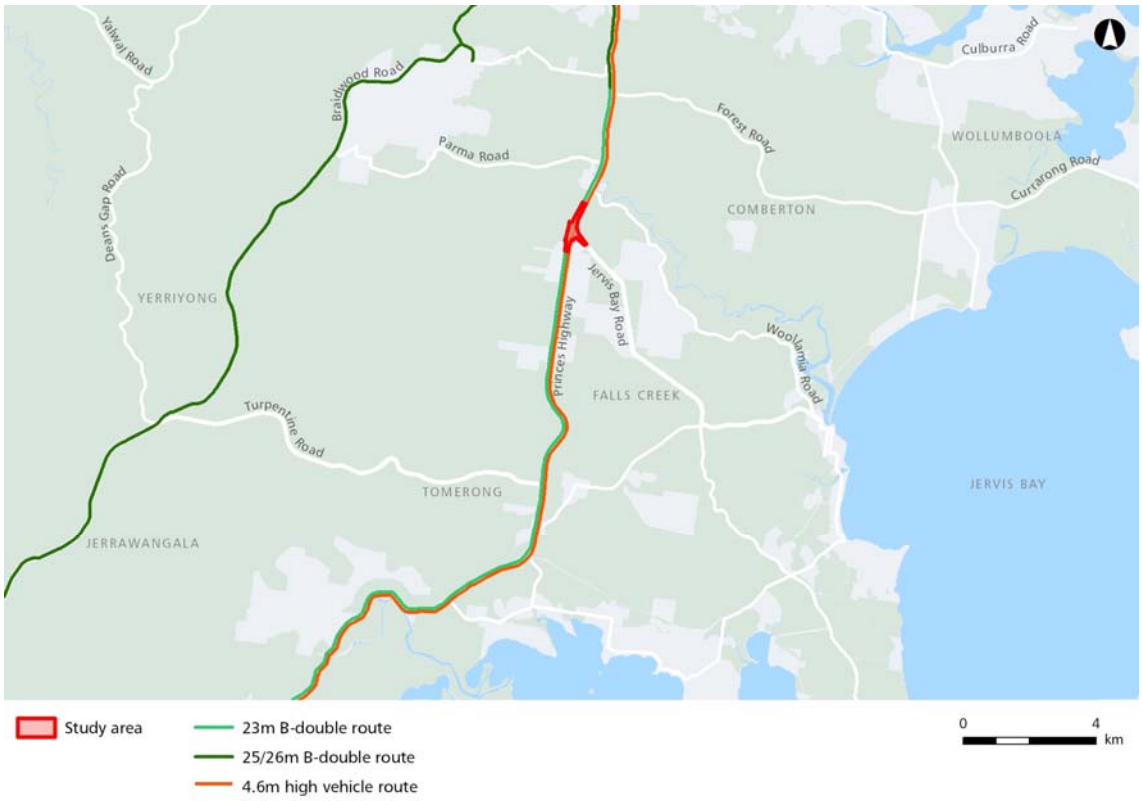


Figure 3-2 Heavy vehicle routes

3.2.3 Public transport

There are three existing bus stops located within the study area at the intersection of the Princes Highway and Jervis Bay Road. These bus stops are not formally signposted, are not accessible via footpaths and have no formal pull over areas. Further there are no provisions such as benches or bus shelters. The bus stops are serviced by the following three private bus services:

- Route 102 – Bomaderry to Vincentia via Nowra and St Georges Basin
- Route 103 – Nowra to Hyams Beach via Erowal Bay
- Route 135 – Bomaderry Station to Berrara via Nowra, Tomerong and Sussex Inlet.

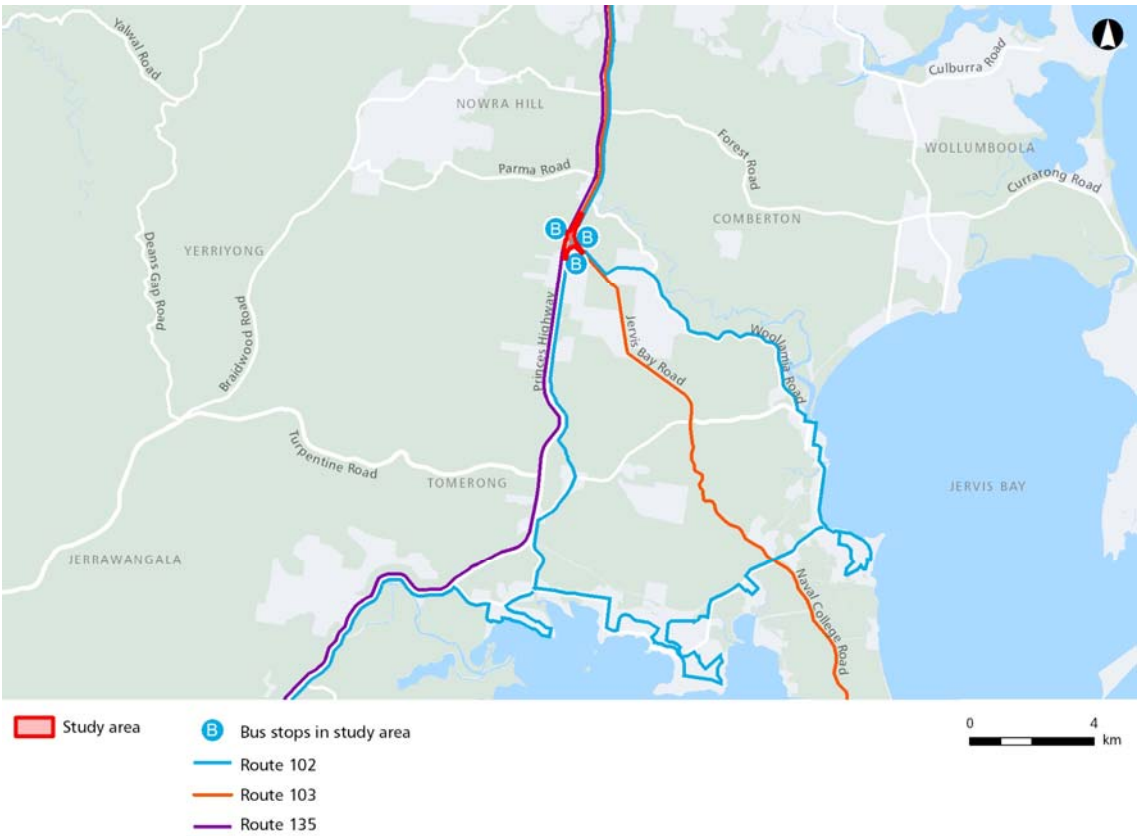


Figure 3-3 shows the bus routes that service the bus stops within the study area.

School buses also use these three bus stops and an additional bus stop on Willowgreen Road near the Princes Highway. School bus services in the region are provided by Shoal Bus. Students often catch private bus buses in combination with other school buses to access schools in Bomaderry, Nowra, Milton and Ulladulla. The bus stop on Willowgreen Road has an informal pull over area and a bus shelter.

The project would, as a minimum, upgrade the existing bus stops to provide a safe arrangement for busses to stop, and provide connectivity to the proposed shared paths through the intersection. These safety and accessibility upgrades will improve usability and facilitate increased provision of services and patronage of public transport in the future.

The area has no direct rail service, with the nearest railway station located in Bomaderry, about 16 kilometres north of the study area.

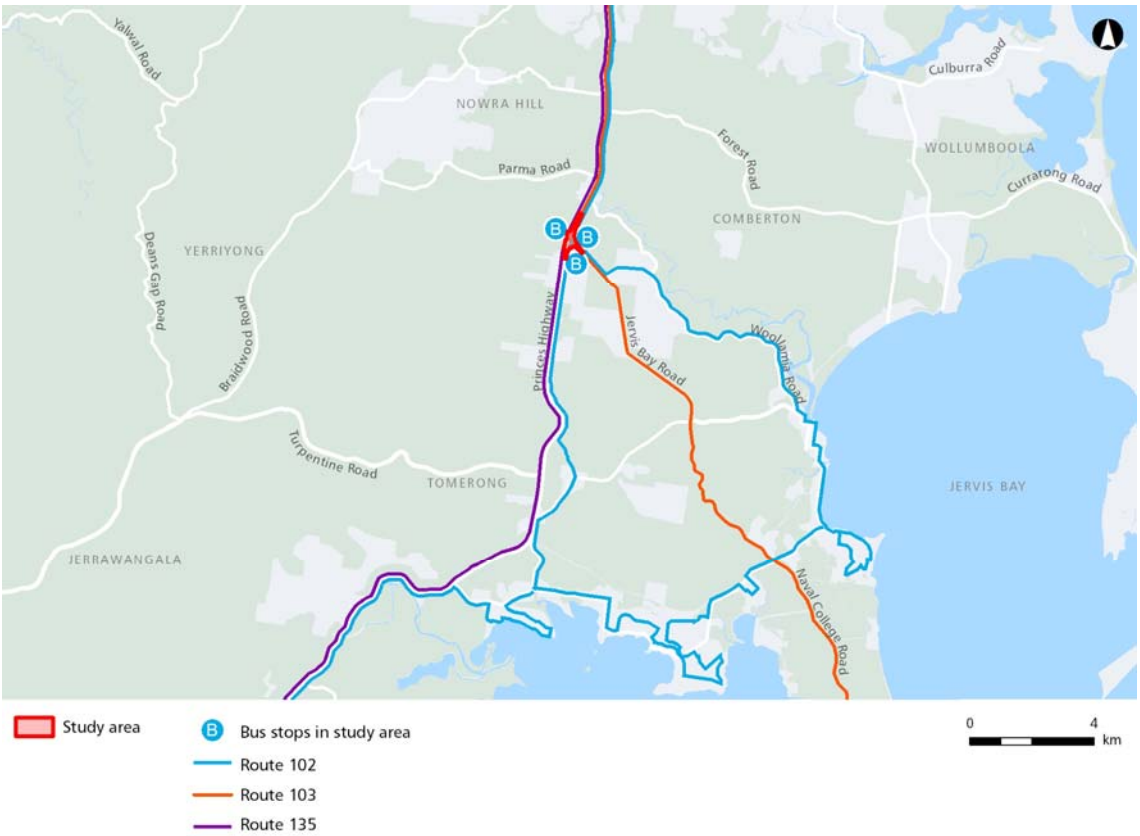


Figure 3-3 Bus routes

3.2.4 Pedestrian and cycling facilities

There are no formal footpaths for pedestrians or cyclists along either the Princes Highway or Jervis Bay Road, however, a dirt path along the southern side of Jervis Bay Road connects to the southbound bus stop on the Princes Highway. There is no formal way for pedestrians to access the northbound bus stop on the Princes Highway and no safe provisions for pedestrians to cross the Princes Highway.

There are no formal bicycle paths within the study area, however, some cyclists use the paved shoulder of the Princes Highway. The existing Princes Highway shoulder width varies from 3 metres to 1 metre within the project footprint and is therefore not suitable for safe cyclist use. Shoulder widths more acceptable for cyclist use along the Princes Highway are available from Parma Road intersection, about 2.5 kilometres north of Jervis Bay Road.

The Jervis Bay Road intersection upgrade would provide 3 metre wide shoulders along the Princes Highway and shared paths through the intersection with formalised crossing points. The shared paths would also connect to the proposed bus stop locations.

3.2.5 Road safety

This assessment is based on the crash data for a 5-year period from 1 January 2014 to 31 December 2018 for the Princes Highway/Jervis Bay Road priority intersection. The crash data includes fatal, injury or vehicle damage accidents.

During this period, 13 crashes were recorded within the study area. Of these:

- 85% of crashes involved at least one person being injured

- Five crashes causing serious injury were recorded
- A total of 23 people were injured within the study area
- No fatal crashes were reported.

The type of crashes recorded during this period are summarised in Table 3-2. The majority of crashes at the intersection are associated with vehicles travelling on Princes Highway southbound colliding with right turning vehicles existing Jervis Bay Road (cross traffic) and vehicles turning right from Princes Highway northbound into Jervis Bay Road (right through).

Table 3-2 Crashes by road user movement

Road user movement	Count	Percentage (%)
Right through	3	23
Cross traffic	4	31
Right near	2	15
Rear end	1	8
Head on (not overtaking)	1	8
Lane sideswipe	1	8
Other same direction	1	8

3.2.6 Safe System approach

The Proposal adopts the Safe System approach, which aims to improve road safety using a holistic view of the road transport system and the interactions among roads and roadsides, travel speeds, vehicles and road users. It is an inclusive approach that caters for all groups using the road system, including drivers, motorcyclists, passengers, pedestrians, cyclists, and commercial and heavy vehicle drivers. It recognises that people will always make mistakes and may have road crashes, but the system should be forgiving and those crashes should not result in death or serious injury.

The Safe System approach therefore favours certain treatments that significantly reduce the exposure, likelihood or severity of crashes. The main treatments considered for this Proposal are:

- Flexible roadside and median barriers (reduced likelihood)
- One-way traffic / divided carriageway on Princes Highway (reduced likelihood)
- Grade separation to remove conflict points between through traffic and intersection traffic and reduce the amount of traffic using the intersection (reduced exposure)
- Roundabouts that cause lower crash severity due to the flatter impact angles (reduced severity)

- Separation of pedestrians and cyclists from vehicular traffic through the intersection (reduced likelihood)
- Lower speed environment at crossing points (reduced severity).

3.2.7 Network performance

Traffic studies identified that the Jervis Bay Road leg of the intersection operates near capacity during normal weekday peak periods with road users experience queueing and high delays trying to enter the Princes Highway. The intersection performance deteriorates further during holiday periods, particularly over summer, with increased delays for vehicles on Jervis Bay Road. Princes Highway road users also experience slight delays travelling through the intersection during peak holiday periods.

Traffic counts show that about 23,000 vehicles use the Princes Highway at this location on an average day. During summer holidays the average daily traffic increases to about 25,000 vehicles on Princes Highway and 9,000 vehicles on Jervis Bay Road.

Intersection operational performance is evaluated by assessing the intersection turning volumes, queue length, vehicle delays and level of service (LOS). LOS is a measure used to determine the effectiveness of intersection operation and is most commonly used to analyse intersections by categorising traffic flow conditions.

Table 3-3 provides the LOS criteria for intersection operation. A LOS of D or better is generally considered to represent acceptable operation.

Table 3-3 Level of service criteria for intersections

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

The traffic modelling has been based on traffic surveys undertaken in June 2019. During this survey, the observed queue length during the morning peak was 110 m and would clear within 25 seconds. This queuing pattern does not appear to align with the traffic patterns that are experienced by transport users on a daily basis and the queue lengths observed by the project

team during a site visit. The traffic volumes align with a traffic survey undertaken in November 2018, however, no queue lengths were surveyed at that time.

Due to the limitations of the data available, an alternative modelling scenario was undertaken that used the traffic volumes obtained during the traffic survey and assumed a gap acceptance of 7 seconds (Transport modelling guidelines provide a range of 6-8 seconds gap acceptance for this intersection type). Table 3-4 below shows the modelling results for 6 seconds gap acceptance (validated against the surveyed queue lengths) and 7 seconds to align with observed queue lengths. This new modelling scenario indicates a queue length of 235 m on Jervis Bay Road due to the increased gap acceptance parameters, reflecting more cautious right-turn movements.

The modelling results show that based on a standard 7 s gap acceptance, Jervis Bay Road operates at LOS F during weekday peak operations. Delays further increase during the holiday peak period to 496 s. Queues on Jervis Bay Road have been surveyed to extend to around 630 metres during the holiday peak hour due to the high volumes of through traffic on the Princes Highway.

Table 3-4 2019 existing intersection level of service results

Peak hour	Approach	Delay (sec)	LOS
AM peak hour (7.30am to 8.30am) *Calibrated to surveyed queue length*	North – Princes Highway	9	A
	East – Jervis Bay Road	25	B
	South – Princes Highway	10	A
	Overall	**25**	**B**
AM peak hour (7.30am to 8.30am) *7 seconds gap acceptance, aligned with observed queue length*	North – Princes Highway	9	A
	East – Jervis Bay Road	68	E
	South – Princes Highway	10	A
	Overall	**68**	**E**
PM peak hour (3.30pm to 4.30pm)	North – Princes Highway	9	A
	East – Jervis Bay Road	30	C
	South – Princes Highway	22	B
	Overall	**30**	**C**
Holiday peak hour (3pm to 4pm)	North – Princes Highway	9	A
	East – Jervis Bay Road	472	F
	South – Princes Highway	25	B
	Overall	**472**	**F**

3.3 Environmental considerations

3.3.1 Biodiversity

The following biodiversity constraints were identified within the study area (Figure 3-4):

- Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion, a Threatened Ecological Community (TEC) listed as Endangered under the BC Act and Critically Endangered under the EPBC Act
- Potential occurrence of BC Act and EPBC Act threatened fauna species (or their habitats) within the study area
- Presence of low to moderate potential groundwater dependent ecosystems (GDEs).

Proposal Implications

Ecologically sensitive areas have been identified within the study area that would be a key consideration for selecting a preferred option for the Proposal in terms of managing both direct and indirect impacts during construction and operation.

Transport would conduct further investigations and specialised field surveys to inform preparation of an environmental impact assessment for the Proposal.

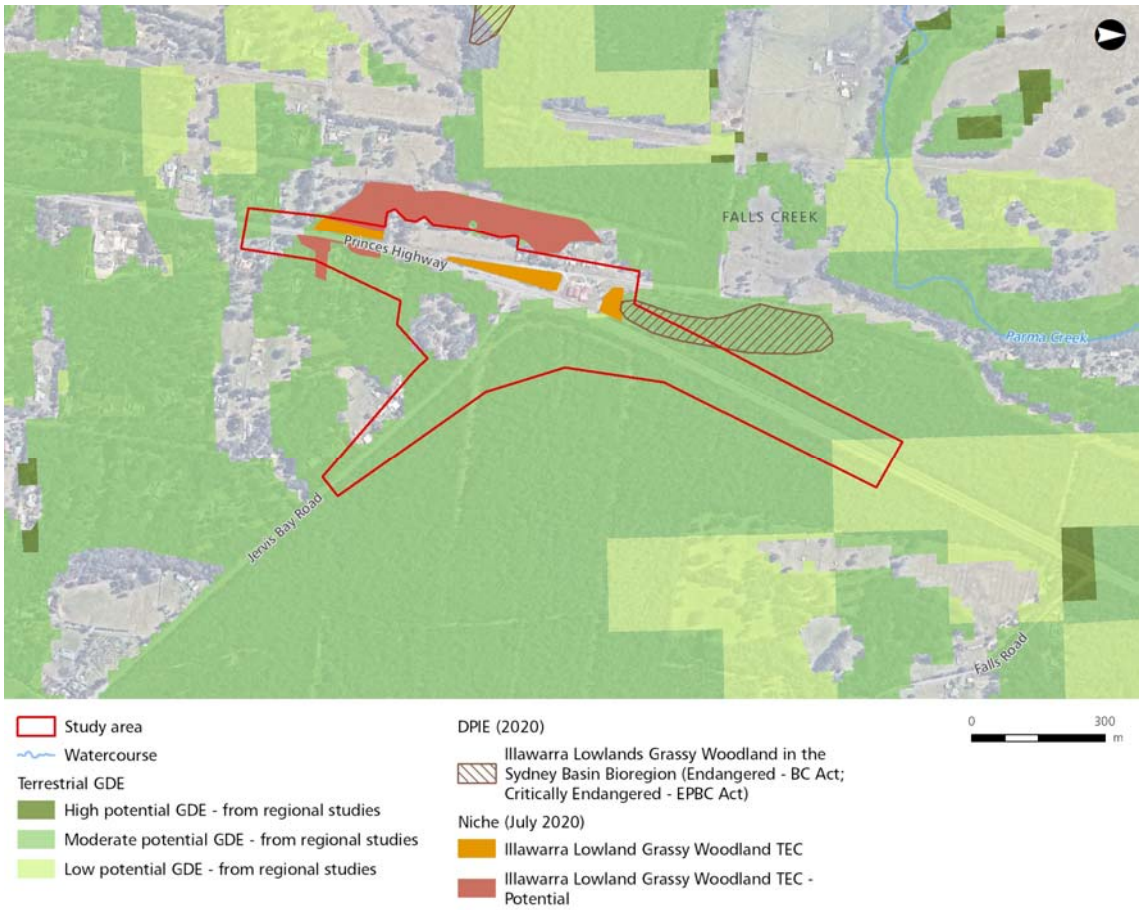


Figure 3-4 Biodiversity considerations

3.3.2 Aboriginal heritage

A search of the Aboriginal Heritage Information Management System (AHIMS) database undertaken in April 2020 did not identify any recorded Aboriginal sites within, or adjacent to, the study area.

There is one Native Title Claim, NC2017/003 – South Coast People (entered on Register 31/01/2018), that affects the study area.

Proposal implications

The potential for previously unrecorded Aboriginal sites would be carefully considered during design development to minimise potential impact. Transport for NSW would undertake further investigations and consultation with local Aboriginal communities to confirm the presence of Aboriginal cultural and archaeological sites.

3.3.3 Non-Aboriginal heritage

No non-Aboriginal heritage listed items have been identified within the study area or the immediate locality.

3.3.4 Landform, geology and soils

The study area and surrounds is mostly flat, with the existing Princes Highway located on a 3-4 m high embankment.

The study area comprises quaternary alluvial deposits and Permian sedimentary rocks. Soils have potential for erosion and has no salting evident. There are no known contamination sites and there is an extremely low risk of acid sulphate soils within the study area.

Proposal implications

Transport for NSW would identify appropriate soil, erosion and sediment control measures to manage construction and operational water quality outcomes during the preparation of an environmental impact assessment for the Proposal.

3.3.5 Hydrology, water quality and groundwater

The study area drains to Jervis Bay via minor watercourses and then Currambene Creek. The investigation area includes potential sensitive receiving environments, including low to moderate potential groundwater potential ecosystems. Parts of the study area to the west of the Princes Highway have been identified by Shoalhaven City Council as areas subject to flooding in a 1 in 100-year average recurrence interval (ARI) event. This includes the assumption of 0.5 metres of freeboard.

Proposal implications

The management of water quality during construction and operation would need to be considered in the development and assessment of the Proposal due to the potential direct and indirect impacts to potential sensitive receiving environments.

Transport for NSW would establish appropriate flood immunity levels for the intersection and consider any potential flooding impacts in the area identified as flood prone land to the west of the intersection.

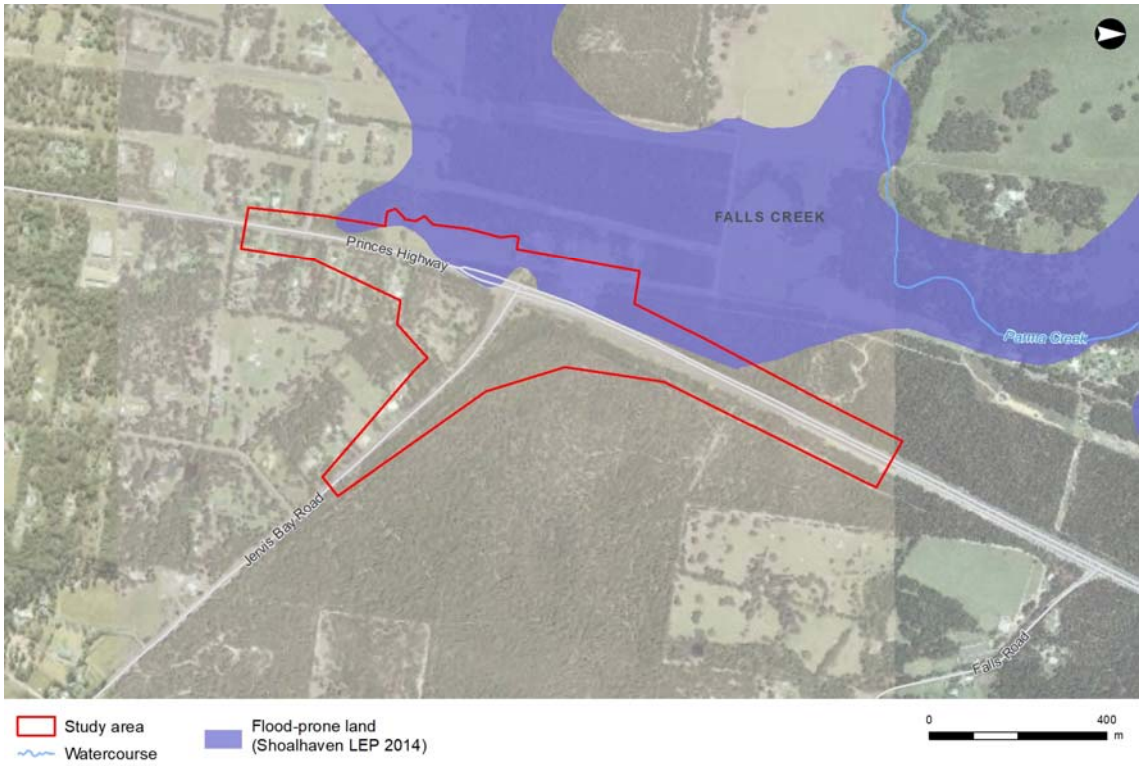


Figure 3-5 Hydrology considerations

3.3.6 Air quality

The study area contains residential areas that would be susceptible to the generation of dust during earthworks and other construction activities. The potential for dust to be generated would depend on the silt and moisture content of the soil, the types of operations being carried out, the size of exposed areas and the prevailing wind conditions.

Proposal implications

An upgraded intersection in the study area is likely to have minimal operational air quality impact on current and future adjacent receivers due to potential changes to road alignment or if traffic lanes were to move closer to those sensitive receivers. Transport for NSW would conduct air quality assessments to inform preparation of an environmental impact assessment for the Proposal.

3.3.7 Noise and vibration

The background noise environment of the study area is generally influenced by the movements of road traffic. The potential noise sensitive receivers within the study area are residential dwellings along the Princes Highway, Jervis Bay Road and the adjacent local road network.

Proposal implications

An upgraded intersection (with changes to the intersection layout) may alter the sound profile of sensitive receivers during construction and operation. Suitable mitigation measures for construction and operational noise and vibration sources would be identified and their effectiveness assessed during the design process and environmental assessment.

3.3.8 Land use

Land uses in the study area includes residential and rural properties in Falls Creek, as well as road infrastructure, including the Princes Highway, Jervis Bay Road and Old Princes Highway.

A large amount of property within the study area is privately owned land for residential and rural purposes. Other parcels of land include City of Shoalhaven Council owned land, land owned by Local Aboriginal Land Councils, Crown land and land subject to Native Title.

Proposal implications

Some intersection treatments may require acquisition of land adjacent to the existing corridor. Development on a land parcel immediately adjacent on the northern side of Jervis Bay Road would involve a complex land acquisition process, which is a significant constraint to options development.

Transport for NSW will implement a community and stakeholder engagement plan for the Proposal to guide consultation throughout development, construction and commissioning. Transport for NSW would be in contact with all directly impacted property owners once a preferred option has been proposed and work closely with them throughout the Proposal.

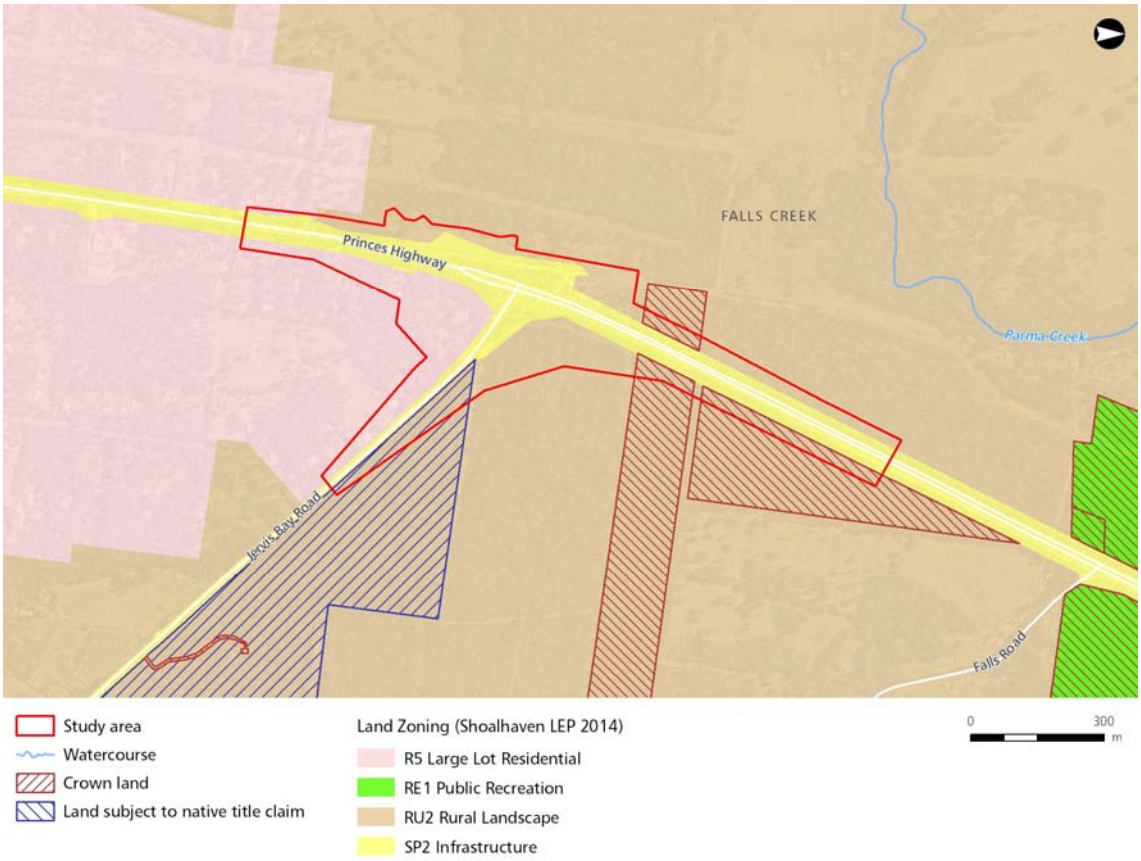


Figure 3-6 Land use considerations

3.3.9 Landscape character and visual amenity

The landscape character and visual setting is strongly influenced by the existing road infrastructure as well as adjacent woodland areas.

Proposal implications

The study area has moderate landscape character sensitivity and would need to be considered with respect to changes to the landscape resulting from the intersection upgrade, such as tree removal and fill embankments to provide a widened road formation and the construction of potential new structures.

3.3.10 Utilities

The utilities currently active within the study area include Electrical (Endeavour Energy), Water Mains (Shoalhaven City Council) and Communications (Telstra and Optus). There are direct buried utilities located in the road corridor along the Princes Highway and Jervis Bay Road, as well as overhead electrical. Among these communication lines is the Nowra to Yatte Yattah major optic fibre line.

Proposal implications

Relocation or protection of utilities may be required as a result of the Proposal. This would be confirmed during future development of the Proposal, in consultation with asset owners.

3.3.11 Contamination

No records of contaminated land within or adjacent to the study area are recorded on the Environmental Protection Authority (EPA) contaminated land record.

A petrol station is located on the western side of the Princes Highway that contains underground and above ground fuel storage tanks.

Proposal implications

Contaminated land may be present in the vicinity of the petrol station. Further environmental assessment would be required if the Proposal is likely to impact on this property.

4. Community involvement and feedback

4.1 Consultation activities to date

4.1.1 Strategic treatment options community consultation

Between 16 March and 13 April 2020, Transport sought community feedback on three intersection treatments including fly-overs (grade separation), roundabouts and traffic signals.

The purpose of this consultation was to understand the public's prioritised values and enable their questions and concerns to be considered before identifying a preferred strategic option.

During the consultation period submissions were received from individuals, community groups and government representatives, who provided feedback through:

- 741 comments via the online survey
- 89 email submissions, including four from emergency services.

4.1.2 Online survey

The online survey asked respondents to place ten values that Transport for NSW considers important to the overall success of the Proposal in order of priority. The respondents' relationship with the Proposal area is summarised in Table 4-1. The following values were placed as the highest priority by online survey respondents:

- 62 per cent of respondents prioritised road safety
- 33 per cent of respondents prioritised reduced congestion
- Less than two per cent of respondents prioritised the remaining values including worker safety, quick to build, minimising environmental impacts, minimising noise impacts, minimising impacts to road users when being built, flexibility in design, ease of building and flexibility to manage local road and emergency access.

Table 4-1 Online survey respondents' relationship with Proposal area

Nearby resident (Jervis Bay area) 69 per cent	**Local resident (Falls creek and nearby)** 16.5 per cent	**Commuter** 8.9 per cent
Local or nearby business 1.7 per cent	**Tourist** 2.3 per cent	**Freight** 0.8 per cent

4.1.3 General feedback

General feedback focused on 11 topics listed below in order of frequency:

1. Intersection treatment options
2. Traffic and transport
3. General/Project Details
4. Bushfire/incident resilience
5. Consultation
6. Proposal need and justification
7. Environment
8. Socio-economic
9. Proposal description
10. Out of scope
11. Placemaking.

4.1.4 Key stakeholder meetings

Stakeholder meetings have been carried out to provide an update and overview of the Proposal.

A total of three proposal briefings have taken place so far in 2020 with Shoalhaven City Council and local community group, Vincentia Matters.

The following key stakeholders have also been identified, and will be further engaged as the Proposal progresses:

- Emergency Services agencies
- Department of Planning, Industry and Environment
- Community groups, such as the Vincentia Ratepayers and Residents.
- Chamber of Commerce
- Business owners surrounding the Proposal area
- Property owners and tenants surrounding the Proposal area

Additional key stakeholders may be identified as the Proposal progresses.

4.2 Community Engagement methods

A summary of community engagement methods proposed to be utilised for the Proposal is included in the table below.

Table 4-2 Community engagement methods

Engagement Method	Details
Princes Highway upgrade portal (princeshighway.nsw.gov.au)	Digital portal including interactive map of all work activities as part of Princes Highway upgrade program. Purpose of digital portal is to explain scope of the program, program benefits, objectives and provide up-to-date information
Website (nswroads.work/jervisbayroad)	Details of the project are provided on the Transport for NSW website. The website also includes a subscription form for members of the public to sign up to project updates and nominate how they would like to receive project information. Online survey was accessible via the website.

Engagement Method	Details
Online survey	The online survey asked respondents to place ten values that Transport for NSW considers important to the overall success of the project in order of priority.
Project email (princeshighway@transport.nsw.gov.au)	Dedicated Princes Highway Upgrade program email address to provide alternative avenue for submitting written feedback submissions. The project email enables contact with project team.
Project information line (1800 719 759)	Project information line to answer questions from the public and obtain feedback from community members unable to submit feedback online or via email.
FAQ	Frequently Asked Questions document accessible via the project website to answer common project questions.
Postcard distribution	Postcards are distributed to over 10,000 properties throughout the Bay and Basin area.
Social Media	Facebook is used to raise awareness of the project and project consultation periods. Facebook posts are geo-targeted to reach Facebook users in the region.
Advertising	Print and digital advertising is used during project consultation periods to inform members of the public of the consultation opportunity and encourage feedback to be provided.
Media release	Media releases will be issued to announce project milestones
Facebook Live Q&A session	30-minute online Q&A sessions via Facebook Live are held answer questions from members of the community to help inform and encourage feedback.
Emails to stakeholder list and subscribers	A subscription database was established utilising known contacts and expanded via an email subscription form via the project website.
Notifications via mail	Notifications have been distributed via letter box to advise nearby residents of environmental and site investigation work.
Phone call	Phone calls have been made to advise nearby residents of environmental investigation work.
Door knocking	Door knocking has been carried out to advise nearby residents of environmental and site investigation work. Social distancing guidelines were in place.

4.3 Ongoing future consultation

We will continue to engage with community and other stakeholders as the Proposal progresses. This will include public displays of the preferred option and concept design and ongoing contact

with property owners and tenants surrounding the Proposal area to inform them of environmental and site investigations near them.

Communication will include phone calls, door knocks, notifications, postcards, email, updates to the website and interactive portal, images / diagrams of designs, reports, stakeholder meetings, media releases and announcements, advertising and information sessions as required.

The final preferred option outlined in this report will be on public display for community feedback from Wednesday 25 November to Sunday 20 December 2020.

5. Alternatives and options considered

5.1 Methodology for selection of recommended option

The approach to selecting a recommended corridor option for the Proposal involved a five-stage process (Figure 5-1):

- Identification of key constraints within the study area – items for consideration in the development of the longlist of options (refer to Section 3)
- Identification of longlist options – development of 26 intersection options for assessment (refer to Section 5.3)
- Identification of shortlist options – fatal flaw and comparative analyses of the 26 longlist options, including opportunities for consolidation of options to identify shortlisted options for further investigation (refer to Section 5.4)
- Development of shortlist options – design development and investigation of the four shortlisted options to inform evaluation and comparison (refer Section 5.5)
- Identification of a recommended option – assessment and comparison of the four shortlisted intersection upgrade design options to identify the preferred option (refer Section 5.5.3-5.5.6 and Section 5.6).

Workshops were held at key stages to ensure collaboration between key stakeholders and members of the project team.

Figure 5-1 Approach to selection of a recommended option

5.2 Alternatives considered

A number of alternative strategic treatment options for the Jervis Bay Road and Princes Highway intersection were considered by Transport, and included:

- Business as usual – the 'do nothing' option
- Traffic signals option

- Roundabout and grade separation options

5.2.1 Evaluation of business as usual option

The business as usual option involves maintaining the intersection of Jervis Bay Road and the Princes highway in its existing design and arrangement. This option was not considered for further assessment as it fails to address any of the project objectives and does not improve safety, improve traffic efficiency and connectivity, improve transport network resilience, or support an increase in active transport and public transport use (as outlined in Section 2.3).

5.2.2 Evaluation of traffic signals option

A traffic signals treatment option was considered by the project team. This option included upgrades to the existing intersection to provide traffic signal control to key movements and was considered in relation to whether traffic signals would provide additional benefit to the business as usual, roundabout and grade separation options.

Following evaluation by the project team, the traffic signals treatment option was not considered for further assessment as the use of traffic signals were considered an unsuitable solution to achieve the safety and traffic efficiency objectives at this location.

5.2.3 Roundabout and grade separated options

These options would involve a major upgrade to the existing intersection to provide either a roundabout and grade separation treatment option. Transport considered this alternative best met the service needs and objectives for the project, providing a safe systems design approach (reducing the likelihood and severity of all crash types) and providing improved traffic efficiency when compared to the other alternatives considered.

A series of roundabout and grade separation design options were developed for further assessment, as documented below.

5.3 Identification of long list of options

An options investigation phase was undertaken by the project team to identify the long list of intersection upgrade options. This involved investigation of various configurations of intersections and interchanges to identify potential solutions, while taking into consideration the key constraints highlighted in Section 3. These potential solutions were then developed to a sufficient level of strategic detail to allow for meaningful comparison of the options to be undertaken.

A long list of 26 options was identified, consisting of both at grade roundabout solutions and a series of grade separated options.

5.3.1 Key design criteria

The following design criteria were used to inform the development of the longlist design options:

- Achieve the target cross section for the Princes Highway as per Figure 5-2
- Requirement for safe consolidated access to Old Princes Highway as part of the project design
- Intersection movement requirements – including catering for U-turn movements on the Princes Highway.

- Alignment with the Safe System approach for road safety improvements.
- Provision of active and shared transport facilities.
- Design speed:
  - Princes Highway - Horizontal: 110 km/h, Vertical 100 km/h (100 km/h posted)
  - Jervis Bay Road – 100 km/h (90 km/h posted)
  - Old Princes Highway – 70km/h (60 km/h posted)
- Design vehicle - Performance based standard Level 2 (B) – 30 metre combination with Higher Mass Limit
- Intersection design vehicle:
  - Jervis Bay Road: Performance based standard Level 2 (B) – 30 metre combination with Higher Mass Limit (26.0m B-double for turn path)
  - Old Princes Highway: Prime mover and semi- trailer – 19 metre combination
- Shared user path width – 3.0m
- Vertical clearance – 5.4m

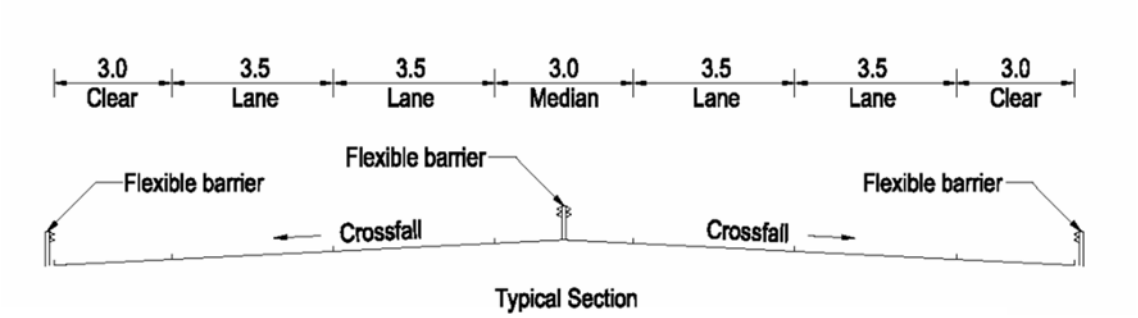


Figure 5-2: Typical Princes Highway cross section

5.3.2 At grade options

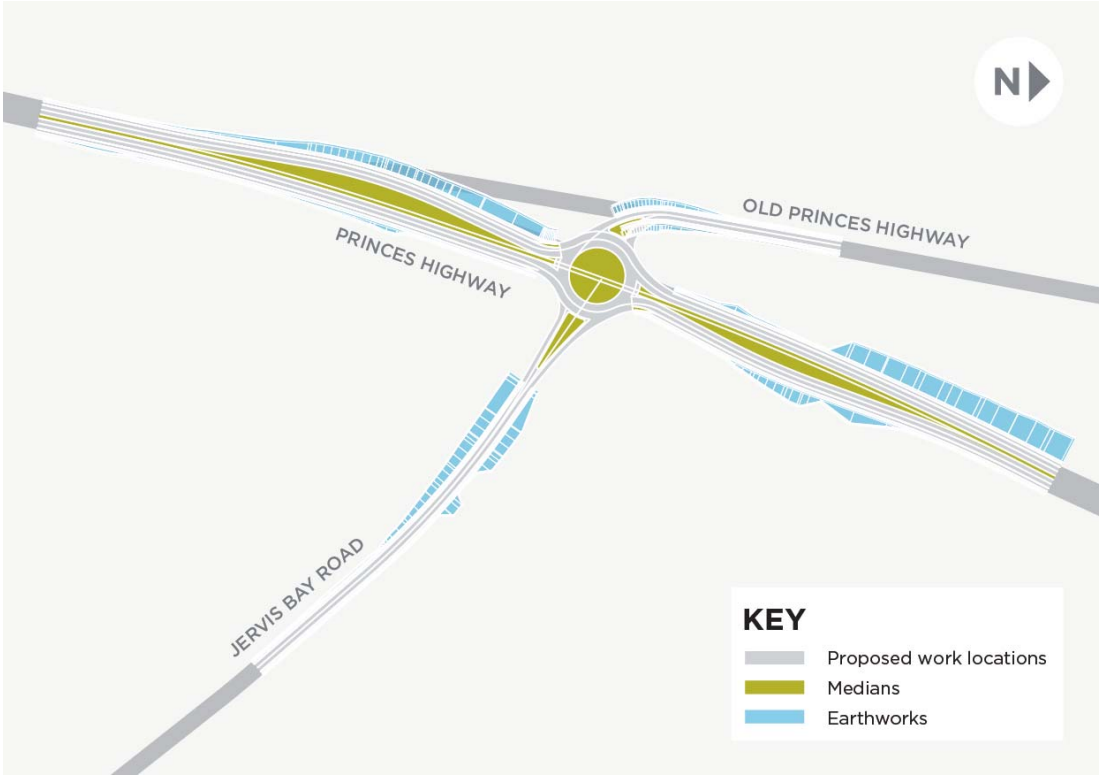
A series of at-grade options involving no elements of grade separation were investigated. This included Options 1001, 1002, 1009, 1010 and 1013. Examples of at grade options are shown in

Figure 5-3.

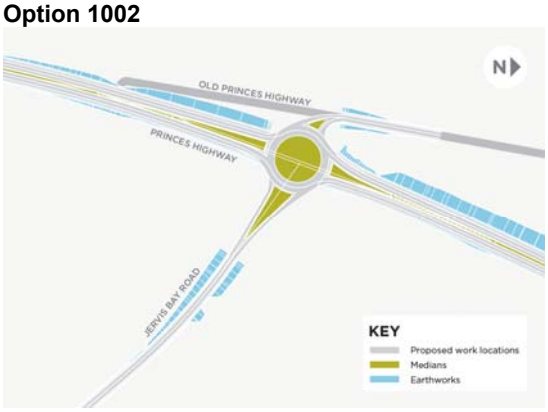
The at-grade options generally took the form of a roundabout incorporating all movements at a single interchange. This would minimise the footprint and achieve all movements with an improved safety outcome.

A variation involving a northbound bypass lane maintaining access to Old Princes Highway at its current location was also considered. The right turn movements conflicting with high speed and volume through movements are highly undesirable from a Safe System approach to road safety improvements.

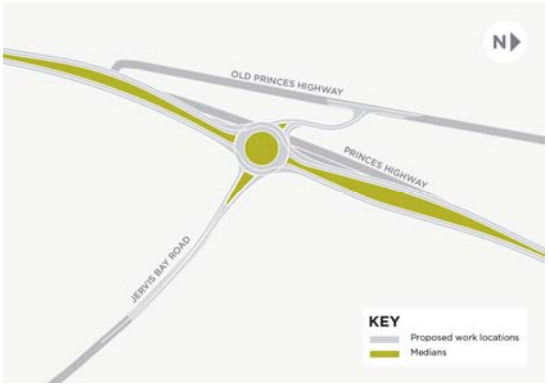
Traffic modelling indicated that an at-grade roundabout would not provide an acceptable intersection level of service for the forecast traffic demands in 2039, resulting to unacceptable queue lengths on the Jervis Bay Road approach.



Option 1002



Option 1001



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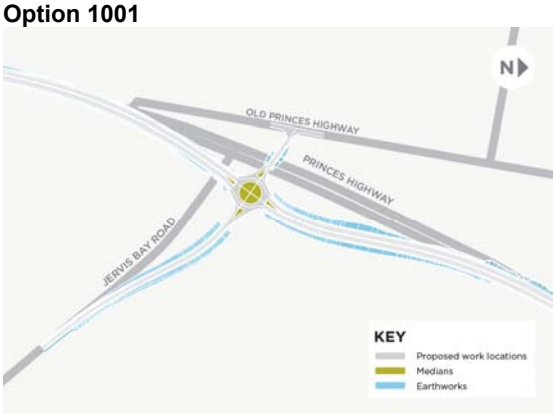
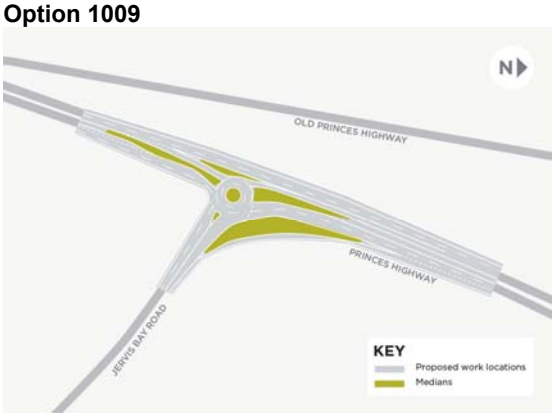


Option 1010



Option 1013

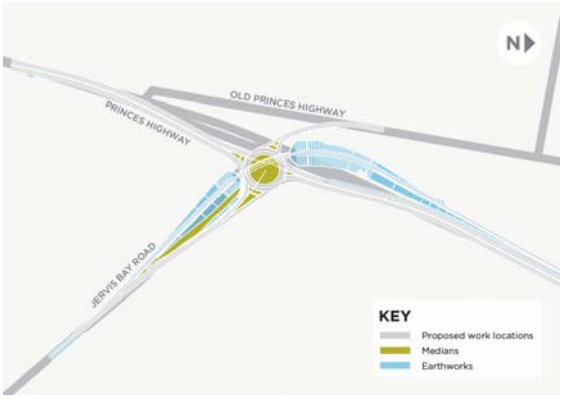
Figure 5-3 At-grade roundabout options

5.3.3 Right turn grade separation

The right turn grade separation options included Options 1004, 1005, 1007, 1011A, 1011B and 1012. Examples of right turn grade separated options are shown in Figure 5-4.

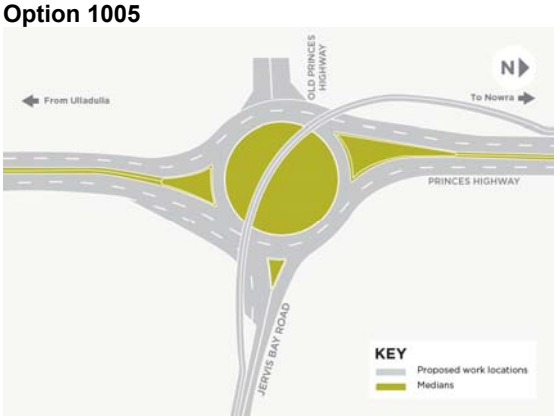
These options separate the right turn movement from Jervis Bay Road to Princes Highway northbound from the intersection. This is in the form of both an overpass and an underpass. Grade separation of these movements alleviates the major traffic conflict at the intersection between the Jervis Bay Road right turn and Princes Highway southbound through traffic.

One option incorporated a right turn flyover whilst maintaining a seagull tuning movement at grade, however this option is undesirable from a Safe System perspective due to the conflicting right turn movement in a high speed and high traffic volume environment.



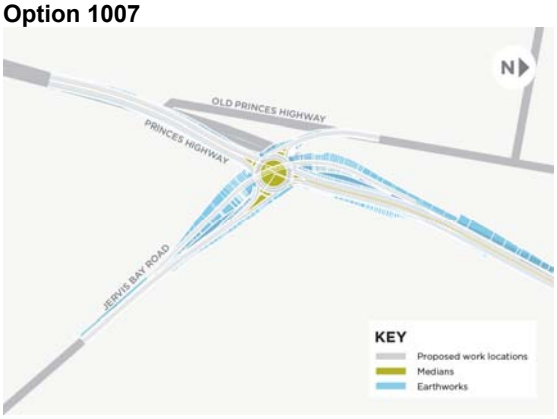
Option 1005

Option 1011A

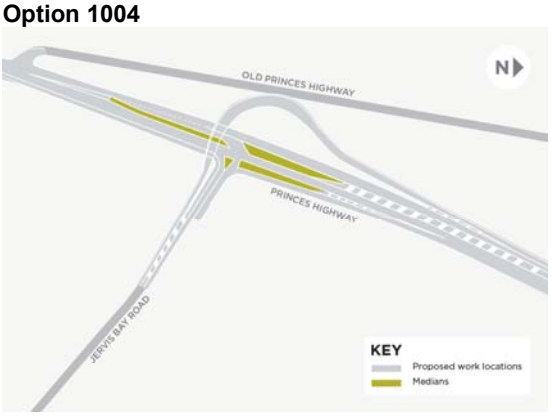


Option 1007

Option 1004



Option 1011B



Option 1012

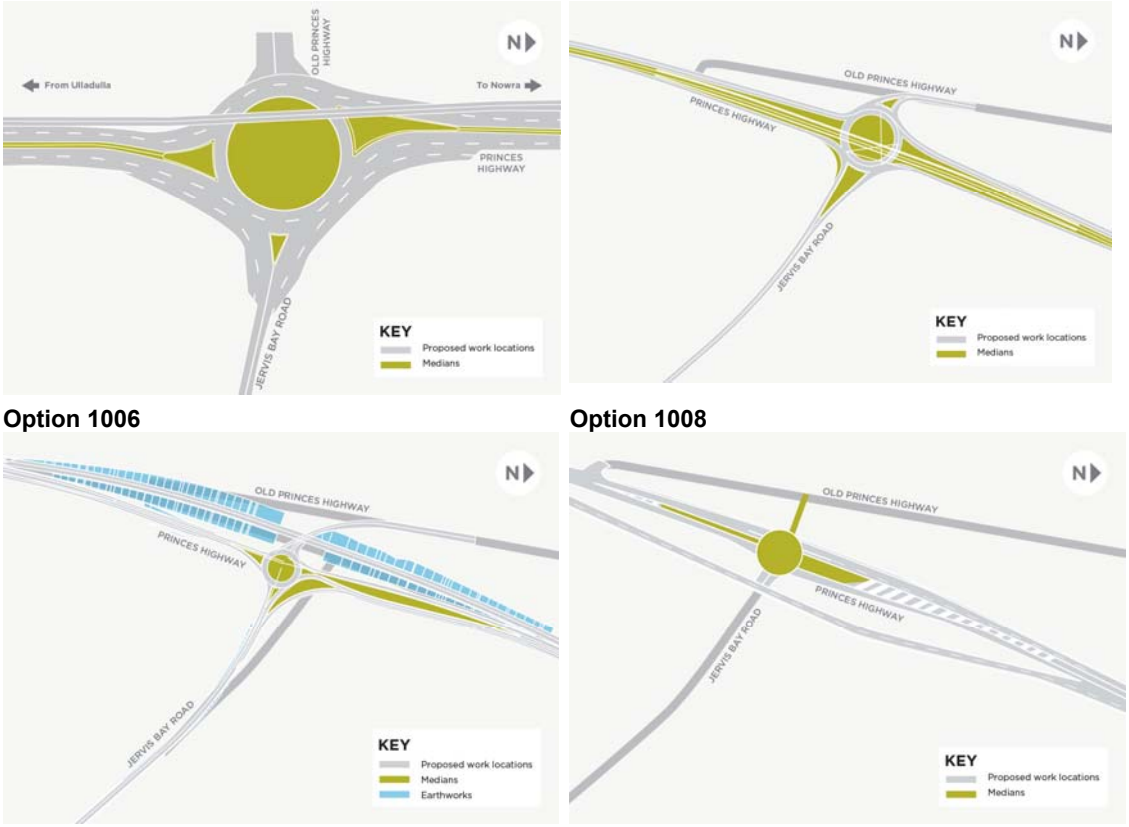
Figure 5-4 Right turn grade separation options

5.3.4 Roundabout with alternative single movement grade separation

Alternative single movement grade separation options were investigated. The grade separated movements included:

- The northbound or southbound Princes Highway traffic crossing over the roundabout (Options 1006, 1008)
- The northbound and southbound traffic offset to cross over the connecting approaches (Options 1013A, 1014).

Examples of alternative single movement grade separation options are shown in Figure 5-5. The separation of only Princes Highway southbound or northbound through traffic from the intersection did not meet traffic performance requirements. It also introduced large diversions for safe cyclist movements around the intersection.



Option 1006 **Option 1008**

Option 1013A **Option 1014**

Figure 5-5 Alternative single movement grade separation options

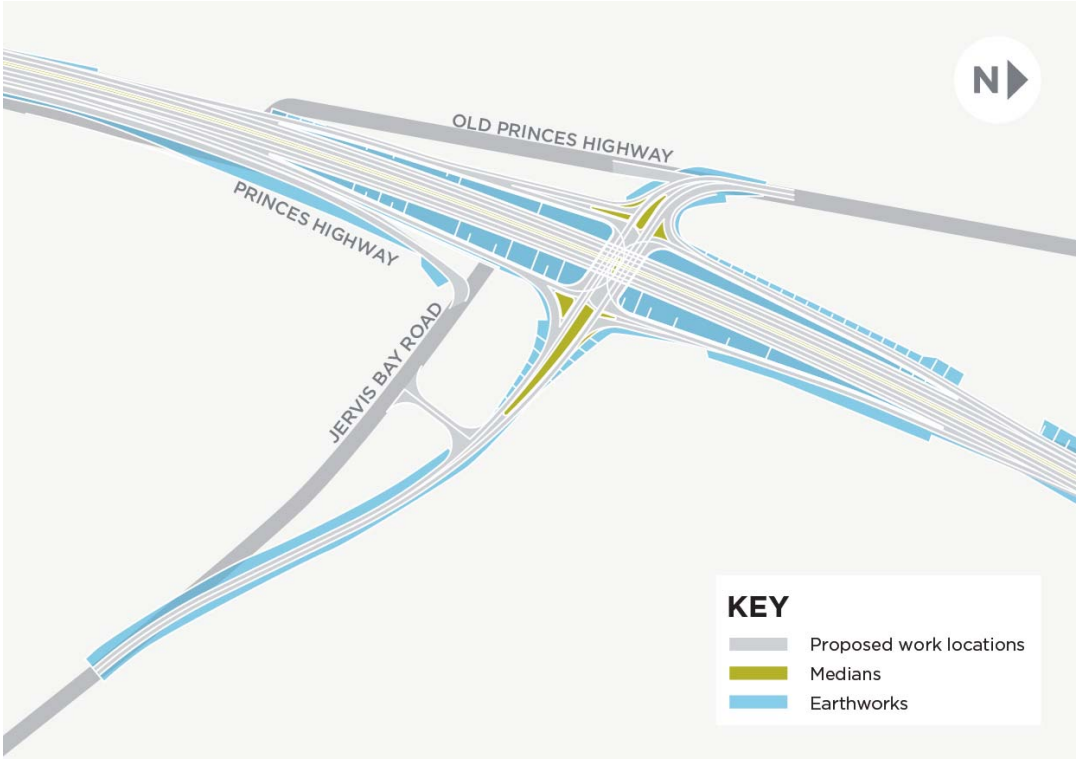
5.3.5 Traditional diamond interchanges

The diamond interchange options provide full grade separation, removing conflicting movements at Jervis Bay Road and the Old Princes Highway for all through traffic on the Princes Highway. Traditional diamond interchange options investigated included Option 2001, 2001A and 2006, as shown in Figure 5-6.

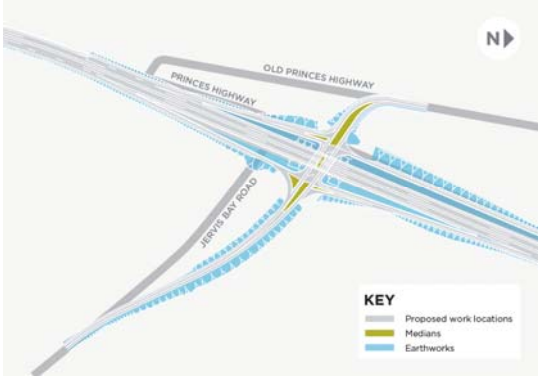
A spread diamond approach was initially considered but not progressed due to its significantly larger footprint. A closed diamond was also investigated, in both and an overpass and underpass arrangement. These options would provide a more compact footprint, however they

would result in conflicting at grade right turn movements where the Princes Highway entry and exit ramps join Jervis Bay Road. These at grade right turn movements are not aligned with the Safe System approach. Other options investigated provided the same movements in a safer arrangement.

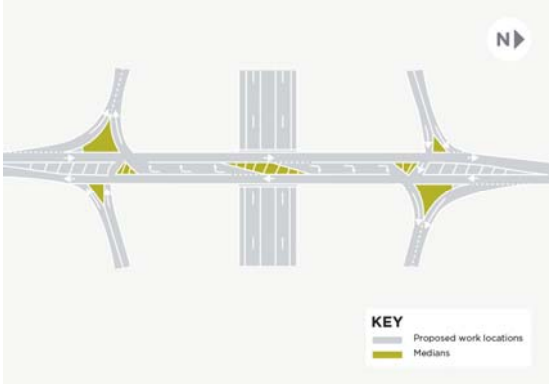
All traditional diamond interchange options were satisfactory for traffic performance.



Option 2001



Option 2001A



Option 2006

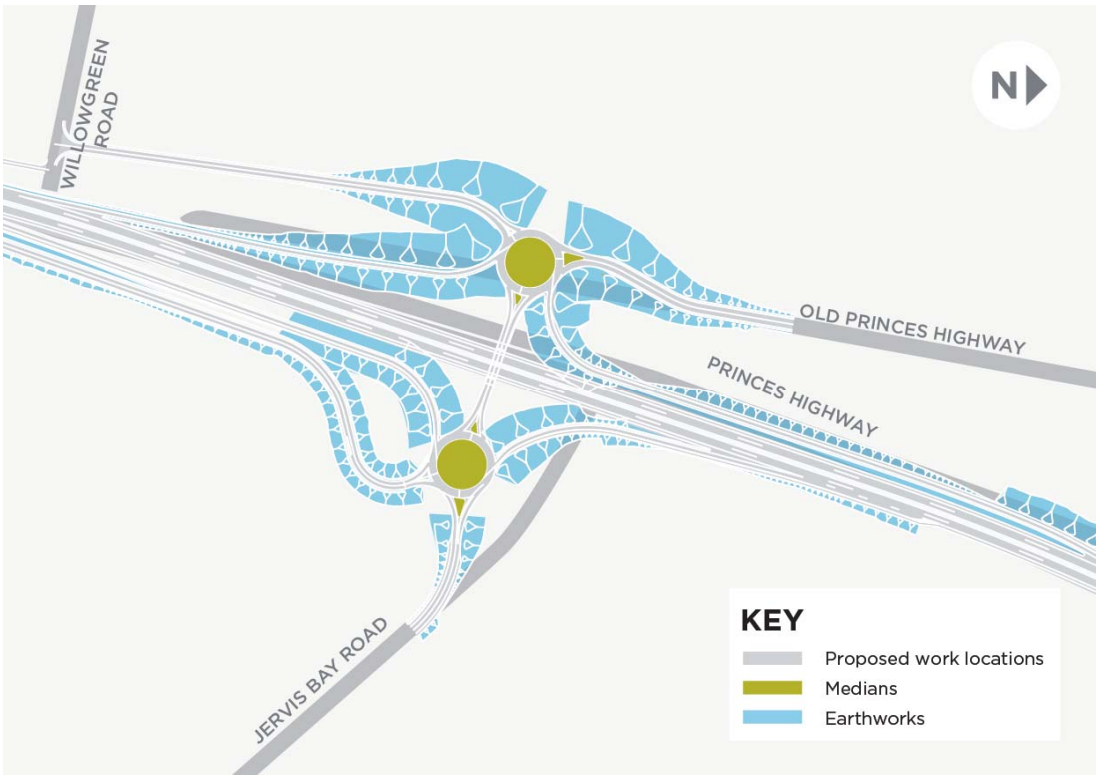
Figure 5-6 Traditional diamond interchange options

5.3.6 Dumbbell interchanges

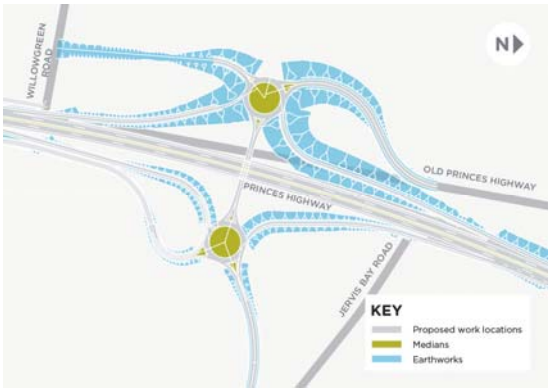
Three dumbbell interchanges (Option 2002, 2002A and 2009) were investigated. These interchanges are known as dumbbell interchanges as they consist of two roundabouts either side of the highway with a connection between the two. The existing Princes Highway is elevated above the adjacent landform through the study area. Options 2002 and 2002A both required large footprints resulting in a larger impact to environmentally sensitive areas and

properties within the investigation area. Option 2009, shown in Figure 5-7 minimised the footprint as the roundabouts could be placed closer together, maximising re-use of the existing road corridor while maintaining the operational benefits. Maintaining the roundabouts at grade with the highway as an overpass resulted in a smaller design footprint, and minimises impacts to environmentally sensitive areas and properties within the investigation area.

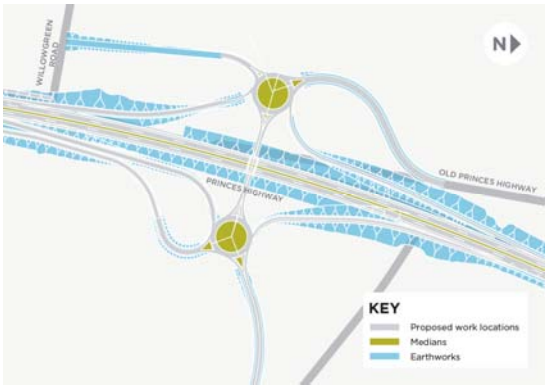
All dumbbell options provide full grade separation of the Princes Highway and would result in satisfactory traffic performance at the intersection.



Option 2009



Option 2002



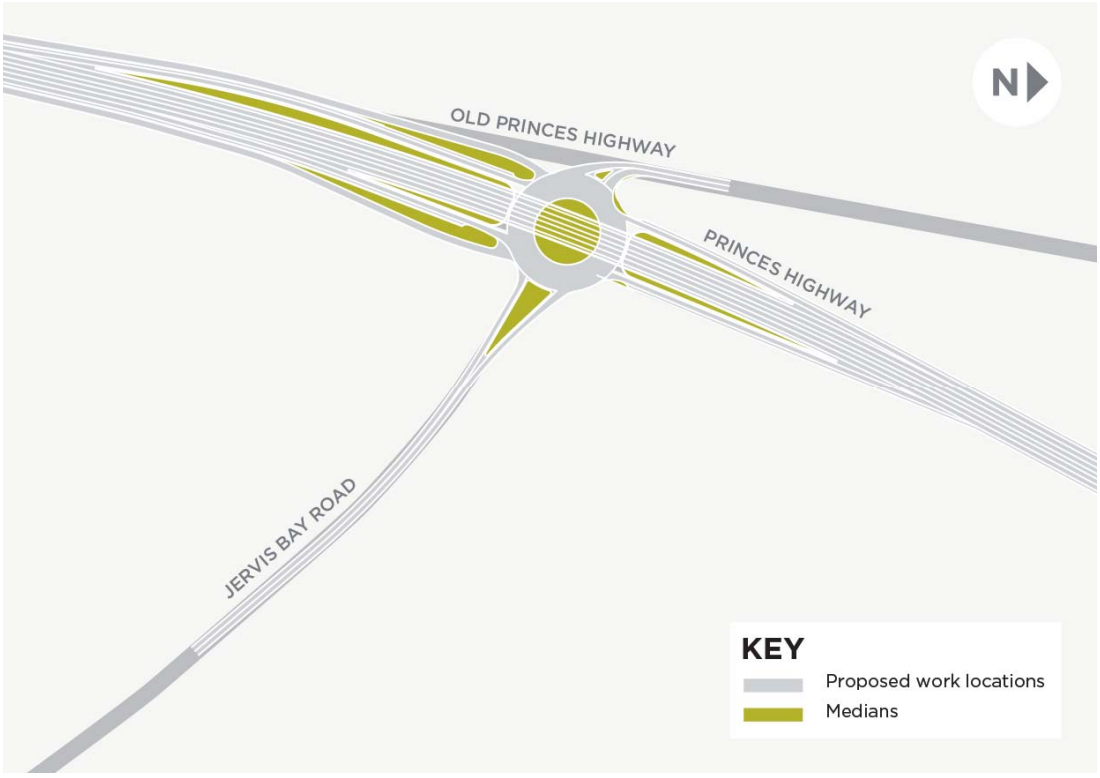
Option 2002A

Figure 5-7 Dumbbell interchange options

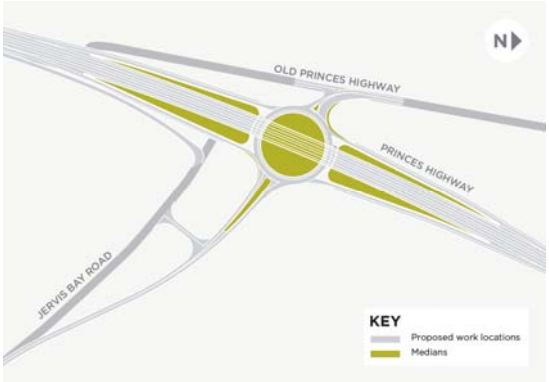
5.3.7 Large roundabout with grade separation

Interchange options consisting of a single large roundabout with the Princes Highway through traffic grade separated were also investigated. This included Options 2003, 2003A and 2005 (shown in Figure 5-8). These options would require larger bridge structures when compared to

other grade separation options, however, like the dumbbell and diamond options, the grade separation means resulted in uninterrupted highway traffic and satisfactory traffic performance at the intersection.



Option 2003



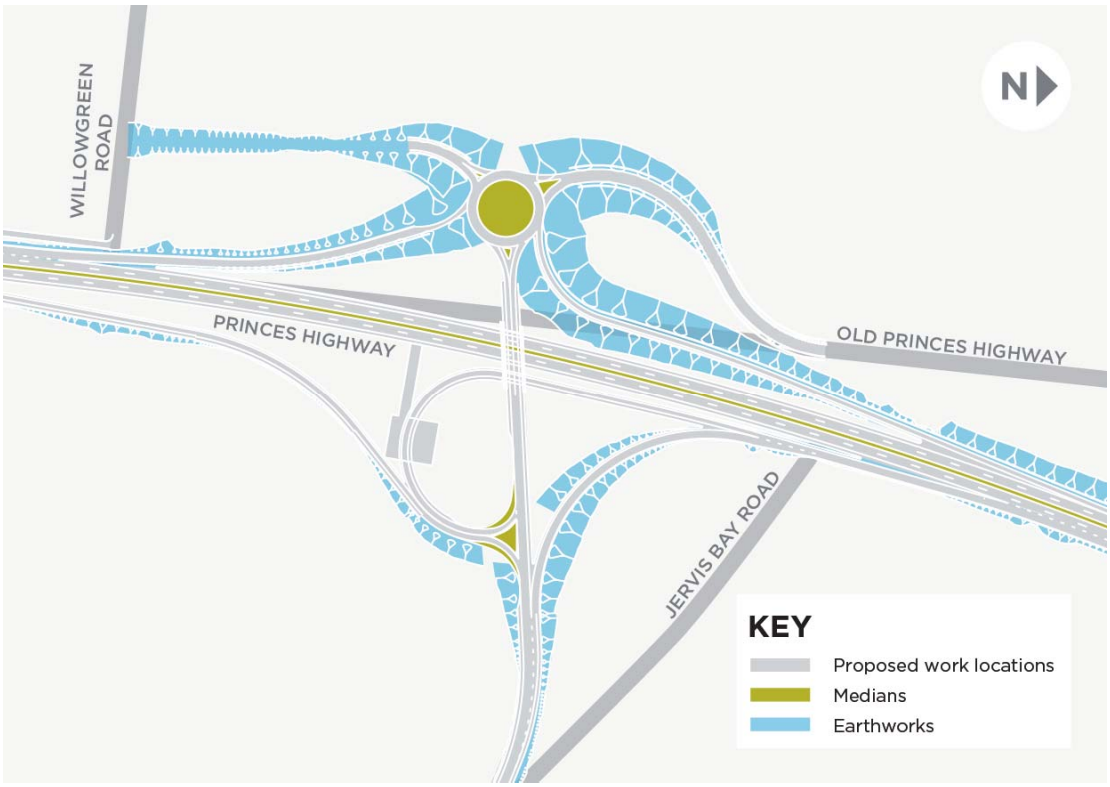
Option 2003A

Option 2005

Figure 5-8 Large roundabout with grade separation options

5.3.8 Alternative grade separations

Alternative grade separation options (Figure 5-9) were investigated to determine if there were any other potential solutions to accommodate all turning movements or safety improvements, such as the incorporation of highway ramp loops to minimise at grade right turn movements at the intersection (Option 2007 and 2008) or to provide multiple levels of grade separation (Option 2010). These options would require additional infrastructure with a significantly larger footprint and associated impacts, while providing a negligible performance benefit.



Option 2007

Option 2008

Option 2010

Figure 5-9 Alternative grade separation options

5.4 Evaluation of long list of options

The long-listed options were evaluated using a fatal flaw and comparative analysis at two internal workshops with project team and key Transport representatives.

5.4.1 Development of “fatal flaw” criteria

Criteria for evaluation of the longlist design options were developed during project team meetings and are aligned to the project objectives (Table 5-1).

Workshop participants agreed that four criteria were treated as “fatal flaws”. If an option failed to address one of these four criteria, it was discarded. Options were considered to fail against a criterion if impacts were unacceptable, and it was determined that impacts could not be

minimised, either through design refinement or mitigation measures, to an acceptable level. The remaining criteria were used to further differentiate and rank the options.

Workshop participants agreed to consider impacts to environmental constraints and property as evaluation criteria where an option caused severe impacts while another option provided the same functionality with less impact.

An additional criterion was added at the first workshop to assess whether impact to a land parcel located on the northern side of Jervis Bay Road could be avoided if required to do so. This land parcel has complex acquisition requirements. Ongoing consultation and investigation will be required to determine whether impacts to this lot would be possible.

The second workshop considered the options that remained following the Fatal Flaw Analysis in comparison to each other, to confirm whether one option provided the same function with less impact and/or complexity than another shortlisted option.

Table 5-1 Fatal flaw analysis criteria

	Area of assessment	In line with project objective	Analysis criteria
Fatal flaws	Function	Objective 1	Does the option provide all movements for the Princes Highway and Jervis Bay Road, including U-turns for Princes Highway traffic? Does the option provide for safe connectivity to the Old Princes Highway?
	Safety		Does the option satisfy the Safe System approach?
	Traffic	Objective 2	Does the option achieve the minimum Level of Service “C” criteria in 2039?
	Active and public transport	Objective 4	Does the option provide the opportunity to enable an increase in the use of public and active transport?
Comparative criteria	Environment	Strategic Priority 4	Are the environmental impacts considered acceptable for this option?
	Property		Are the impacts to the Falls Creek community considered acceptable for this option?
Added at first workshop	Property	Strategic Priority 4	Can the land parcel north of Jervis Bay Road with complex acquisition requirements likely be avoided?
Added at second workshop	Function		Is there no other option that achieves the same function with less impact and/or complexity?

5.4.2 Workshop 1 – fatal flaw analysis

An initial workshop was held on 27 July 2020 attended by project team and key Transport representatives. The aim of the workshop was to rule out any options that were “fatally flawed” against the criteria in Table 5-1 and confirm the shortlist of options for progression to further design development and investigation.

Options were divided into two categories: roundabout options and grade separated options. Workshop participants assessed each longlist option against the fatal flaw criteria which assisted to inform whether the option would be retained for further assessment. Table 5-2 and Table 5-3 provide the results of the fatal flaw analysis.

Following the first workshop, there were three[1] roundabout options and four grade separated options remaining for further evaluation in the second workshop.

[1] Five options were retained at the first workshop, however the workshop participants agreed to combine options 1004, 1011A/B and 1007 and optimise one roundabout with right-turn flyover option.

Table 5-2 Roundabout options analysis

Fatal flaw analysis criteria	Roundabout options													
	1001	1002	1004	1005	1006	1007	1008	1009	1010	1011 A/B	1012	1013	1013 A	1014
Does the option provide all movements for the Princes Highway and Jervis Bay Road, including U-turns for Princes Highway traffic? Does the option provide for safe connectivity to the Old Princes Highway?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Does the option satisfy the Safe System approach?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Does the option achieve the minimum Level of Service "C" criteria in 2039?	✗	✗	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	✗
Does the option provide the opportunity to enable an increase in the use of public and active transport?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓
Are the environmental impacts considered acceptable for this option?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Are the impacts to the Falls Creek community considered acceptable for this option?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Can the land parcel north of Jervis Bay Road with complex acquisition requirements likely be avoided?	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓
Retained?	**No**	**No**	**Yes***	**Yes**	**No****		**No**	**No**	**No**	*	**No**	**No**	**Yes**	**No**

* The workshop agreed to adopt a single roundabout with right-turn flyover option based on an optimised arrangement of options 1004, 1011A/B, 1007.

** Option 1006 provides the same functionality as option 1013A but with a considerably longer structure. The workshop agreed to only progress option 1013A.

Table 5-3 Grade separated options analysis

Fatal flaw analysis criteria	Grade separated options											
	2001	2001A	2002	2002A	2003	2003A	2005	2006	2007	2008	2009	2010
Does the option provide all movements for the Princes Highway and Jervis Bay Road, including U-turns for Princes Highway traffic? Does the option provide for safe connectivity to the Old Princes Highway?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Does the option satisfy the Safe System approach?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Does the option achieve the minimum Level of Service "C" criteria in 2039?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Does the option provide the opportunity to enable an increase in the use of public and active transport?	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✗
Are the environmental impacts considered acceptable for this option?	✓	✓	✗	✗	✓	✓	✓	✗	✗	✗	✓	✓
Are the impacts to the Falls Creek community considered acceptable for this option?	✓	✓	✗	✗	✓	✓	✓	✗	✗	✗	✓	✓
Can the land parcel north of Jervis Bay Road with complex acquisition requirements likely be avoided?	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	TBC	✓
Retained?	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**Yes**	**No**

5.4.3 Workshop 2 – comparative analysis

A second workshop was held on 30 July 2020 attended by project team and key Transport representatives. The aim of the workshop was to review and compare the remaining options against one another, and assess each option against the additional criterion:

- Is there no other option that achieves the same function with less impact and/or complexity?

The following sections summarise the comparative analysis.

At grade roundabout with right turn overpass (Option 1004) versus underpass (Option 1005)

The comparison between a right turn overpass and right turn underpass is presented in Table 5-4.

Workshop participants agreed to take both options were taken forward for further design development and investigation at this stage. Should 1 in 100-year flood immunity not be achievable for the underpass (Option 1005), this option would be discarded prior to the Value Management Workshop.

Through further design development, it became apparent that the potential flood immunity issue can be addressed through engineering solutions. Workshop participants agreed that the underpass would need to achieve free draining functionality (i.e. avoid the need for a sump pump) to meet operational and maintenance requirements.

Table 5-4 Option 1004 vs Option 1005 comparative analysis

Criteria	Option 1004 (overpass)	Option 1005 (underpass)
Visual Impact	More obtrusive structure	Concealed underpass
Structure	Longer, potentially more complex structure	Shorter, potentially more simple structure/s
Constructability	Potentially less constructability issues to be overcome. Structure construction completed following traffic switch onto new roundabout	Potentially more constructability issues to be overcome. Partial structure construction offline prior to traffic switch onto new roundabout. Complete of structure construction following traffic switch.
Flood immunity	Achieves flood immunity	Achieves flood immunity only with engineering solution or refinement of design option.

At grade roundabout with Princes Highway grade separation northbound only (Option 1013A) versus northbound (NB) and southbound (SB) (Option 2005)

The comparison between the Princes Highway northbound only grade separation versus northbound and southbound grade separation is presented in Table 5-5.

Considering functionality and safety, the workshop participants considered Option 2005 far superior to Option 1013A.

Table 5-5 Option 1013A vs Option 2005 comparative analysis

Criteria	Option 1013A (NB grade separated)	Option 2005 (NB and SB grade separated)
Structure	Shorter, potentially more simple structure/s	Longer, potentially more complex structure
Performance	Maintains northbound Princes Highway at 100km/h only.	Maintains northbound and southbound Princes Highway at 100km/h. Improved freight efficiency.
Safety - vehicles	Potentially more safety issues to be overcome. Right hand diverge from Princes Highway to access Jervis Bay Road and slower northbound entry ramp traffic operating speed joining Princes Highway through traffic as an added fast lane.	Potentially less safety issues to be overcome. Standard merge/diverge arrangement
Safety - active transport	Potentially more safety issues to be overcome. Northbound cyclists would need to bypass the full length of the intersection.	Potentially less safety issues to be overcome. Standard roundabout access arrangement and less traffic as all through movements on the Princes Highway are removed from the at-grade intersection.

At grade roundabout with Princes Highway grade separation (Option 2005) versus fast diamond options over (Option 2001) and under (Option 2001A)

The comparison between a roundabout with Princes Highway grade separation options versus fast diamond options is presented in Table 5-6.

The options performed similarly with regard to footprint and noise impacts. Based on the functionality and safety of the options, the workshop participants considered an at-grade roundabout (Option 2005) superior to the fast diamond options, while also noting that the fast diamond options would present more complex constructability issues.

Table 5-6 Option 2005 vs Option 2001A/B comparative analysis

Criteria	Option 2005 (Roundabout with Princes Highway grade separated)	Option 2001/2001A (Closed diamond)
Structure	Longer, potentially more complex structure	Longer, potentially more complex structure for Princes Highway overpass. Shorter, potentially less complex structure for Jervis Bay Road overpass
Performance	Maintains Princes Highway at 100km/h	Maintains Princes Highway at 100km/h. Potential that a signalised intersection

Criteria	Option 2005 (Roundabout with Princes Highway grade separated)	Option 2001/2001A (Closed diamond)
		would be required at ramp connections to Jervis Bay Road for safety reasons due to conflicting vehicle movements and higher impact angles.
Safety -vehicles	Potentially less safety issues to be overcome. All conflict points at 45-degree angle through roundabout. Most dominant movements removed from roundabout due to Princes Highway overpass	Potentially more safety issues to be overcome. Conflicting right turn movements at ramp connections to Jervis Bay Road. Most dominant movements removed due Princes Highway overpass or Jervis Bay Road overpass.
Safety - active transport	Standard arrangement for at grade roundabout. Less traffic as all through traffic is bypassed	Potentially more safety issues to be overcome. Conflicting right turn movements on Jervis Bay Road for cyclists to and from Princes Highway. Pedestrians and cyclists along Old Princes Highway to Jervis Bay Road would cross at un-signalised or potentially signalised intersection
Footprint	Similar footprint to fast diamond	Similar footprint to roundabout with Princes Highway grade separation
Constructability	Potentially less constructability issues to be overcome. Design can be optimised to move roundabout and mainline offline to improve constructability.	Potentially more complex constructability issues to be overcome. Option 2001 undercuts the existing Princes Highway pavement by 4.5 metres to facilitate connection to the Old Princes Highway. Raising the alignment to avoid undercutting would lead to extensive impacts along the Old Princes Highway. Option 2001A lifts the existing Princes Highway pavement by 4.5 metres to facilitate Jervis Bay Road passing underneath without lowering it further than existing Old Princes Highway levels. This, together with building an underpass across the Princes Highway, would require extensive traffic diversions.
Multi-modal transport connectivity	Potential opportunity for future provision of multi-modal interchange facilities near the roundabout.	Potentially less opportunity for future provision of multi-modal interchange facilities near the roundabout.

Modified dumbbell (Option 2009)

The workshop participants agreed that Option 2009 would be the only dumbbell option to be shortlisted, due to the significantly larger footprint and associated environmental and property impacts of the other dumbbell options. Workshop participants noted that Option 2005 is similar

to Option 2009 in terms of functionality and safety, and potentially fewer constructability challenges and less complex bridge structure.

5.4.4 Final shortlisting evaluation

Table 5-7 summarises the final evaluation of the seven shortlisted options. This evaluation considered both the fatal flaw analysis conducted in the first workshop and the comparative analysis conducted in the second workshop.

Table 5-7 Final shortlisting evaluation

Fatal flaw analysis criteria	Roundabout options			Grade separated options			
	1004	1005	1013 A	2001	2001 A	2005	2009
Does the option provide all movements for Princes Highway, Jervis Bay Road and the Old Princes Highway?	✓	✓	✓	✓	✓	✓	✓
Does the option satisfy the safe systems approach?	✓	✓	✓	✓	✓	✓	✓
Does the option achieve minimum Level of Service criteria in 2039?	✓	✓	✓	✓	✓	✓	✓
Does the option provide the opportunity to enhance the use of public and active transport?	✓	✓	✓	✓	✓	✓	✓
Are the environmental impacts considered acceptable for this project?	✓	✓	✓	✓	✓	✓	✓
Are the impacts to the Falls Creek community considered acceptable for this project?	✓	✓	✓	✓	✓	✓	✓
Can the land parcel north of Jervis Bay Road with complex acquisition requirements likely be avoided?	✓	✓	✓	✓	✓	✓	✓
Is there no other option that achieves the same function with less impact/ complexity?	✓	✓	✗	✗	✗	✓	✓
Retained?	**Yes**	**Yes**	**No**	**No**	**No**	**Yes**	**Yes**

5.4.5 Recommended short-listed options

The final shortlist options shortlisted for further design development and investigation, and evaluation at the Value Management workshop were:

- Option 1004 - Roundabout with right turn flyover
- Option 1005 - Roundabout with right turn underpass
- Option 2005 - Mainline grade separated over at-grade roundabout

- Option 2009 - Modified dumbbell.

5.5 Development of short-listed options

The four shortlisted options were further investigated and developed to enable a comparative assessment of the options during the value management workshop. Further design details and features were developed and the intersection options were optimised to avoid the land parcel north of Jervis Bay Road with complex acquisition requirements, review and minimise the design footprint and impacts to key constraints, and to improve constructability. Figure 5-10 shows the layout of the shortlisted options that were assessed during the value management workshop.

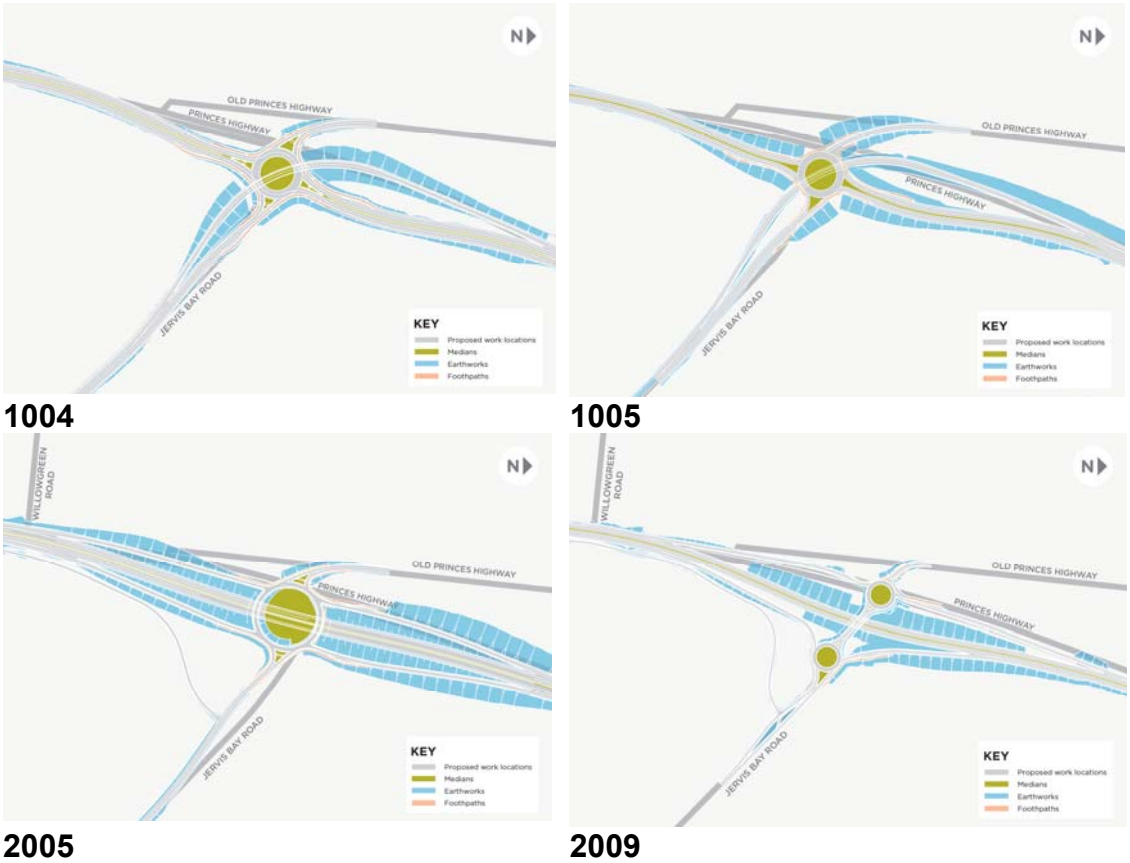


Figure 5-10 Developed short-listed options: Option 1004; Option 1005; Option 2005; and Option 2009

5.5.1 Development of Key Result Areas

Key Result Areas (KRA's) were developed for each objective by the project team and confirmed during a project objectives workshop held on 22 July 2020 attended by key Transport representatives. KRA's represent the various factors that contribute to a design solution meeting the objectives and are established for the purpose of measuring, either qualitatively or quantitatively, how well a design solution meets each objective. The KRA's are presented in Table 5-8.

Table 5-8 Key Results Areas

Objective	Key Result Area (KRA)
1. Improve safety at the intersection	1.1 Improve operational safety at the intersection
	1.2 Ensure safe construction and maintenance of the intersection
2. Improve transport network efficiency and connectivity to support regional economic development, tourism and freight	2.1 Improve traffic efficiency and reduce travel times during weekday peak periods
	2.2 Improve traffic efficiency and reduce travel times during holiday peak periods
	2.3 Improve arrangements for freight
	2.4 Improve access and connectivity for the community
3. Improve transport network resilience	3.1 Improve resilience to unexpected peaks, unexpected future traffic growth and land use changes
	3.2 Improve resilience to major flood events
	3.3 Improve resilience to bushfire emergencies
	3.4 Improve resilience to major traffic incidents within the intersection
4. Support an increase in active transport (walking and cycling) and use of public transport	4.1 Support an increase in active transport by improving accessibility and connectivity
	4.2 Support an increase in public transport use by improving accessibility and facilities
	4.3 Provide opportunity to support other mode shifts
Strategic Priority 4 from the TfNSW Corporate Plan 2018-2021: Respect our community and the environment	5.1 Minimise disruption to the community through the construction phase
	5.2 Minimise impact on biodiversity
	5.3 Minimise aboriginal heritage impacts
	5.4 Minimise non- aboriginal heritage impacts
	5.5 Minimise property impact
	5.6 Minimise noise and air quality impacts
	5.7 Minimise business impact
	5.8 Provide a sustainable solution
	5.9 Minimise landscape character and visual impact
Strategic Priority 1 from the TfNSW Corporate Plan 2018-2021: Increase customer value	6.1 Provide value for money

5.5.2 Additional investigations

Additional investigations were undertaken that informed evaluation and comparative assessment of the short-listed options during the value management workshop, as described below.

Safe System Assessment

An assessment was undertaken using the framework as described in Section 3.2.6 to aid comparison of the options from a transport safety perspective. A score was generated for the baseline, or “do-nothing”, case and for each of the four shortlisted options. Overall, the full grade separated options (Option 2005 and 2009) performed better than the roundabout with right turn grade separation options (Options 1004 and 1005), and Option 2009 performed slightly better than 2005 from a Safe System perspective.

Constructability and Health & Safety in Design Workshop

A combined Constructability and Health and Safety in Design (HSiD) workshop was held on 26 August 2020 with a range of project team, technical and subject matter expert representatives.

The objective of the Constructability Workshop was to identify and evaluate constructability issues and challenges associated with each of the design options and ensure all features can be constructed and maintained safely, efficiently and practically while meeting project objectives and complying with statutory requirements.

In the workshop, the following items were considered:

- Programme and construction staging
- Widening works
- Site investigations
- Earthworks and pavements
- Stormwater drainage
- Utility adjustments
- Bridge and other structures.

A review of the categories above was undertaken by the workshop participants to establish the various constructability challenges, issues and risks associated with the four shortlisted design options. Subject matter experts discussed the challenges and opportunities for each option and provided a recommended score against each constructability assessment criteria. The recommended scores were discussed by the workshop participants and a consensus score was reached for each options for each category.

At the conclusion of scoring, workshop participants agreed that Option 2009 provided the least constructability challenges and risks on balance when considered against the other design options.

The purpose of the HSiD Workshop was to identify safety hazards for persons carrying out construction, maintenance and operation of the shortlisted options (using a whole-of-life cycle approach) while also considering the various user groups at the intersection. Following identification of the safety hazards, workshop participants identified the likely level of control measures available for implementation to either eliminate, or mitigate the hazard.

In the workshop, the following categories were considered:

- Site topography
- Site geology
- Contamination
- Utilities
- Ease of construction
- Proximity to human activity
- Tie-ins to existing roads
- Maintenance and operations.

A review of the categories identified above was undertaken by the workshop participants. The potential hazards were categorised and ranked based on the ability to implement control measures to eliminate or mitigate hazards so far as reasonably practicable.

At the conclusion of scoring, workshop participants agreed that Option 2009 was found to perform the best against the identified hazard categories, with key factors such as improved construction staging opportunities for Option 2009 being identified.

Traffic and Transport Assessment

A traffic and transport assessment was undertaken to analyse existing traffic data and assess the existing traffic and transport conditions. Based on this data analysis and a review of available growth data, future demands where forecast to test the traffic performance of the shortlisted intersection options.

The Value Management Workshop scoring was informed by the future do nothing assessment, and an assessment of the shortlisted design options, including a sensitivity assessment for holiday peaks. The results of this study were used to establish comparative scoring of each shortlisted design option against the relevant KRAs. A degree of saturation modelling check was also undertaken as an input to inform the intersection resilience scoring.

Traffic modelling results showed that an at-grade roundabout would not provide an acceptable level of service for forecast future traffic volumes at the intersection and that the grade separation of at least one key turning movement was required.

For further details on the outcomes of this study please refer to Section 3.2.

Flood Study

Flood modelling was undertaken of the Parma Creek catchment area upstream of the Princes Highway to provide information on creek flows and backwater flooding. The modelling indicates that, under existing conditions, backwater flooding affects up to 400 metres of the Princes Highway embankment. This is consistent with flood-prone land identified by the Shoalhaven LEP (described in Section 3.3.5).

The flood study also identified a potentially undersized existing culvert that could lead to overtopping of both the Princes Highway and Jervis Bay Road in the event of a one in 100-year flood event. This constraint, and the potential culvert upgrade requirement, was considered during the Value Management Workshop.

Landscape Character and Visual Impact

A preliminary urban design assessment of the four shortlisted options was undertaken to inform the value management process. Three landscape character zones (LCZ) were defined within (and surrounding) the study area:

- LCZ 1 Rural residential – south and southwest area of the study area, consistent with the Shoalhaven LEP zoning (as described in Section 3.3.8)
- LCZ 2 Mixed use – west area of the study area, comprising smaller lots with residential dwellings and commercial properties
- LCZ 3 Bushland – north and northeast area of the study area, as well as a small patch to the west, characterised by continues tree canopy and understory.

Each shortlisted option was assessed against a set of urban design criteria established to consider the landscape character and visual impact, connectivity and impact to existing land uses associated with each option. The assessment identified that Option 1004 would likely have the least landscape character and visual impact when conspired against the urban design criteria. This findings of this assessment were considered during the value management Workshop.

Biodiversity

A preliminary estimate of vegetation clearing required for each of the four shortlisted options was prepared. Each option would impact on two native vegetation plant community types, as described in Section 3.3.1. Option 1004 would result in the least area of impact on native vegetation, while Option 2009 would likely have the largest area of impact.

Noise

A preliminary qualitative noise assessment was undertaken to assess each of the shortlisted intersection upgrade options against the existing conditions. This assessment was undertaken based on the following criteria:

- Change in elevation (m) relative to the existing road
- Change in proximity to sensitive receivers (m) relative to the existing road

These two criteria were used as an input for both a qualitative noise assessment and an estimated change in noise levels at the identified noise receivers. Preliminary findings indicate that Option 1004 would likely have the lowest additional impact to noise levels while Option 2009 may have the largest impact with respect to changes in noise levels, however the slowing and accelerating of vehicle through the intersection may influence this outcome. Further noise investigation and assessment will be undertaken as part of the environmental assessment for the project.

5.5.3 Value Management Workshop

A Value Management Workshop was held on 15 September 2020 with a range of project team representatives, technical specialists and additional subject matter experts from Shoalhaven City Council, NSW Police and the Department of Planning, Industry and Environment. The purpose of this workshop was to undertake a multi-criteria analysis of each of the four short-listed options and agree on a recommended preferred option to be taken for further design development, investigation and assessment.

During the workshop, an overview of the proposal background and recent investigations and development activities was presented. The proposal objectives were also presented for review and confirmation by workshop participants. A summary of key environmental and engineering constraints, the options investigation phase and the shortlisting process was presented and the four shortlisted options were reviewed and discussed in more detail.

Subject matter experts presented results of investigations undertaken for the shortlisted design options with respect to each key result area. Workshop participants reviewed and discussed the investigation results for each option and comparatively assessed how each shortlisted option performed against the respective KRA. The workshop group scored each shortlisted option from one to 10, with one indicating poor performance and 10 indicating optimal performance against each KRA. This evaluation process enabled a relative ranking of each design option against each KRA. A ranking of one indicates the best option comparatively when aligned to the KRA, and a ranking of four indicates the worst option comparatively.

Table 5-9 summarises the comparative assessment results.

Table 5-9 Value management workshop multi-criteria analysis KRA rankings

Objective	Key Result Area (KRA)	Ranking 1 = indicates the best option comparatively 4 = indicates the worst option comparatively			
		1004	1005	2005	2009
1. Improve safety at the intersection	1.1 Improve operational safety at the intersection	3	3	2	1
	1.2 Ensure safe construction and maintenance of the intersection	3	3	2	1
2. Improve transport network efficiency and connectivity to support regional economic development, tourism and freight	2.1 Improve traffic efficiency and reduce travel times during weekday peak periods	3	3	2	1
	2.2 Improve traffic efficiency and reduce travel times during holiday peak periods	2	2	1	1
	2.3 Improve arrangements for freight	2	2	1	1
	2.4 Improve access and connectivity for the community	2	2	1	1
3. Improve transport network resilience	3.1 Improve resilience to unexpected peaks, unexpected future traffic growth and land use changes	3	3	1	2
	3.2 Improve resilience to major flood events	1	2	1	1
	3.3 Improve resilience to bushfire emergencies	4	3	2	1
	3.4 Improve resilience in major traffic incidents within the intersection	2	2	1	1
4. Support an increase in active transport (walking and cycling) and use of public transport	4.1 Support an increase in active transport by improving accessibility and connectivity	3	4	2	1
	4.2 Support an increase in public transport use by improving accessibility and facilities	2	2	1	1
	4.3 Provide opportunity to support other mode shifts	2	2	1	1

Objective	Key Result Area (KRA)	Ranking 1 = indicates the best option comparatively 4 = indicates the worst option comparatively			
		1004	1005	2005	2009
Strategic Priority 4 from the TfNSW Corporate Plan 2018-2021: Respect our community and the environment	5.1 Minimise disruption to the community through the construction phase	2	3	4	1
	5.2 Minimise impact on biodiversity	2	2	3	1
	5.3 Minimise aboriginal heritage impacts	1	1	2	2
	5.4 Minimise non- aboriginal heritage impacts	Not scored[2]			
	5.5 Minimise property impact	1	2	3	2
	5.6 Minimise noise and air quality impacts	1	2	2	3
	5.7 Minimise business impact	Not scored[3]			
	5.8 Provide a sustainable solution	Not scored[4]			
	5.9 Minimise landscape character and visual impact	1	2	3	4
Strategic Priority 1 from the TfNSW Corporate Plan 2018-2021: Increase customer value	6.1 Provide value for money	1	2	4	3

[2] Investigations at the time of the Value Management Workshop found no non-aboriginal heritage items within the study area. As there was means for differentiation, the KRA was not scored.

[3] Business access to commercially zoned properties is improved for all options to a similar degree. The attendees agreed not to score the KRA due to lack of differentiation.

[4] It was agreed by workshop participants that, while this KRA had been identified at the objectives workshop, it would not be scored. Participants noted that sustainability does not just measure material impacts, such as embodied carbon, but is a holistic measure of all impacts and benefits of a project. As such the value management assessment process is essentially a tool to ensure a sustainable solution is recommended for the project and a specific KRA would not capture any factors not already considered in the scoring of other KRAs.

5.5.4 Sensitivity analysis

Following the comparative assessment and scoring process for each of the options against each KRA, a sensitivity analysis was completed to inform the workshop participant's recommendation of a preferred option. The sensitivity analysis process included testing a series of scenarios where project objectives were assigned different weightings to determine the ranking of the options based on the adjusted weighted scores for each the scenarios. A ranking of '1' means the option is the best performing of the four options in that sensitivity test scenario, with a rank of '4' means the option is the worst performing for that scenario.

The initial scenario was to consider all objectives with an equal weighting, irrespective of the number of KRA's associated with each objective. The next scenario tested the relative ranking with all KRA's assigned and equal weighting and therefore objectives with more KRA's would be have a higher weighting when compared to objectives with less KRA's. Workshop participants were invited to nominate a range of scenarios that assigned different relative objective weightings as part of the sensitivity analysis.

The sensitivity analysis results for the weighting scenarios considered during the workshop are presented in Table 5-10.

Table 5-10 Sensitive analysis results

Test Number and Description	Option 1004	Option 1005	Option 2005	Option 2009
001 - All Objectives Equal	3	4	2	1
002 - All KRAs Equal	3	4	2	1
003 - Traffic x2	3	4	2	1
004 - Value for Money x2	2	4	3	1
005 - Safety x2	3	4	2	1
006 - Safety x3	3	4	2	1
007 - Safety x2 Traffic x2	3	4	2	1
008 - Enviro x2	3	4	2	1
009 - Enviro x3	2	4	3	1
010 - Value for Money x0	3	4	2	1
011 - Value for Money x3	2	3	4	1
012 - Value for Money x4	2	3	4	1
013 - Value for Money x5	2	3	4	1
014 - Enviro x2 Value for Money x2	2	4	3	1

Test Number and Description	Option 1004	Option 1005	Option 2005	Option 2009
015 - Safety x3 Traffic x2 Value for Money x7	2	3	4	1
016 - Safety x3 Traffic x2 Value for Money x7 (2009 Value for money lowered to 5)	1	3	4	2
017 - Safety x3 Traffic x2 Value for Money x5 (2009 Value for money lowered to 5)	1	3	4	2
018 - Safety x3 Traffic x2 Value for Money x4 (2009 Value for money lowered to 5)	2	4	3	1

The first 15 scenarios were based on different weighting of the various objectives to represent different perspectives held by workshop participants. All 15 scenarios identified Option 2009 as the highest ranking, or best performing, option.

A workshop participant challenged the team to identify the value threshold at which Option 2009 ceased to be the best performing option. The last three scenarios considered the impact of reducing the value for money assessment score assigned earlier in the workshop to review if that would have an impact on the ranking of Option 2009. The Safety and Traffic Objectives were assigned a relative weighting of three and two times more than the other objectives to recognise that a safer and more reliable intersection is the priority for this project. This sensitivity test identified that the Value for Money objective would need to be weighted five times higher than the other objectives for Option 2009 to no longer be the highest ranking or best performing option.

5.6 Identification of a recommended option

Following completion of the multi-criteria analysis assessment, sensitivity analysis and discussion amongst workshop attendees, workshop attendees reached a consensus that recommended that Option 2009 (Figure 6-1) best satisfied the proposal objectives and the purpose of the proposal.

Option 2009 was recommended as the preferred option as it provides, on balance, the best performing safety and transport network efficiency improvements, allowing for uninterrupted through movements for northbound and southbound Princes Highway traffic and significantly improve intersection performance for both Princes Highway and Jervis Bay Road traffic. Option 2009 also provides improved transport network resilience and safer provisions for active and public transport.

Workshop participants noted that while Option 2009 would result in potentially greater environmental impact due to a larger footprint and higher visual impact, the improvements to intersection safety, both during construction and operation, as well as improvements to traffic efficiency, resilience and connectivity were considered to best address the project objectives and service needs.

6. Recommended option

Following an extensive option investigation and assessment process for the Jervis Bay Road and Princes Highway intersection, a preferred option for the project has been identified. The preferred option, Option 2009, is considered to best meet the project objectives for a safer, more reliable and resilient intersection. The layout and key features of the preferred option are shown in Figure 6-1

Option 2009, the modified dumbbell option, would include the following features:

- Two lanes each way of uninterrupted highway traffic, with a raised road level and short bridge for highway traffic across Jervis Bay Road.
    - The new highway corridor would be east of the existing highway
- Roundabouts on either side of the intersection to further reduce the likelihood of accidents and improve connectivity for all transport users with local roads and the highway entry and exit lanes.
    - The two roundabouts would be a similar level to the existing road levels to reduce the design footprint and improve construction staging.
    - The western intersection would be located near the existing highway intersection to reduce property impacts and provide safe access to the Old Princes Highway.
- Longer entry and exit lanes on and off the highway would improve safety and efficiency and reduce congestion.
- Access to Willowgreen Road via a new section of road connected to the Old Princes Highway.

Transport are investigating the following items to identify further design features for the preferred option:

- Access for properties on the Princes Highway and Jervis Bay Road.
- Improved services and facilities for pedestrians, cyclists and public transport users

Details of these investigations and design features will be available in the concept design and environmental assessment, which will be placed on display for community feedback in 2021.

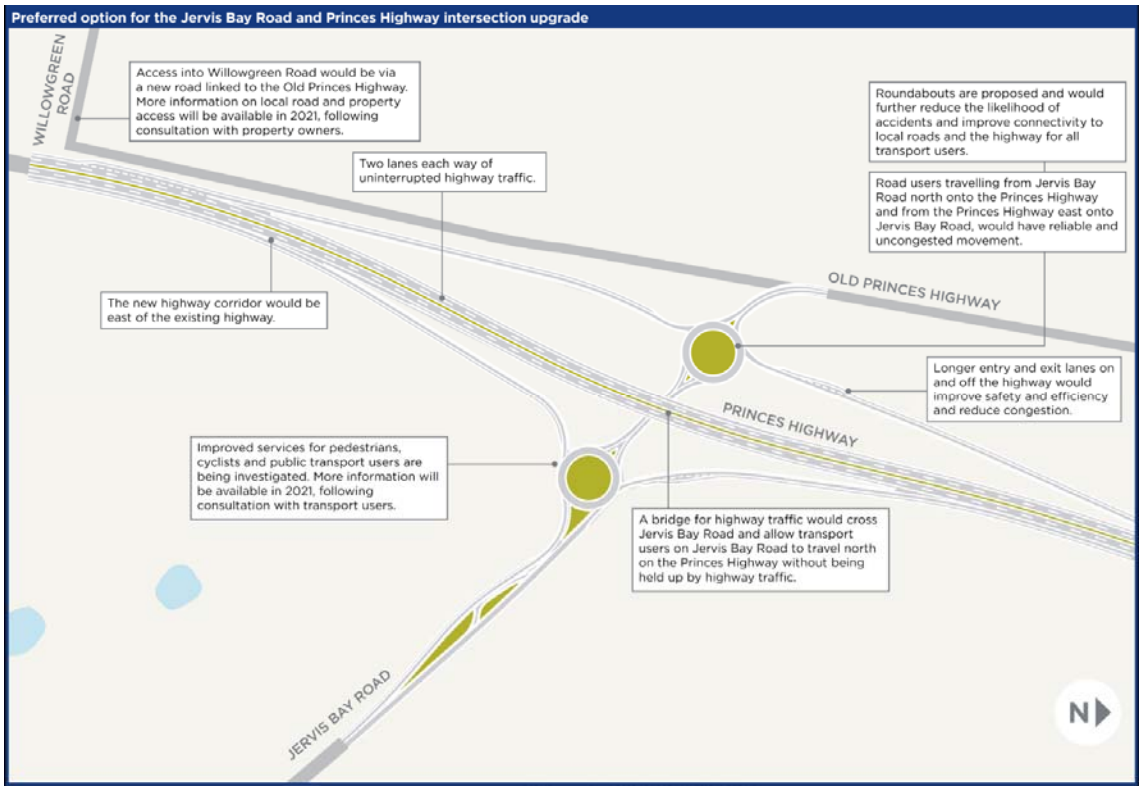


Figure 6-1 Preferred Option for the Jervis Bay Road and Princes Highway intersection

7. Next steps

The preferred option will be placed on public display until Sunday 20 December 2020 to provide the community and stakeholders an opportunity to review the preferred option and provide feedback.

Transport will consider community and stakeholder feedback as we further develop and refine the design for the preferred option. Transport have started work on the environmental impact assessment for the proposal which will explain the potential benefits and impacts of the project and provide more detail on the proposed features of the intersection upgrade.

The environmental assessment and concept design for the project will be on display for community feedback in 2021.

Please visit the project website at https://www.rms.nsw.gov.au/projects/princes-highway-and-jervis-bay-road/index.html for more information and to provide your feedback.