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BUILDING OUR FUTURE



The Northern Road Upgrade Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park

NSW Environmental Impact Statement /
Commonwealth Draft Environmental Impact Statement

Volume 1: Main Report

June 2017



The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park

**NSW Environmental Impact
Statement / Commonwealth Draft
Environmental Impact Statement
June 2017**

Volume 1: Main Report

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4 Project development and alternatives

This chapter describes the alternatives to the project that were considered as part of the project development process and explains how and why the project was selected as the preferred option. The chapter also outlines how particular elements of the project have been refined. Table 4-1 outlines the environmental assessment requirements (SEARs) of the Secretary of the Department of Planning and Environment and the Commonwealth EIS Guidelines as they relate to the development of options and alternatives for the project.

Table 4-1 EIS assessment requirements – project development and alternatives

Requirements	Where addressed in EIS
Secretary's Environmental Assessment Requirements (NSW EP&A Act)	
An analysis of feasible alternatives to the carrying out of the proposal and proposal justification, including:	Section 4.1 Section 4.2 Section 4.3
An analysis of alternatives/options considered having regard to the proposal's objectives (including an assessment of the beneficial and detrimental environmental impacts of the proposal relative to alternatives and the consequences of not carrying out the proposal	Section 4.2 Section 4.3.3 Section 4.3.5 Section 4.2.1
The provision of a clear discussion of the route development and selection process,	Section 4.3
The suitability of the chosen alignment and whether or not the proposal is in the public interest	
Justification for the preferred proposal taking into consideration the objects of the <i>Environmental Planning and Assessment Act 1979</i>	Chapter 13
Details of how the principles of ecologically sustainable development will be incorporated in the design, construction and ongoing operation phases of the proposal	Section 4.4 Chapter 10
Commonwealth EIS Guidelines (Commonwealth EPBC Act)	
3 Feasible alternatives Any feasible alternatives to the action to the extent reasonably practicable, including: if relevant, the alternative of taking no action;	Section 4.1 Section 4.2 Section 4.3 Section 4.2.1
A comparative description of the impacts of each alternative on the MNES protected by controlling provisions of Part 3 of the EPBC Act for the action; and	Section 4.2 Section 4.3.3 Section 4.3.5
Sufficient detail to make clear why any alternative is preferred to another.	Section 4.2 Section 4.3

Requirements	Where addressed in EIS
Short, medium and long-term advantages and disadvantages of the options should be discussed.	Section 4.2 Section 4.3.3 Section 4.3.5
Details of the relevant cost and benefits of alternative options to the proposed action	Sections 4.2 Section 4.3.3 Section 4.3.5

4.1 Alternatives considered

The merits of the project were considered in the context of a range of other potentially available alternatives. The alternatives considered are consistent with those considered for recent Western Sydney Infrastructure Plan (WSIP) projects and broader Sydney region motorway projects. The following alternatives to the project were considered:

- Alternative 1 – the base case, or ‘do minimum’
- Alternative 2 – realignment and upgrading of The Northern Road.

Other potential alternatives that were discarded, and were not considered in the alternatives and options assessment process, were:

- ‘Do nothing. The current alignment of The Northern Road traverses the site of the planned Western Sydney Airport and would not be retained within airport land following construction of the airport. In this case a ‘do nothing’ scenario would involve truncating The Northern Road north and south of the planned airport site with no provision of an alternative route between Bringelly (in the south) and Luddenham (in the north). As such, a ‘do nothing’ option was not considered to be a realistic alternative or representative of a base case for project decision making at this location so was not considered further
- Investing only in public transport, or a combination of public transport and road development. The project would be part of the WSIP, a 10 year, \$3.6 billion road investment program for western Sydney that would deliver major road infrastructure upgrades to support an integrated transport solution for the region and capitalise on the economic benefits of developing the Western Sydney Airport. Non road-based public transport alternatives (such as rail) would not meet key WSIP and project objectives (refer Section 3.4). Alternative 2 considers a realistic, road-based public transport option and this was considered in the cost analysis carried out for the alternatives.

It should be noted, however, that in accordance with key strategic planning and policy documents, there are a number of large public transport projects currently being constructed or in planning across the western Sydney region. These include:

- Light rail projects including:
 - Parramatta light rail, currently in planning, with construction to start in late 2018 (subject to planning approval)
- Sydney metro projects including:
 - Sydney Metro Northwest, currently under construction and planned to open in 2019
 - Sydney Metro City and Southwest, currently in planning with services expected to start in 2024
- Joint scoping study on Western Sydney rail needs
- Bus network improvements identified in Sydney’s Bus Future and State Infrastructure Strategy.

The two selected alternatives have been considered and assessed based on the extent to which they can meet the project objectives and project assessment criteria and how well they perform

against other transport, environmental, engineering, social and economic factors. As such, non-road based public transport options are not considered in this EIS. The two alternatives to the project are described below.

4.1.1 Alternative 1 – the base case or ‘do minimum’

A realistic ‘do minimum’ alternative would involve realigning the existing two-lane The Northern Road around the Western Sydney Airport site, as there are no suitable local roads to provide such a connection.

This alternative would not include any road upgrade work or any changes to existing intersections, but would involve maintenance of the existing road infrastructure.

4.1.2 Alternative 2 – realignment and upgrading of The Northern Road

This alternative would involve realigning the section of The Northern Road that bisects the Western Sydney Airport site to a location that allows for construction and operation of the airport.

This alternative would generally include:

- Upgrading The Northern Road to three lanes for northbound and southbound traffic (two general traffic lanes and one bus lane) between Mersey Road and Bradley Street
- Upgrading The Northern Road to four lanes (three general traffic and one bus lane) between Bradley Street and Glenmore Parkway
- Realigning The Northern Road around the Western Sydney Airport
- Upgrading existing intersections and associated traffic management infrastructure to improve safety and traffic performance
- Providing new intersections and associated traffic management infrastructure where required (such as in realigned sections)
- Upgrading public transport (bus) infrastructure including a bus lane in each direction and improved bus stops
- Providing new shared paths and footpaths to cater for pedestrians and cyclists
- Installing auxiliary infrastructure to support the operation of the project, such as Intelligent Transport Systems (ITS) infrastructure, heavy vehicle inspection bays, incident response facilities, drainage infrastructure and noise mitigation measures.

4.2 Evaluation of alternatives considered

The alternatives were evaluated against the following criteria:

- WSIP objectives outlined in Section 3.4
- Project objectives and project assessment criteria outlined in Section 3.4
- The beneficial or detrimental environmental impacts of each alternative
- The short, medium and long-term advantages and disadvantages of each alternative.

Table 4-2 summarises whether each alternative would meet, or fail to meet, key WSIP and project objectives outlined in Section 3.4. Further discussion on how each alternative would meet, or fail to meet the project objectives is provided in Sections 4.2.1 to Section 4.2.3.

As outlined above, each alternative requires a portion of The Northern Road to be realigned to accommodate the Western Sydney Airport. While a ‘do nothing’ alternative is not feasible, it is recognised that each of the alternatives would result in greater footprint related impacts than a ‘do nothing’ alternative due to the realignment around the Western Sydney Airport.

4.2.1 Alternative 1 – The base case or ‘do minimum’

The 'do minimum' alternative would have a number of short, medium and long-term advantages and beneficial impacts. In particular, it would:

- Be substantially cheaper than Alternative 2, which would provide a short-term benefit
- Involve shorter construction timeframes than Alternative 2, resulting in fewer construction impacts such as air quality, noise and traffic disruptions, which would provide a short and medium-term benefit
- Allow for the construction of the Western Sydney Airport, which would provide a short to long-term benefit
- Accommodate access to the north and south of the airport, which would provide a short to long-term benefit
- Maintain the arterial road function of The Northern Road, which would provide a short to long-term benefit
- Have a smaller construction and operational footprint than Alternative 2, resulting in reduced impacts on threatened ecological communities, including fewer impacts on NSW and Commonwealth listed Cumberland Plain Woodland, which would provide a short to long-term benefit
- Require less private property acquisition and, therefore, cause less property and socio-economic impacts from loss of land, which would provide a short to long-term benefit
- Require less acquisition of and impacts on Commonwealth owned land at the Western Sydney Airport and no acquisition of land at the Defence Establishment Orchard Hills (DEOH), which would provide a short to long-term benefit.

The 'do minimum' alternative would, however, fail to meet all the WSIP and project objectives and would not deliver a range of benefits that Alternative 2 would provide (refer to Section 4.2.2).

Network traffic modelling carried out for the project, incorporating anticipated land use change, development and population growth associated with planned large-scale land use changes, indicates that existing road capacity is unlikely to adequately accommodate future traffic demand. Under the 'do minimum' alternative the following disadvantages and detrimental impacts would likely occur:

- There would be a decline in local accessibility of the existing The Northern Road over time due to its inability to accommodate future traffic growth, which would result in a medium to long-term disadvantage
- There would be a lack of adequate access to and from the Western Sydney Airport and throughout the Western Sydney Priority Growth Area (WSPGA) as the airport expands and more land release precincts come online, which would result in a medium to long-term disadvantage
- There would be an increase in traffic congestion and a decline in intersection performance due to a failure to accommodate increased traffic growth, which would result in a medium to long-term disadvantage
- There would be an increase in emissions from vehicles having to operate in increasing traffic congestion, which would result in a medium to long-term disadvantage
- There would be a likely increase in the vehicle crash rate, in crash severity and heavy vehicle crashes due to failure to safely accommodate the increased proportion of heavy vehicles involved in both construction and operation of the Western Sydney Airport, which would result in a medium to long-term disadvantage
- It would not provide a cost effective project compared to Alternative 2, as demonstrated by the cost benefit analysis

- There would be a loss of opportunity to improve the accessibility and efficiency of public transport, which is likely to be important for the operation of a Western Sydney Airport, which would result in a short to long-term disadvantage
- There would be a loss of opportunity to improve safety for pedestrians, cyclists and motorists through an off-road shared pathway, which would result in a short to long-term disadvantage.

Traffic modelling carried out for the 'do minimum' alternative shows average travel speeds on The Northern Road would decrease to around 20 km/h with significant travel time increases in both the AM and PM peak times (refer to Section 7-1). Traffic modelling also shows that there would be insufficient intersection capacity along The Northern Road under the existing arrangement with all intersections operating at or over capacity by 2031.

The Northern Road would not be capable of catering for future traffic flow and would be less likely to provide reliable journeys. The 'do minimum' alternative would not meet the objective of providing resilient transport connections to the Western Sydney Airport site and other key surrounding developments. Furthermore, the 'do minimum' alternative would not provide improvements for public and active transport.

In addition, there is an identified need to provide a high capacity link with other proposed road upgrades in the region (such as the proposed M12 Motorway and other upgrades of sections of The Northern Road). The 'do minimum' alternative would not realise the full benefit of the other planned and constructed projects that form part of the WSIP. Traffic moving from completed stages to the existing The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park would be forced to queue as a result of a reduction in traffic lanes from the 'do minimum' alternative.

The benefits of the proposed M12 Motorway would also be reduced as the intersection of the proposed motorway would have a lower level of service due to capacity constraints on The Northern Road. The 'do minimum' alternative would therefore not meet the WSIP program objective to provide road improvements to support and integrate with the broader transport network.

The 'do minimum' alternative would have fewer impacts on matters of national environmental significance (MNES), which are protected by controlling provisions of Part 3 of the EPBC Act. Specifically, it would require less acquisition of and impacts on the environment of Commonwealth owned land at the Western Sydney Airport and no acquisition at the DEOH. It would also result in fewer impacts on NSW and Commonwealth listed Cumberland Plain Woodland.

The 'do minimum' alternative, although a feasible option, was not considered further as The Northern Road corridor would be unable to accommodate the forecast growth in traffic that is expected due to the development of the Western Sydney Airport and the planned land use changes in western Sydney. The difficulty of getting to and from the area would not only impact existing communities; it would also limit planned business and residential development in the future. This would result in reduced economic benefits for the region and the State.

4.2.2 Alternative 2 – Realignment and upgrade of The Northern Road

Realigning and upgrading The Northern Road would support the broader strategic planning and policy framework outlined in Section 3.1 and Section 3.2. Upgrading The Northern Road would also support the NSW Government's commitment to facilitate the Australian Government's timetable and transport functionality for construction and operation of the Western Sydney Airport.

Realigning and upgrading The Northern Road would best meet the WSIP and project objectives overall by supporting proposed land use change and residential growth and providing connections to the Western Sydney Airport for freight and commuters.

The WSIP identifies a number of other key infrastructure upgrades that would require connections to The Northern Road. Upgrading The Northern Road would improve transport connections to those transport corridors, including the proposed M12 Motorway, M4 Western Motorway and other The Northern Road Upgrade projects. Realigning and upgrading The Northern Road would support

the WSIP objective of providing improvements to support and integrate with the broader transport network.

Alternative 2 would have a number of short, medium and long-term advantages and beneficial impacts. In particular, it would:

- Provide road improvements to support and integrate with the broader transport network, which would provide a medium to long-term benefit
- Support the Western Sydney Airport, and land use change and residential growth, and balance functional, social, and environmental and value for money considerations, which would provide a short to long-term benefit
- Cater for future traffic demand to improve the flow of traffic to provide reliable journeys, which would provide a medium to long-term benefit
- Provide a cost effective solution when compared to Alternative 1, as demonstrated by the cost benefit analysis
- It would allow for the construction of the Western Sydney Airport, which would provide a short to long-term benefit
- Improve facilities for public and active transport, which would provide a short to long-term benefit
- Improve safety for pedestrians, cyclists and motorists through an off-road shared pathway, which would provide a short to long-term benefit
- Maintain the arterial road function of The Northern Road, which would provide a short to long-term benefit
- Provide access to the north and south of the Western Sydney Airport, which would provide a short to long-term benefit.

The footprint of the road would increase and this would result in disadvantages and detrimental impacts on the environment, including Commonwealth MNES and Commonwealth land. In particular:

- Clearing of remnant vegetation, including NSW and Commonwealth listed threatened ecological communities and habitat for potentially endangered and threatened species, would result in a short to long-term disadvantage
- Land acquisition of private land and impacts to the environment of Commonwealth owned land would result in a short to long-term disadvantage
- Impacts and Aboriginal and Non-Aboriginal heritage items and places would result in a short to long-term disadvantage
- Disruption to the community, businesses and the transport network during construction, in particular properties along The Northern Road, would result in a short to medium disadvantage.

Overall, upgrading and realigning The Northern Road is considered the best alternative to meet the WSIP and project objectives as it would cater for future traffic demand and improve connections to current and future land uses including the Western Sydney Airport at Badgerys Creek.

4.2.3 Comparison of alternatives considered

As discussed above, each alternative has a number of advantages and disadvantages. The 'do minimum' alternative (Alternative 1) would provide a number of short and medium-term cost and environmental benefits over Alternative 2. However, it would result in medium to long-term disadvantages associated with the performance and safety off The Northern Road, not providing adequate access to and from the Western Sydney Airport and throughout the Western Sydney Priority Growth Area (WSPGA).

Further to the commentary above, Table 4-2 gives a big-picture view of whether each alternative would meet, or fail to meet, key WSIP and project objectives.

Table 4-2 Comparison of alternatives against key objectives

Project objectives	Meets objective?	
	Alternative 1 – ‘Do minimum’	Alternative 2 – Realignment and upgrade of The Northern Road
WSIP program objectives		
Development and demand – support the Western Sydney Airport, and land use change and residential growth; balancing functional, social, and environmental and value for money considerations	No	Yes
Connectivity to airport – provide a resilient connection to the Western Sydney Airport site for freight and people	No	Yes
Integrated network – provide road improvements to support and integrate with the broader transport network	No	Yes
Customer focus – provide meaningful engagement with customers and stakeholders throughout the program life	Yes	Yes
The Northern Road project objectives		
Realignment of The Northern Road around the Western Sydney Airport site to allow construction and facilitation of a Western Sydney Airport at Badgerys Creek	Yes	Yes
Cater for future traffic demand to improve the flow of traffic to provide reliable journeys	No	Yes
Improve transport connections to the Western Sydney Airport site and surrounding developments including the South West Growth Centre (now known as the South West Priority Growth Area) and Broader Western Sydney Employment Area (now known as the WSPGA)	No	Yes
Improve facilities for public and active transport to promote sustainable and efficient journeys	No	Yes

Analysis of Table 4-2 is also provided in Section 4.2.1 to Section 4.2.3 along with consideration of the environmental impacts of each alternative.

A benefit cost analysis was carried out for Alternative 1 and Alternative 2. This is a method of measuring and evaluating the relative merits of public infrastructure projects that considers the

discounted costs and benefits accruing to the community. The evaluation used a road user cost benefit analysis that considered both the capital costs associated with construction, operation and ongoing maintenance of the road, and the cost of mitigation measures. As part of the economic analysis, the following benefits were quantitatively evaluated for both alternatives:

- Vehicle travel time savings
- Vehicle operating cost savings
- Crash cost reduction
- Externality costs
- Residual value.

The above were derived from Roads and Maritime's strategic traffic and transport model.

Based on the economic analysis:

- Alternative 2 has a benefit cost ratio (BCR) above one, indicating its economic feasibility. It is considered to generate substantial benefits to both local and regional road users, particularly through improved travel times and reduced accident risk
- Alternative 1 has a BCR of less than 1, indicating poor economic feasibility.

Therefore, Alternative 2 is the superior alternative in terms of economic feasibility.

A benefit cost analysis was not carried out for the route options outlined in Section 4.3 given the benefits, as noted above, were considered equal. The strategic designs used for the route option analysis showed little to no variance in cross section, route length and number of intersections. In a scenario where benefits are equal between options the analysis only compares costs. Non-cost items are captured in the value management process.

4.2.4 Preferred alternative

Based on the alternatives evaluation in Section 4.2.1 and Section 4.2.3, Roads and Maritime concluded that Alternative 2 – realignment and upgrade of The Northern Road – is the preferred alternative. A summary of the assessment of the preferred alternatives against the WSIP and project objectives is provided in Table 4-3.

It is considered that Alternative 2 would provide the best outcome as it would support the Western Sydney Airport and cater for growth in travel demand resulting from the planned land use changes in the region. Without the upgrades, the reduced road performance and accessibility to the area would limit the level of development that can be supported and the benefits the Western Sydney Airport can deliver.

Table 4-3 How Alternative 2 (the preferred alternative) complies with WSIP and project objectives

Objectives	How Alternative 2 would meet this objective
WSIP program objectives	
Development and demand Support the Western Sydney Airport, and land use change and residential growth; balancing functional, social, and environmental and value for money	The preferred alternative would meet this objective by: <ul style="list-style-type: none"> • Providing a safe modern high capacity road corridor to support future increased traffic generation from the construction and operation of the Western Sydney Airport, and land use changes in the region • Linking with other proposed road upgrades in the region to provide a high capacity integrated road network

Objectives	How Alternative 2 would meet this objective
considerations	<ul style="list-style-type: none"> Minimising environmental and social impacts through design and development of appropriate environmental management measures Providing value for money by servicing both the Western Sydney Airport and land use changes in the region.
Connectivity to airport Provide a resilient connection to the Western Sydney Airport site for freight and people	The preferred alternative would meet this objective by: <ul style="list-style-type: none"> Linking with other proposed road upgrades in the region (eg the proposed M12 Motorway) to provide a high capacity link to the Western Sydney Airport Providing high capacity freight access to the south-western section of the Western Sydney Airport site Providing dedicated bus lanes, which would form part of the initial main public transport link to the Western Sydney Airport.
Integrated network Provide road improvements to support and integrate with the broader transport network	The preferred alternative would meet this objective by: <ul style="list-style-type: none"> Integrating with other planned road upgrades (including The Northern Road upgrades to the south of Mersey Road, Bringelly and to the north of Glenmore Parkway, Glenmore Park and the proposed M12 Motorway) Providing dedicated bus lanes, which would integrate with existing and new bus routes in the region.
Customer focus Provide meaningful engagement with customers and stakeholders throughout the program life	<ul style="list-style-type: none"> All project development activities have and would be undertaken to comply with this objective. For example, substantial and meaningful engagement with customers, the community and other stakeholders has been undertaken to identify the route for the section of The Northern Road that needs to be realigned (refer to Section 6 for further detail). Engagement activities would continue throughout the EIS, design, construction and operational phases.
The Northern Road Upgrade project objectives	
Realignment of The Northern Road around the Western Sydney Airport site to allow construction and facilitation of a Western Sydney Airport at Badgerys Creek	The preferred alternative would meet this objective by: <ul style="list-style-type: none"> Realigning the section of The Northern Road that currently bisects the Western Sydney Airport site Providing a high capacity road corridor and direct links to the Western Sydney Airport site to support airport related construction.
Cater for future traffic demand to improve the flow of traffic to provide reliable journeys	The preferred alternative would meet this objective by: <ul style="list-style-type: none"> Providing three lanes northbound and southbound (two general traffic lanes and one bus lane each way) between Mersey Road and Bradley Street and upgrading to four lanes (three general

Objectives	How Alternative 2 would meet this objective
	<p>traffic lanes and one bus lane) between Bradley Street and Glenmore Parkway to cater for future traffic demand. In some sections, the provision of four lanes may be staged to occur after 2019</p> <ul style="list-style-type: none"> • Upgrading intersections and associated traffic controls to provide more reliable journeys and reduce crashes • Providing Intelligent Transport Systems (ITS) infrastructure to provide information on traffic conditions and incidents to road users.
Improve the transport connections from the Penrith region and M4 Western Motorway to the Western Sydney Airport and surrounding developments including the SWPGA and WSPGA	<p>The preferred alternative would meet this objective by:</p> <ul style="list-style-type: none"> • Integrating with other planned road upgrades (including The Northern Road upgrades to the south of Mersey Road, Bringelly and to the north of Glenmore Parkway, Glenmore Park and the proposed M12 Motorway) • Providing new or upgraded intersections with other arterial and local roads.
Improve facilities for public and active transport to promote sustainable and efficient journeys	<p>The preferred alternative would meet this objective by:</p> <ul style="list-style-type: none"> • Providing dedicated southbound and northbound bus lanes • Providing upgraded bus stops and supporting possible new bus routes • Providing a shared path for cyclists and pedestrians along the western side of the upgrade and a footpath along the eastern side as required.

4.3 Route options development

The upgrade of The Northern Road is part of the WSIP and involves the upgrade of around 35 km of road between The Old Northern Road, Narellan and Jamison Road, South Penrith. When initially announced by the Australian and NSW governments in April 2014, The Northern Road Upgrade was divided into four stages (1, 2, 3 and 4) but due to design refinement would now be planned in sections as described in Table 1-2.

During the preliminary design and route options assessment, the project was referred to as The Northern Road Upgrade Stage 3 (between Littlefields Road, Luddenham and Jamieson Road, Penrith) and Stage 4 (between Mersey Road, Bringelly and Littlefields Road, Luddenham).

The preferred alternative of realigning and upgrading The Northern Road has evolved from a series of ongoing concept developments and evaluations since 2014. The project was divided into two key segments to facilitate the development and assessment of upgrading and realignment options. These segments are:

- Segment 1 – The Northern Road corridor between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park (previously referred to as part of Stage 3). Route option considerations for the upgrade of Segment 1 were limited to widening the corridor either to the west or east of the existing alignment

- Segment 2 – Realignment of The Northern Road between Mersey Road, Bringelly and Littlefields Road, Luddenham to bypass the Western Sydney Airport (previously referred to as Stage 4). As this segment requires realigning to allow construction of the Western Sydney Airport at Badgerys Creek, a comprehensive route options development and assessment process was undertaken.

4.3.1 Route options development process

The route options development process for segment 1 and segment 2 is discussed in the following section.

Segment 1 – Road widening options between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park

The existing road reserve between Littlefield Road, Luddenham and Glenmore Parkway, Glenmore Park is generally about 40 m wide. During early concept design it was identified that an additional 20 m of corridor may be required to provide for the proposed upgrade of The Northern Road.

A preliminary environmental investigation was carried out in May 2014 for the area between Mersey Road, Luddenham and Bringelly Road, Penrith, to identify environmental constraints. The investigations were based on desktop assessments and were used during the route options analysis.

An Options and Scoping Value Management Workshop was held in March 2015 and attended by Roads and Maritime project team members, Transport for NSW and Penrith City Council representative. The purpose of the workshop was to assess preliminary design options for the corridor to ensure it aligns with project objectives and stakeholder expectations.

During the Options and Scoping Value Management Workshop, participants agreed that it was preferable to utilise the existing road reserve as much as possible to accommodate the road upgrade rather than investigate realignment options that would result in larger property acquisitions or property severance.

To achieve this, two options were presented to workshop attendees that utilised the existing 40 m wide road corridor with one option extending an additional 20 m to the east and the other option extending an additional 20 m to the west. The strategic designs for each of these options were assessed for their relative engineering and environmental constraints.

The workshop participants considered the relative cost of each option based on strategic project cost estimates. The estimates included the cost of property acquisition, utility relocation, and environmental costs with appropriate contingency levels to cover uncertainties and unknowns. Each option was then assessed against the project objectives and project assessment criteria.

Following selection of the preferred option, the community was invited to provide feedback on the preliminary design in July and August 2015 including feedback on the access strategy.

During preparation of the EIS, and in response to the Commonwealth EIS guidelines, further detail on the relative impacts on MNES and the costs of each option was required.

Segment 2 – Road realignment options for Western Sydney Airport bypass

The existing alignment of The Northern Road between Mersey Road, Bringelly and Littlefields Road, Luddenham crosses a substantial portion of the Western Sydney Airport site. To enable construction of the airport, Roads and Maritime investigated preliminary route options, which comprised bypass options. In developing a long list of route options, and based on preliminary desktop investigations, consideration was also given to whether or not to bypass Luddenham due to the impacts road widening would have on the township.

THE NORTHERN ROAD REALIGNMENT OPTIONS PROCESS

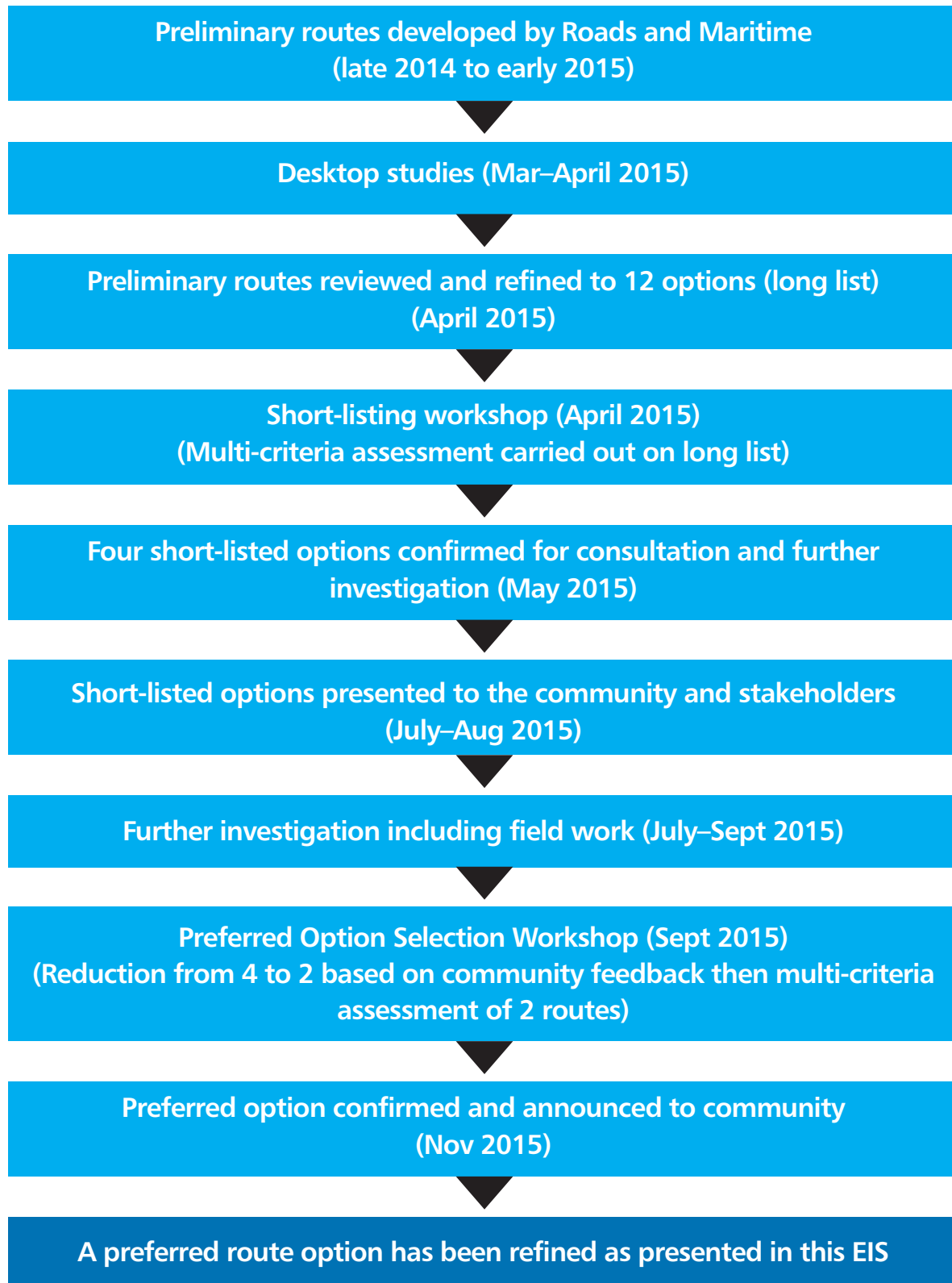


Figure 4-1 The Northern Road realignment options process for Segment 2 – Western Sydney Airport bypass

As shown in Figure 4-1, the process for evaluating realignment options for segment 2 began with the development of preliminary routes by Roads and Maritime in late 2014 and early 2015. These routes were based on desktop environmental studies, engineering constraints and geometric design parameters.

A preliminary workshop was then held in March 2015. The workshop was attended by Roads and Maritime project representatives and was used to review the preliminary routes against engineering and environmental constraints and to carry out a multi-criteria analysis of the preliminary routes. Constraints included land use, heritage, biodiversity, geology and the existing and planned road network. The workshop refined the preliminary route to a long list of 12 route options. The 12 route options are summarised in Table 4-4 and shown on Figure 4-2. The options were identified by number for ease of description and analysis. The relative cost of each long-listed option was analysed.

A Short-listing Options Workshop was held in April 2015. The purpose of the workshop was to review the multi-criteria analysis applied to the 12 long-listed route options and refine the long-listed route options to a short list of options to be taken forward to community engagement. The workshop included representatives from Australian, NSW and local government agencies, Roads and Maritime, and specialist engineering and environmental consultants. The workshop participants recommended a short list of four options to be included in the community engagement process.

Roads and Maritime identified names for the short-listed route options for the community, as described in Section 4.3.4. The main purpose of the names was to assist with community consultation as they reflected the obvious locational differences of each option. From this point on in the reporting and analysis process, these names were used to identify the route options being assessed.

As part of a broader WSIP community consultation process, the four short-listed options were presented to the community throughout July and August 2015. Detail of the consultation carried out is provided in Chapter 6. Community feedback was used as part of the assessment of the short-listed options. A project issues register was developed with about 140 comments submitted specifically relating to the Luddenham and Western Sydney Airport bypass options.

Detailed information on the consultation activities and outcomes can be found in The Northern Road Stage 4 Options Analysis Community Feedback Report (Roads and Maritime, 2015).

During the short-listing process, key areas were identified where additional field-based investigations would help to assess the route options. Early field investigations of Aboriginal heritage, European heritage and biodiversity were carried out between July and September 2015. Preliminary strategic designs and strategic cost estimates were developed for each short-listed options.

A Preferred Option Selection Workshop was held in September 2015 to select a preferred option from the four short-listed options. The workshop included representatives from Australian, NSW and local government agencies, Roads and Maritime representatives, and specialist engineering and environmental consultants. The purpose of the workshop was to evaluate the four short-listed options against the community feedback provided, and then use a multi-criteria assessment to recommend a preferred option.

During the Preferred Option Selection Workshop Penrith City Council identified a community preference for the study area to remain a more rural community with greater connection to the Mulgoa Valley and rural villages to the west, rather than the more developed areas to the east. It was also noted that The Northern Road currently provides a boundary between the proposed employment lands associated with the WSPGA and the SWPGA to the east and the rural lands to the west.

During the short-listing process, two of the four short-listed options clearly performed lower against the project objectives and assessment criteria. The information collected from the community consultation, field investigations and design development produced nothing that would alter the lower performance of these two options. To focus on the selection of a preferred option, a decision

was endorsed by workshop participants to only progress the two highest performing options to the multi-criteria analysis. The multi-criteria analysis assigned weightings to each criteria based on its relative importance to the overall project. The outcomes of the workshop and multi-criteria analysis process are outlined in The Northern Road Stage 4 Strategic Route Options Report (RMS and WSP, 2015).

The preferred route option was then confirmed and announced to the community in November 2015.

Following the selection of the preferred option, the ability to provide a higher level of access to Luddenham town centre was further considered and comprised the provision of signalised intersections. Two town access options were developed and assessed against the project objectives. The preferred access option was announced on 20 July 2016 with the release of the Strategic Design and Access Strategy for The Northern Road from Easton to Littlefields Road.

4.3.2 Description of the long-listed realignment options

Segment 1 – Road widening options between Littlefields Road and Glenmore Parkway

As outlined in Section 4.3.1, Roads and Maritime did not carry out investigations for route options between Littlefields Road and Glenmore Parkway as there was a 40 m wide road reserve capable of accommodating a large portion of the upgrade. A description of the two widening options in segment 1 is outlined in Section 4.3.4.

Segment 2 – Road realignment options for Western Sydney Airport bypass

The 12 long-listed route options (including nine main options and three sub-options) are presented in Figure 4-2 and described in Table 4-4.

Table 4-4 Segment 2 – long-listed options

Preliminary route Option	Description
Option 1	Option 1 deviates around the Western Sydney Airport site, from north of Dwyer Road, Bringelly joining the existing alignment of The Northern Road at Roots Avenue, Luddenham. The route follows the existing alignment of The Northern Road to Littlefields Road, Luddenham. In Luddenham town centre, the speed limit would need to remain at 60 km/h, while the rest of the upgrade could be posted at 80 km/h. Option 1 utilises Commonwealth land set aside for the Western Sydney Airport to the east of Willowdene Avenue.
Option 2	Option 2 is comparable to route option 1, differing through the use of Campbell Street as a bypass of Luddenham. The existing Park Road would be upgraded as a signalised intersection and act as an indirect link to Luddenham. The alignment would tie into the existing The Northern Road corridor 1 km north of Park Road. In Luddenham town centre, the speed limit would need to remain at 60 km/h. The Holy Family Church and Primary School at the intersection of Campbell Street and Willowdene Avenue would require a 40 km/h school zone. Option 2 utilises Commonwealth land set aside for the Western Sydney Airport to the east of Willowdene Avenue.

Preliminary route Option	Description
Options 3A and 3B	Option 3A would construct a new alignment about 600 m to the west of the Luddenham town centre joining the existing alignment of The Northern Road one kilometre north of the intersection at Elizabeth Drive, Luddenham. The alignment of option 3B differs from option 3A by joining the existing alignment of The Northern Road at the intersection with Elizabeth Drive. Options 3A and 3B utilise Commonwealth land set aside for the Western Sydney Airport to the east of Willowdene Avenue.
Options 4A and 4B	Options 4A and 4B are to the west of option 3A and use the existing alignment of Willowdene Avenue. At the northern end of Willowdene Avenue the alignment is the same as option 3A. Option 4B diverts from Willowdene Avenue about one kilometre south of Silverwood Avenue, Luddenham. Option 4A and 4B utilises Commonwealth land to the west of Willowdene Avenue.
Option 5	Option 5 deviates about 800 m to the west of Willowdene Avenue before it crosses Willowdene Avenue and follows a common route with options 3A and 4. Option 5 avoids utilising Commonwealth land.
Option 6	Option 6 deviates about 1.1 km to the west of Willowdene Avenue. It shares a common alignment with route options 3A and 4 to the north of Park Road. Option 6 avoids utilising Commonwealth land.
Option 7	Option 7 deviates from option 6 south of Park Road and follows a corridor to the west of Queenshill Drive. Option 7 avoids utilising Commonwealth land.
Option 8	Option 8 involves replacing the existing The Northern Road route through the Western Sydney Airport site with a tunnel beneath the airport site. Option 8 avoids utilising Commonwealth land.
Option 9A and 9B	Option 9A is similar to option 1 around the Western Sydney Airport site and continues east around the north-western boundary of the site. It crosses the existing The Northern Road at Eaton Road, and continues north to the east of the Luddenham town centre, joining the existing alignment to The Northern Road at the Elizabeth Drive intersection. Option 9a utilises Commonwealth land to the west of Willowdene Avenue. Option 9B is similar to option 9A but utilises Commonwealth land set aside for the Western Sydney Airport to the east of Willowdene Avenue.

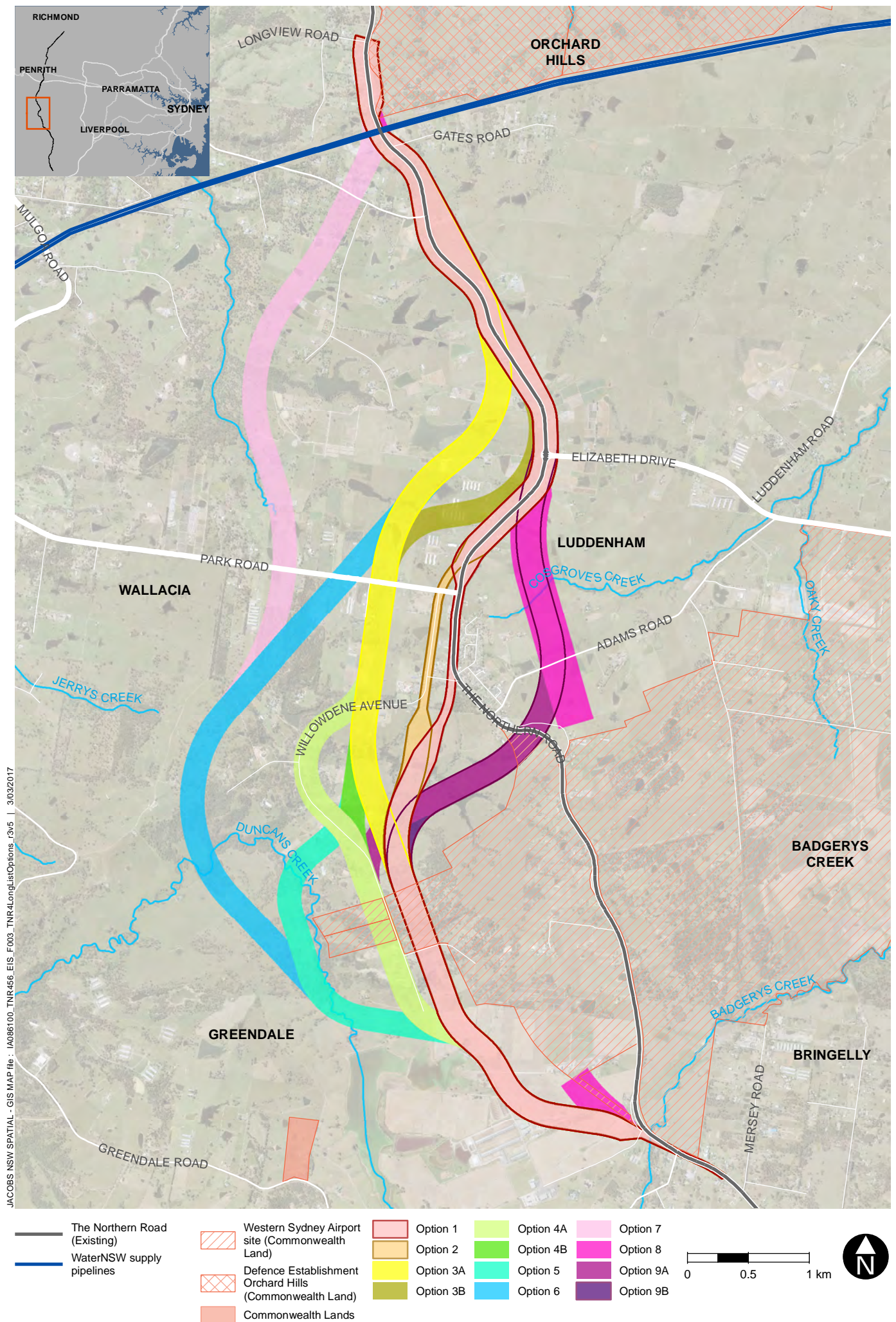


Figure 4-2 | The Northern Road Upgrade Luddenham and Western Sydney Airport bypass – longlisted route options

4.3.3 Evaluation of long-listed realignment options

Segment 2 – Road realignment options for Western Sydney Airport bypass

A comparison of the 12 long-listed route options was carried out against the WSIP and project objectives, and project assessment criteria. An assessment against the criteria for each option is provided in The Northern Road Upgrade Stage 4 – Options Identification Report (RMS and PB, 2015). A summary of the performance of the 12 options is provided below.

Route options 1, 2, 3, 3A, 3B, 4A, 4B, 5, 8, 9A, 9B, which are closer to the current and future planned development areas, perform better against the Development and Demand WSIP objective, and would also have lower impacts on the higher quality environmental areas, including NSW and Commonwealth listed Cumberland Plain Woodland, as they cross fewer waterways and traverse more areas that are more disturbed. For this reason, options 6 and 7 were not progressed through to the short-listing phase. This would result in short to long-term advantages. The better performing route options are also shorter and so perform better against the project objectives of catering for traffic demand and to improve flow. This would result in medium to long-term benefits.

The shorter routes (options 1, 2, 3, 3B, 4A, 4B, 5 and 8) and options that do not involve as much construction along existing roads (options 3A, 9A and 9B) allow for easier and quicker construction, and so perform well against the project objective of supporting airport construction. This would result in short to medium-term benefits.

Utilising the existing Willowdene Avenue road corridor does not provide sufficient benefits to offset the problems with the existing road geometry, topography and constructability issues. Therefore, the sub-options (4A and 4B) that use the Willowdene Avenue alignment were not taken forward to the short list.

As there was no certainty about the provision of Commonwealth land at the options evaluation stage, there needed to be an option taken forward that could be delivered without using any Commonwealth land. The best performing of those options (option 5) was taken forward to the short list.

The option of tunnelling under the airport (option 8) was not taken forward to the short list because of high construction and operation costs, which means it performs poorly against the WSIP objective of providing value for money. It would result in short to long-term disadvantages. The tunnel construction would need to integrate with airport construction, which may be difficult with the proposed timing of the two projects. It would also be difficult to provide access to the airport from a tunnel. Consequently, this option performed poorly against the objective to allow construction and facilitation of Western Sydney Airport.

When assessing the southern section of the long list of route options around the Western Sydney Airport site, the workshop participants agreed that there are generally three route options for the upgrade: one to the east of Willowdene Avenue (located on Commonwealth land set aside for the Western Sydney Airport), one along Willowdene Avenue, and one along the back of the properties on the western side of Willowdene.

The workshop concluded that:

- The easternmost of these routes is favourable, but not feasible as the Commonwealth land had not yet been confirmed to be available for the upgrade
- The route along Willowdene Avenue is an appropriate option but is also contingent on the availability of Commonwealth land to the west of Willowdene Avenue
- The route along the back of the properties on the western side of Willowdene Avenue is considered to be the preferred route option should no Commonwealth land be made available for the upgrade. This back-up option was named the Southern sub-option, and is described in Section 4.3.4.

4.3.4 Description of short-listed realignment options

Segment 1 – Road widening options between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park

As noted in Section 4.3.1 two widening options were considered between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park. These would involve widening of the existing corridor to the east and widening of the existing corridor to the west. These options are described below.

Option 1 – Widening the existing corridor to the west

Option 1 would provide an eight-lane divided road between Bradley Street, Mulgoa to about 100 m south of Glenmore Parkway, Glenmore Park (three general traffic lanes and a kerbside bus lane in each direction separated by a median) by widening the existing corridor to west.

South of Glenmore Parkway, the alignment would continue along the existing corridor with widening to the western side to provide a six-lane divided road between Bradley Street, Mulgoa and Littlefields Road, Luddenham (two general traffic lanes and a kerbside bus lane in each direction separated by a wide central median). The vertical and horizontal alignment would be upgraded to meet current road design requirements for 90 km/h.

Along the western side of The Northern Road, the area mostly comprises low-density rural residential areas of Mulgoa. The higher density residential area of Glenmore Park is also located west of The Northern Road between Glenmore Parkway and Bradley Street.

The landscape to the west contains pastures and grasslands with a mix of open and vegetated areas. There are pockets of remnant woodlands, open paddocks and rural residential clusters. Native vegetation includes stands of endangered Cumberland Shale Plains Woodland and Cumberland Shale Hills Woodland.

Option 2 – Widening the existing corridor to the east

Option 2 would provide the same lane configuration as option 1. The alignment would continue along the existing road corridor with widening generally to the eastern side. The exception to this is adjacent the main entry to the DEOH, and at the Endeavour Energy sub-station where the widening would be to the west.

Land to the east of the existing corridor is dominated by the DEOH. South of the (Warragamba to Prospect Pipelines (from here referred to as the WaterNSW Supply Pipelines) to Littlefields Road consists of low density, semi-rural properties. The DEOH is consistent in character with surrounding land uses, containing a similar mix of open and vegetated areas. It comprises intact native vegetation including regrowth natural vegetation areas associated with the endangered Cumberland Plain Woodland, and the Commonwealth heritage listed place.

Segment 2 – Road realignment options for Western Sydney Airport bypass

The four short-listed route options were:

- Central option (previously option 1)
- Campbell Street option (previously option 2)
- Western option (previously option 3B)
- Eastern option (previously option 9A).

These route options are presented in Figure 4-3 to Figure 4-6 and described below.

Central option (option 1)

The central option deviates around the Western Sydney Airport site, from north of Dwyer Road, Bringelly, joining the existing alignment of The Northern Road at Roots Avenue, Luddenham. The route follows the existing alignment of The Northern Road to Littlefields Road, Luddenham

The speed limit would be 60 km/h through Luddenham and the maximum grade of this alignment would be about five per cent.

The central option is about 10 km long. A map of the option is presented in Figure 4-3.

Campbell Street option (option 2)

The Campbell Street option is similar to the central option, differing through the use of Campbell Street as a bypass of the town of Luddenham. This option was developed as an alternative to the central option to reduce the number of residences and businesses directly impacted by the project.

The local road environment through Luddenham would require the speed limit to be reduced to 60 km/h, and a 40 km/h school zone would be required at the Holy Family Church and Primary School at the intersection of Campbell Street and Willowdene Avenue, Luddenham.

As part of the Campbell Street option, it is likely that the main connection into the Luddenham town centre would occur via Park Road, Luddenham. The upgrade would connect to The Northern Road's existing alignment about one kilometre north of Park Road.

The Campbell Street option is about 10 km long. A map of the option is presented in Figure 4-4.

Western option (option 3)

The western option would provide a new alignment about 600 m to the west of the Luddenham town centre joining the existing alignment of The Northern Road at the intersection with Elizabeth Drive. This option would provide access to the Luddenham town centre from the intersection on Park Road. This option includes a western alternative sub-option to connect to the existing The Northern Road north of Elizabeth Drive.

This option would pass about 200 m to 300 m west of major community infrastructure items including the Holy Family Church and Primary School and the Luddenham Showground.

The western option is the shortest of the four options. A map of the option is presented in Figure 4-5.

Eastern option (option 9)

The eastern option is similar to the central option around the Western Sydney Airport site. It crosses the existing The Northern Road at Eaton Road, and continues north to the east of the Luddenham town centre, joining the existing The Northern Road at the Elizabeth Drive intersection.

This option would require the additional acquisition of some Commonwealth land on the southern side of the existing The Northern Road near the intersection with Eaton Road, Luddenham. A connection into The Northern Road would be provided where the upgrade crosses near Eaton Road (the southern access to the Luddenham town centre).

This option would provide access to the Luddenham town centre from the north at the Elizabeth Drive intersection and the south around the intersection of the existing The Northern Road and Eaton Road. These connections had not been developed at the time of the short-listing workshop but were subsequently developed as described in Section 4.3.4.

The eastern option is the longest of the four options. A map of the option is presented in Figure 4-6.

Common section (Southern sub-option)

All of the short-listed route options include a common alternative alignment identified as the Southern sub-option. This sub-option (shown in Figures 4-3 to Figure 4-5) was identified to avoid the use of Commonwealth land identified for the Western Sydney Airport. While the Southern sub-option was not progressed to the short list of route options in its own right, the DIRD was not in a position to confirm if the land would be made available for road uses until late in the route option selection process. As a result, options that did not utilise Commonwealth land needed to be considered and communicated to the community. For all of the identified short-listed route options, the Southern sub-option would connect to a point along the southern section of Willowdene Avenue, Luddenham and generally be on the western side of properties along Willowdene Avenue to avoid Commonwealth land.

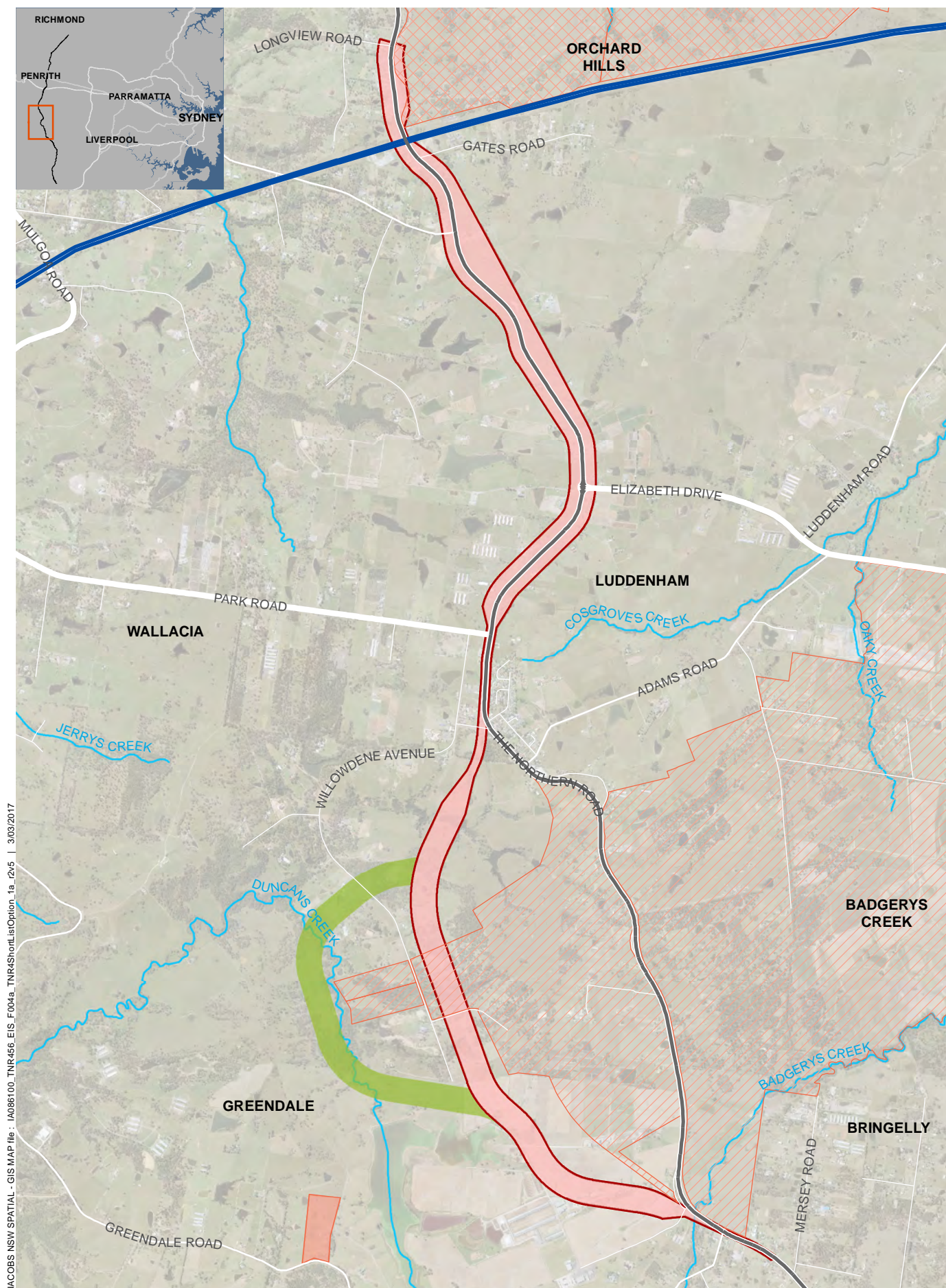


Figure 4-3 | The Northern Road Upgrade – central option

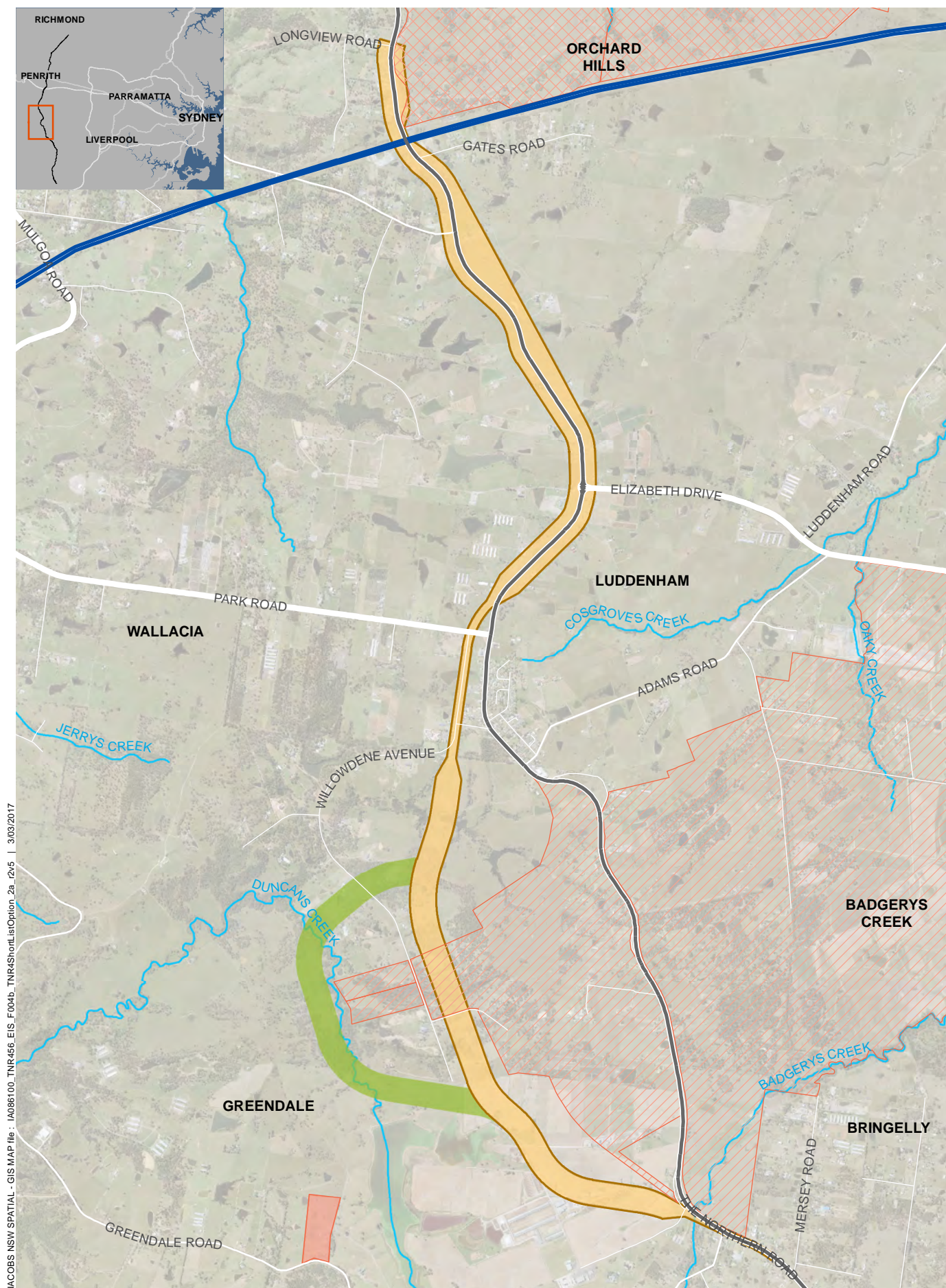


Figure 4-4 | The Northern Road Upgrade – Campbell Street option

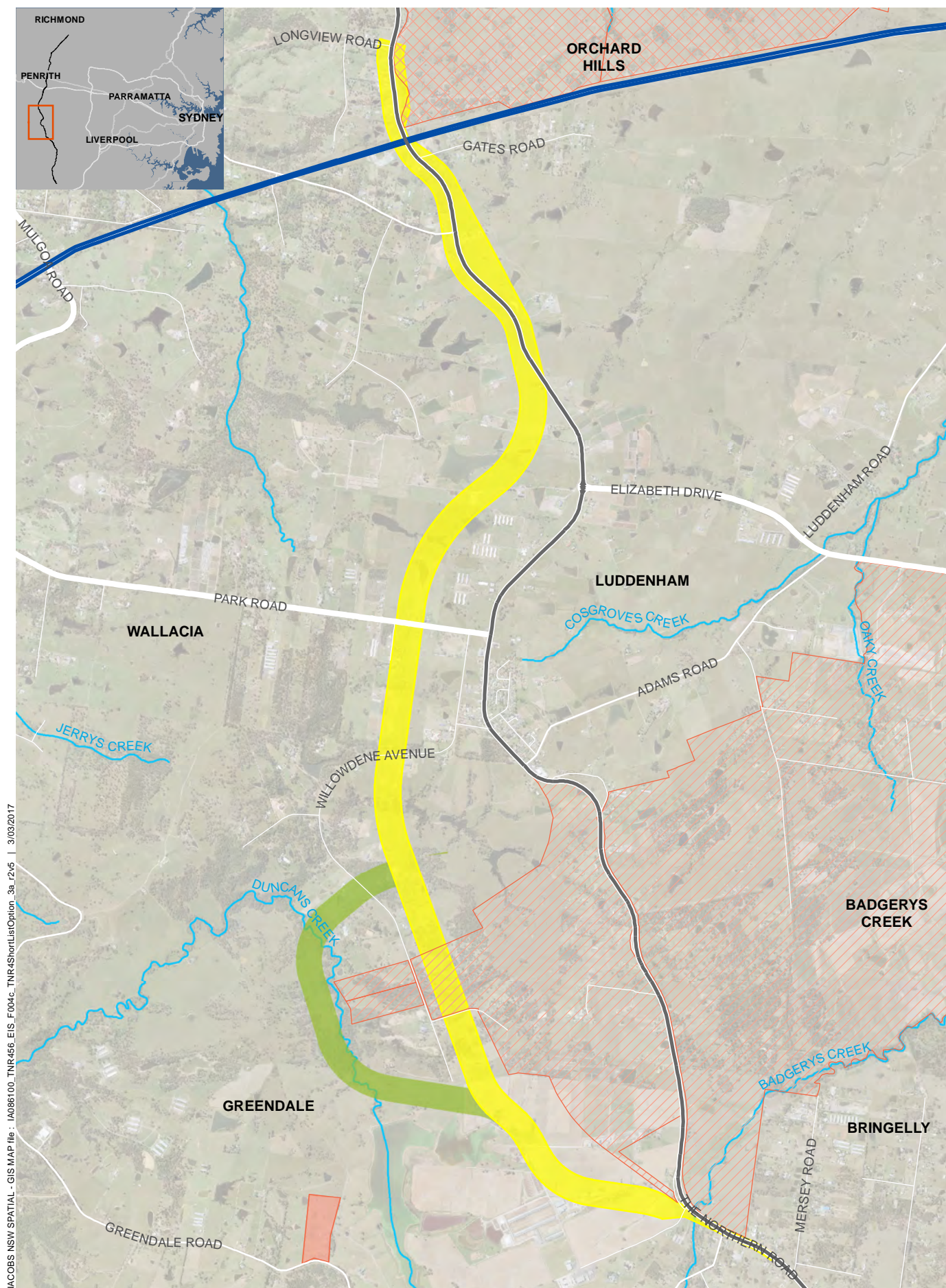


Figure 4-5 | The Northern Road Upgrade – western option

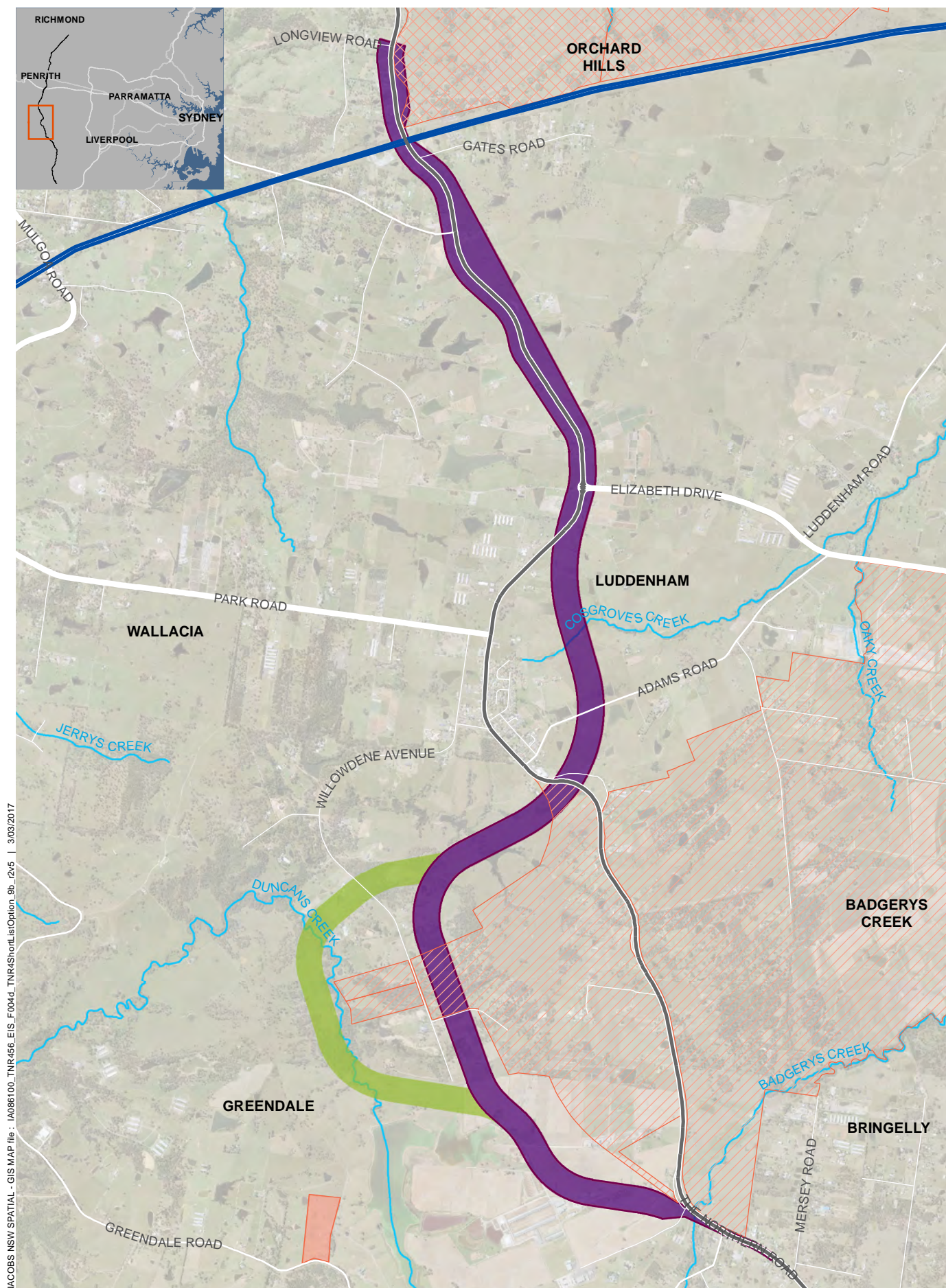


Figure 4-6 | The Northern Road Upgrade – eastern option

4.3.5 Evaluation of short-listed realignment options

Segment 1 – Road widening options between Littlefields Road and Glenmore Parkway

The Options and Scoping Value Management Workshop evaluated the two widening options against the WSIP and project objectives and project assessment criteria. The relative advantages and disadvantages of both options are presented below.

Option 1

Widening to the west (option 1) would have short, medium and long-term advantages and beneficial impacts. In particular, it would:

- Support the Western Sydney Airport, and land use change and residential growth, which would provide a short to long-term benefit
- Provide road improvements to support and integrate with the broader transport network, which would provide a medium to long-term benefit
- Cater for future traffic demand to improve the flow of traffic to provide reliable journeys, which would provide a medium to long-term benefit
- Improve facilities for public and active transport, which would provide a short to long-term benefit
- Improve safety for pedestrians, cyclists and motorists through an off-road shared pathway, which would provide a short to long-term benefit
- Maintain the arterial road function of The Northern Road, which would provide a short to long-term benefit
- Reduce impact on MNES including areas of Cumberland Plain Woodland (EPBC Act and TSC Act), which would provide a short to long term-advantage
- Avoid the requirement to acquire Commonwealth land from the DEOH and the uncertainties with timeframes and possible project delays associated with negotiations of sale with relevant Commonwealth departments, which would provide a short to long-term advantage.

However, option 1 would also have short, medium and long-term disadvantages and detrimental impacts. In particular, it would:

- Result in greater engineering complexity, cost and construction impacts compared to widening to the east because most of the intersecting roads in this section of The Northern Road are from the west; this would provide a short to long-term disadvantage
- Require land acquisition from 46 private properties, including up to 17 total acquisitions, which would provide a short to long-term disadvantage
- Result in greater local community and stakeholder impacts because of the required acquisition of private property and amenity impacts associated with widening the road closer to residents; this would provide a short to medium term disadvantage
- Require greater utility relocations than widening to the east because there are more utilities on the western side of the current alignment; this would provide a short-term disadvantage
- Result in project costs being about 20 per cent higher due to property acquisition and utility relocations; this would provide a short to medium-term disadvantage
- Result in delays due to the need to acquire multiple properties and manage utility relocation requirements; this would provide a short to medium-term disadvantage
- Fail to show a whole-of-government approach to minimising potential impacts associated with private property acquisition; this would provide a short to long-term disadvantage.

Option 2

The short, medium and long-term disadvantages and detrimental impacts associated with widening to the west were considered by workshop participants as providing the converse beneficial outcomes to widening to the east (option 2). In particular, it would:

- Require less engineering complexity and associated cost as there are no local roads requiring adjustments. This would have the benefit of a comparatively reduced construction program
- Require acquisition of government owned land from the DEOH and two private properties as opposed to 46 private properties for the western side
- Result in less local community impacts as there would be fewer private property acquisitions
- Require less utility relocations than option 1
- Have a comparatively lower cost as there would be fewer utility relocations and private property acquisitions
- Provide an option that meets the local community expectations about providing a whole-of-government approach.

In addition to the points raised above, option 2 would provide a number of short, medium and long-term advantages and benefits. In particular, it would:

- Support the Western Sydney Airport, and land use change and residential growth, which would provide a short to long-term benefit
- Provide road improvements to support and integrate with the broader transport network, which would provide a medium to long-term benefit
- Cater for future traffic demand to improve the flow of traffic to provide reliable journeys, which would provide a medium to long-term benefit
- Improve facilities for public and active transport, which would provide a short to long-term benefit
- Improve safety for pedestrians, cyclists and motorists through an off-road shared pathway, which would provide a short to long-term benefit
- Maintain the arterial road function of The Northern Road, which would provide a short to long-term benefit.

However, widening to the east (option 2) would also have short, medium and long-term disadvantages and detrimental impacts. In particular, it would:

- Require the acquisition of Commonwealth land from the DEOH, which would provide a short to long-term disadvantage
- Result in the acquisition of land from two private properties, which would provide a short to long-term disadvantage
- Result in the removal of Cumberland Plain Woodland (EPBC Act and TSC Act listed community), which would provide a long-term disadvantage.

Land acquisition from the Department of Defence is not subject to the NSW *Land Acquisition (Just Terms Compensation) Act 1991*. In this regard, the certainty of acquisition and timeframes for possession are subject to ongoing negotiations and agreement with the Department of Defence and Department of Finance. If the land at the DEOH were not made available, then widening to the west would be the only option.

Further to the commentary above, Table 4-5 summarises how each option would meet, or fail to meet, the WSIP and project objectives.

Table 4-5 How Segment 1 options would meet the WSIP and project objectives

	Option 1 (widening to the west)	Option 2 (widening to the east)
WSIP program objectives		
Development and demand – Support the planned western Sydney airport, and land use change and residential growth; balancing functional, social, and environmental and value for money considerations	Partial	Yes
Connectivity to airport – Provide a resilient connection to the planned western Sydney airport site for freight and people	Yes	Yes
Integrated network – Provide road improvements to support and integrate with the broader transport network	Yes	Yes
Customer focus – Provide meaningful engagement with customers and stakeholders throughout the program life	Yes	Yes
The Northern Road Upgrade project objectives		
Realignment of The Northern Road around the Western Sydney Airport site to allow construction and facilitation of a Western Sydney Airport at Badgerys Creek	N/A	N/A
Cater for future traffic demand to improve the flow of traffic to provide reliable journeys	Yes	Yes
Improve the transport connections from the Penrith region and M4 Western Motorway to the Western Sydney Airport and surrounding developments including the SWPLRA and WSPGA	Yes	Yes
Improve facilities for public and active transport to promote sustainable and efficient journeys	Yes	Yes

As shown in Table 4-5, while both options meet the project objectives, option 2 performs better than option 1 in terms of the WSIP objectives as it meets the Development and Demand objective.

The higher complexity and cost of option 1 compared to Option 2 means it only partially delivers on the WSIP program objective of delivering a cost effective project.

Workshop participants acknowledged option 2 would have a greater impact than option 1 on threatened ecological communities, including Cumberland Plain Woodland. However, given option 2 would result in impact on substantially less private properties than option 1, and because option 2 would have lower project costs and a higher overall performance against the WSIP and project objectives, it was selected as the preferred option in Segment 1.

Post workshop assessment

As outlined in Section 4.3.1, during preparation of the EIS, and in response to the Commonwealth EIS Guidelines, further detail of the relative impacts on MNES of each option in Segment 1 were required. The following information is provided to address these requirements.

The figures below are based on the design that was assessed during the workshop but utilises some additional information that was obtained during preparation of the EIS. Based on the additional information, the key areas of differentiation between the two options relate to:

- The Commonwealth natural heritage values associated with the DEOH
- The field investigations and development of a biodiversity offset strategy, which has provided a clearer picture of the costs of biodiversity offsetting
- Refinement of cost estimates for utility and property acquisition.

Option 1

Based on the key areas of differentiation, option 1 would:

- Remove about 0.74 ha of vegetation that has been mapped as Cumberland Plain Woodland in the Sydney Basin Bioregion, which would provide a short to long-term disadvantage
- Remove about 0.40 ha of vegetation that has been mapped as Cumberland Plain Woodlands Shale Gravel Transition Forest, which would provide a short to long-term disadvantage
- Require biodiversity offsetting for impacts on threatened ecological communities, which represents about one per cent of the project cost estimates
- Increase property acquisitions and utility relocations by about 15 per cent, based on refined cost estimates (based on the refined cost estimates, property acquisition and utility relocations would be about 10 per cent more than option 2).

Option 2

Based on the key areas of differentiation, option 2 would:

- Require acquisition of about 6.63 ha of land from the DEOH
- Remove about 1.1 ha of vegetation that has been mapped as Cumberland Plain Woodlands Shale Gravel Transition Forest, which would provide a short to long-term disadvantage
- Remove about 1.46 ha of vegetation that has been mapped as Cumberland Plain Woodland in the Sydney Basin Bioregion, which would provide a short to long-term disadvantage
- Remove about 0.2 ha of Riverflat Eucalyptus Forest, which would provide a short to long-term disadvantage
- Require offsetting of threatened ecological communities; this represents about seven per cent of project estimates, which is about double the cost of offsets for option 1
- Acquire about 4.21 ha of the Orchard Hills Commonwealth heritage listed place.

Roads and Maritime reviewed the key areas of differentiation of each option, based on refined cost estimates and information obtained during preparation of the EIS, with a view to confirm if option 2 was still preferred.

As outlined above, option 2 was recognised by workshop participants as having greater impact on threatened ecological communities than option 1. This is confirmed by the refined estimates that show option 2 requires the removal of 1.42 ha of Cumberland Plain Woodland more than option 1 and the removal of about 0.2 ha of Riverflat Eucalyptus Forest. Based on the area of mapped vegetation within each option, biodiversity offsets are estimated to be about 111 per cent higher for option 2.

Option 2 also requires acquisition of about 6.63 ha of Commonwealth land from the DEOH. This option would have an impact on the environment of Commonwealth land including the removal of about 4.21 ha of the Orchard Hills Commonwealth heritage listed place. Based on the DEOH Heritage Management Plan, the area within option 1 is predominately of low heritage significance with sections containing moderate to high heritage significance. Further, the 4.21 ha represents about 0.31 per cent of the listing. Option 1 does not require the acquisition of Commonwealth land or impact on Commonwealth heritage values.

As per the outcomes of the workshop, the refined estimates confirm option 2 would have a greater detrimental impact to MNES and the environment of Commonwealth land. The additional information obtained during preparation of the EIS identified option 2 as also having greater

detrimental impacts on Commonwealth heritage values than option 1. These detrimental impacts are mostly confined to low to moderate heritage significant areas and represent about 0.31 per cent of the listing.

Option 1 was considered by workshop participants as having greater cost and socio-economic impacts due to private property acquisitions. This is confirmed by the refined cost estimates showing property acquisition and utility relocations costs being 15 per cent higher for option 1. The refined cost estimates also reveal that while the costs associated with biodiversity offsets for option 2 were larger than initially estimated they are still less than one-third of the costs of acquiring private property and relocating utilities that would be incurred with option 1.

As noted above, option 1 would have large socio-economic impacts due to the acquisition of 46 properties and due to amenity impacts associated with the road being closer to residents. The feedback from community consultation has consistently revealed a community expectation that government owned land to the east of The Northern Road would be used in preference to acquiring privately owned properties to the west.

Based on the revised cost estimates and additional information, option 2 has a greater detrimental impact on MNES, including on Commonwealth heritage values, than option 1. However, given option 2 would result in impact on substantially fewer private properties than option 1, and because option 2 would have lower project costs and higher overall performance against the WSIP and project objectives, it is confirmed as the preferred option in Segment 1.

Segment 2 – Road realignment options – Luddenham and Western Sydney Airport bypass

Community and stakeholder consultation

As outlined in Section 4.3.1, the four short-listed route options in segment 2 were placed on public display for community feedback. A number of submissions opposing the central and Campbell Street options were received during the consultation period. Key issues raised included:

- Opposition to both options on the grounds that they would divide the community and remove the historic character of Luddenham town centre
- Submissions on the Campbell Street option also expressed concern about potential direct and indirect impact on the grounds of Holy Family Church and Primary School
- Concerns about the impact on traffic flow as a result of the speed limit around school zones
- Concerns about property acquisition including demolition of homes and the compensation that would be provided for acquisition of affected properties.

Overall, the central and Campbell Street options were not supported by the local community.

Submissions regarding the western option expressed the view that this alignment would impact fewer properties than the other short-listed options, as it would be mainly located on farmland. Owners of properties that would be impacted by this option expressed concern that a partial compulsory acquisition of their land would impact the feasibility of their agricultural businesses.

Submissions received regarding the eastern option expressed the view that this alignment would have the least impact on Luddenham businesses and residents. This option was also favoured by some submissions as it would avoid impact on the Holy Family Church and Primary School, the Luddenham Showground and Luddenham town centre. Conversely, some submissions raised concern that avoiding the town centre, in the eastern, western or Campbell Street options, would cause a potential loss of passing trade in Luddenham town centre.

Nevertheless, business stakeholders generally expressed a preference for the eastern option, over the other options, on the grounds that it would improve opportunities for connection to Luddenham town centre and is expected to have fewer adverse business and socio-economic impacts within Luddenham town centre than the other options.

Some submissions noted the potential positive impacts for Luddenham traffic as a result of diverting The Northern Road around Luddenham town centre, as proposed in the eastern and western options.

Multi-criteria analysis of the eastern (option 1) and western (option 2) routes

As outlined in Section 4.3.1, due to information collected from the community consultation, field investigations and design development, only the eastern option and western option were progressed to the multi-criteria analysis.

Overall, the eastern option generally performs better against the WSIP and project objectives and assessment criteria, as presented in Table 4-6.

Table 4-6 Assessment of eastern and western options

WSIP/Project objective	Criteria used for multi-criteria analysis	Assessment of options
1 Support airport construction		
Realignment of The Northern Road around the Western Sydney Airport site to allow construction and facilitation of a Western Sydney Airport at Badgerys Creek	1A project delivery The length of the option (directly relates to length of construction period)	The western option performs marginally better as it would be slightly shorter than the eastern option.
	1B Staging of construction Ability to stage construction to support the early development of the Western Sydney Airport while still facilitating traffic flow along The Northern Road	The eastern option performs substantially better on this criterion than the western option due to its greater flexibility in construction staging, which would enable the early relocation of the section of The Northern Road that bisects the Western Sydney Airport site.
2 Land-use integration		
Development and demand – support the Western Sydney Airport, and land use change and residential growth; balancing functional, social, and environmental and value for money considerations Improve transport connections to the Western Sydney Airport site and surrounding developments including the SWPGA	2A Current development Impacts on current land use	The eastern option performed higher than the western option as it would have a relatively smaller impact on large lot agricultural premises and could provide better access to businesses in the south-east area of the Luddenham town centre.
	2B Future development The opportunities to support the development of the WSPGA and to protect the Mulgoa Valley	The eastern option was considered to better support WSPGA and protect the rural values associated with the Mulgoa Valley.
Realignment of The Northern Road around the Western Sydney Airport site to allow construction and facilitation of a	2C Airport connectivity The opportunities to provide road connections to the Western Sydney Airport site during construction and	The common alignment of all options around the south-western section of the Western Sydney Airport site would allow the provision of a dedicated service access from

WSIP/Project objective	Criteria used for multi-criteria analysis	Assessment of options
Western Sydney Airport at Badgerys Creek	operation of an airport.	The Northern Road Upgrade to the planned airport The eastern option would provide an additional potential access to the Western Sydney Airport site which could be used during construction of an airport.
3 Community		
Development and demand – support the Western Sydney Airport, and land use change and residential growth; balancing functional, social, and environmental and value for money considerations Improve transport connections to the Western Sydney Airport site and surrounding developments including the SWPGA	3A Property acquisition The number and size of private properties requiring total and partial acquisition.	Both the Western and Eastern options would have similar impacts on land use and properties.
	3B Impact on existing businesses Connectivity and access to existing businesses in Luddenham	The eastern option would provide better connectivity for Luddenham
Customer focus – provide meaningful engagement with customers and stakeholders throughout the program life	3C Community preference Feedback from community consultation	Overall the local community expressed a preference for the eastern option.
4 Environment		
Development and demand – support the Western Sydney Airport, and land use change and residential growth; balancing functional, social, and environmental and value for money considerations	4A Non-Aboriginal heritage Impacts on Non-Aboriginal heritage sites or items	Preliminary studies indicated that the eastern option would impact up to four known Non-Aboriginal heritage sites, while the western option would not impact any known Non-Aboriginal heritage sites.
	4B Aboriginal heritage Impacts on Aboriginal heritage sites or items	Both the eastern and western options would impact Aboriginal heritage sites. However, neither option would have significant impacts.
	4C Biodiversity Impacts on State-listed (TSC Act) and Commonwealth listed (EPBC Act) threatened species and communities	Both the eastern and western options would require clearing of State listed and Commonwealth listed threatened vegetation communities. The western option

WSIP/Project objective	Criteria used for multi-criteria analysis	Assessment of options
		would directly impact marginally more areas of threatened vegetation communities than the Eastern option. This was not a differential in the choice of options.
	4D Noise impacts Impacts on the community and sensitive receivers from traffic noise	Overall it was difficult to quantify the difference in potential noise impacts between the two options.
5 Functionality		
Cater for future traffic demand to improve the flow of traffic to provide reliable journeys	5A Maintain arterial road function The ability to maintain a speed limit of 80 km/h, provide a safe road environment and length of road	There was no difference between the eastern and western options in road speed and safety.
Integrated network – provide road improvements to support and integrate with the broader transport network Connectivity to airport – provide a resilient connection to the Western Sydney Airport site for freight and people Cater for future traffic demand to improve the flow of traffic to provide reliable journeys	5B Future motorways connection The opportunities, costs and complexity of connections with the proposed M12 Motorway, Outer Sydney Orbital (OSO) and Elizabeth Drive	The eastern option would provide a wider range of possible connections with the proposed M12 Motorway, and Elizabeth Drive. Also the costs and complexity of the connections with The Northern Road would be lower.
Connectivity to airport – provide a resilient connection to the Western Sydney Airport site for freight and people Cater for future traffic demand to improve the flow of traffic to provide reliable journeys	5C Operation The maximum and average grade of road and other design parameters	Both options performed equally on this criterion.
6 Relative cost / constructability		
Development and demand – support the Western	6A Cost/constructability Cost using the western	The costs for both options were based on early or strategic designs

WSIP/Project objective	Criteria used for multi-criteria analysis	Assessment of options
Sydney Airport, and land use change and residential growth; balancing functional, social, and environmental and value for money considerations	option for comparison	and did not include property acquisition costs. The cost difference was minor.

Summary of evaluation

The outcomes of the workshop and multi-criteria analysis process are outlined in The Northern Road Stage 4 Strategic Route Options Report (RMS and WSP, 2015).

The workshop found that the eastern option is the better overall option when considered across all the evaluation criteria. In particular:

- The eastern option performs better against the WSIP objective of supporting development and demand by providing closer links to the WSPGA and additional opportunities to connect to the Western Sydney airport
- The eastern option supports the current development better by maintaining and improving access through Luddenham
- The eastern option better meets the objective of integrating with the broader transport network as it better supports a future connection with the proposed M12 motorway
- The eastern option performs strongly against the project objective to allow construction of Western Sydney Airport as it allows staging of the road's construction and the closure of The Northern Road existing alignment through the proposed airport site at the earliest opportunity and more opportunities for construction access.

4.3.6 The preferred option

The preferred option is described below.

Segment 1 – between Littlefields Road, Mulgoa and Glenmore Parkway, Glenmore Park

The existing The Northern Road alignment with widening generally to the east.

Segment 2 – Western Sydney Airport bypass

The preferred option involves realigning the road to the west of the Western Sydney Airport site and to the east of Luddenham (the eastern option), before re-joining the existing road alignment at Elizabeth Drive.

After selecting the preferred option, DIRD provided in-principle agreement to use Commonwealth land on the western side of Willowdene Avenue, which meant that the Southern sub-option was no longer required for consideration. At this stage, Roads and Maritime continued discussions with DIRD on the availability of Commonwealth land to the east of Willowdene Avenue for the upgrade. The preferred option that was displayed to the community included a wider corridor around the Western Sydney Airport site that used Commonwealth land to the west and east of Willowdene Avenue. This wider corridor remained until DIRD provided in-principle agreement to use Commonwealth land to the east of Willowdene Avenue (refer Section 4.3.7).

4.3.7 Design refinements to the preferred option

Willowdene Avenue, Luddenham

After announcing the eastern option to the community in November 2015, the Federal Government advised that land on the eastern side of Willowdene Avenue would be available for the upgrade.

Locating on the eastern side of Willowdene Avenue would reduce private property impacts and improve travel times as the route would be shorter and flatter and thus would perform better against assessment criteria 3A, 5A and 5C and the associated project objectives (refer Table 4-6).

As a result, the design of the preferred option was refined to use the land on the eastern side of Willowdene Avenue. Roads and Maritime worked with DIRD to refine the design with consideration to the Western Sydney Airport operational clearance requirements.

The design of the eastern option was also refined to better align with property boundaries to minimise severance of properties, impact on utilities and earthworks.

Defence Establishment Orchard Hills (DEOH)

The preferred option in Segment 1 (option 2) was further refined as part of the concept design process. Following selection of the preferred option and in consultation with the Department of Defence, the area of land take from the Department increased to accommodate property adjustments and drainage infrastructure. The drainage structures are required to minimise increases in the extent of flooding due to the road upgrade. This has resulted in a doubling of the area of impact on DEOH land over what was assessed at the route options stage.

General refinements

As the project progressed through the design development process, changes to the design occurred which are shown in the EIS design. These changes include:

- Removing the section between Glenmore Parkway, Glenmore Park and Jamison Road, Penrith from the project (as outlined in Section 2.10). This is being delivered as a separate project by Roads and Maritime Services and a separate review of environmental factors has been prepared and determined for this project
- Adding kerbside bus lanes to the project. This is to support the provision of road based public transport to the region and, in particular, to the Western Sydney Airport.

Northern access to Luddenham – assessment of options

Different options were considered for connecting the existing The Northern Road and Elizabeth Drive to the preferred eastern route option, including whether to have one or two intersections. Two options were selected based on impact on properties and allowance of appropriate space between traffic lights:

- Luddenham northern access option 1 – a four-way signalised intersection, with realigned Elizabeth Drive
- Luddenham northern access option 2 – two T intersections, namely, a ‘Staggered T’ arrangement with signalised t-intersections at Elizabeth Drive and a new connection to the existing The Northern Road.

The options developed are shown in Figure 4-7 and Figure 4-8.

To determine a preferred Luddenham access option, a multi-criteria analysis was used (as for the short-listed options analysis in Section 4.3.3). Table 4-7 summarises the outcomes of the assessment against the assessment criteria.

Table 4-7 Assessment of Luddenham northern access options

Assessment criteria	Assessment of Luddenham northern access options
1 Support airport construction	
1A project delivery	This is not applicable to either design option.

Assessment criteria	Assessment of Luddenham northern access options
The length of the option (directly related to length of construction period)	
1B Staging of construction Ability to stage construction to support the early development of a Western Sydney Airport at Badgerys Creek while still facilitating traffic flow along The Northern Road	Option 1 scores higher as it can be constructed off The Northern Road mainline, leading to fewer traffic impacts and less traffic management.
2 Land-use integration	
2A Current development Impacts on current land use	Option 1 scores slightly lower due to the potential impacts on an operating business.
2B Future development The opportunities to support the development of the WSPGA and SWPGA	Both options would support the development of the WSPGA and SWPGA.
2C Airport connectivity The opportunities to provide road connections to the Western Sydney Airport site during construction and operation of an airport.	Both options would provide road connections to the Western Sydney Airport site during construction and operation of the airport.
3 Community	
3A Property acquisition The number and size of private properties requiring total and partial acquisition.	Both options would require the partial acquisition of one property.
3B Impact on existing businesses Connectivity and access to existing businesses in Luddenham	Option 1 scores higher as it would provide a direct connection from Elizabeth Drive into Luddenham where there is a concentration on businesses. A view was taken that this factor outweighs the impact on individual business at the intersection.
3C Community preference Feedback from community consultation	Option 1 scores higher as the preference from the community during previous displays for The Northern Road upgrade has been for less traffic lights along The Northern Road.
4 Environment	
4A Non-Aboriginal heritage Impacts on Non-Aboriginal heritage sites or items	Preliminary studies indicate that neither option would impact any known non-Aboriginal heritage sites.
4B Aboriginal heritage	Both options would impact Aboriginal heritage sites.

Assessment criteria	Assessment of Luddenham northern access options
Impacts on Aboriginal heritage sites or items	Option 2 scores slightly higher as it would potentially impact one known potential archaeological deposit (PAD), while option 1 would potentially impact 2 PADs.
4C Biodiversity Impacts on NSW listed (TSC Act) and Commonwealth listed (EPBC Act) threatened species and communities	Both options would minimise impacts on threatened species and communities listed under the NSW TSC Act and Commonwealth EPBC Act.
4D Noise impacts Impacts on the community and sensitive receivers from traffic noise	Overall it was difficult to quantify the difference in potential noise impacts between the two options.
5 Functionality	
5A Maintain arterial road function The ability to maintain a speed limit of 80 km/h, provide a safe road environment and length of road	Both options are designed to achieve an 80 km/h posted speed on the mainline of The Northern Road. During consultation, the community has indicated a preference for fewer intersections. Fewer connections means fewer decision points and potential conflict points, and provide for a safer road environment, with improved legibility for motorists. For these reasons, option 1 scores higher.
5B Future motorways connection The opportunities, costs and complexity of connections with the proposed M12 Motorway, Outer Sydney Orbital (OSO) and Elizabeth Drive	Both options are designed to accommodate the proposed M12 Motorway, Outer Sydney Orbital and Elizabeth Drive connections with The Northern Road.
5C Operation The maximum and average grade of road and other design parameters	Both options are designed to meet Roads and Maritime road design criteria and Austroads standards.
6 Relative cost/constructability	
6A Cost/constructability Cost using the western option for comparison	Option 1 scores higher as it can be constructed off The Northern Road mainline, leading to fewer traffic impacts and less traffic management. This option requires less disruption to the roundabout at the current The Northern Road/Elizabeth Drive intersection while the new intersection is constructed.

Traffic modelling of the two options was also undertaken and is detailed in Section 7.1. The results of the modelling showed moderate performance advantages of option 1 (single four-way intersection) over option 2 (two T intersections).

Based on the above assessment and with consideration of the traffic modelling, on balance, option 1 (single four-way intersection) is the preferred option for access into Luddenham from the north.

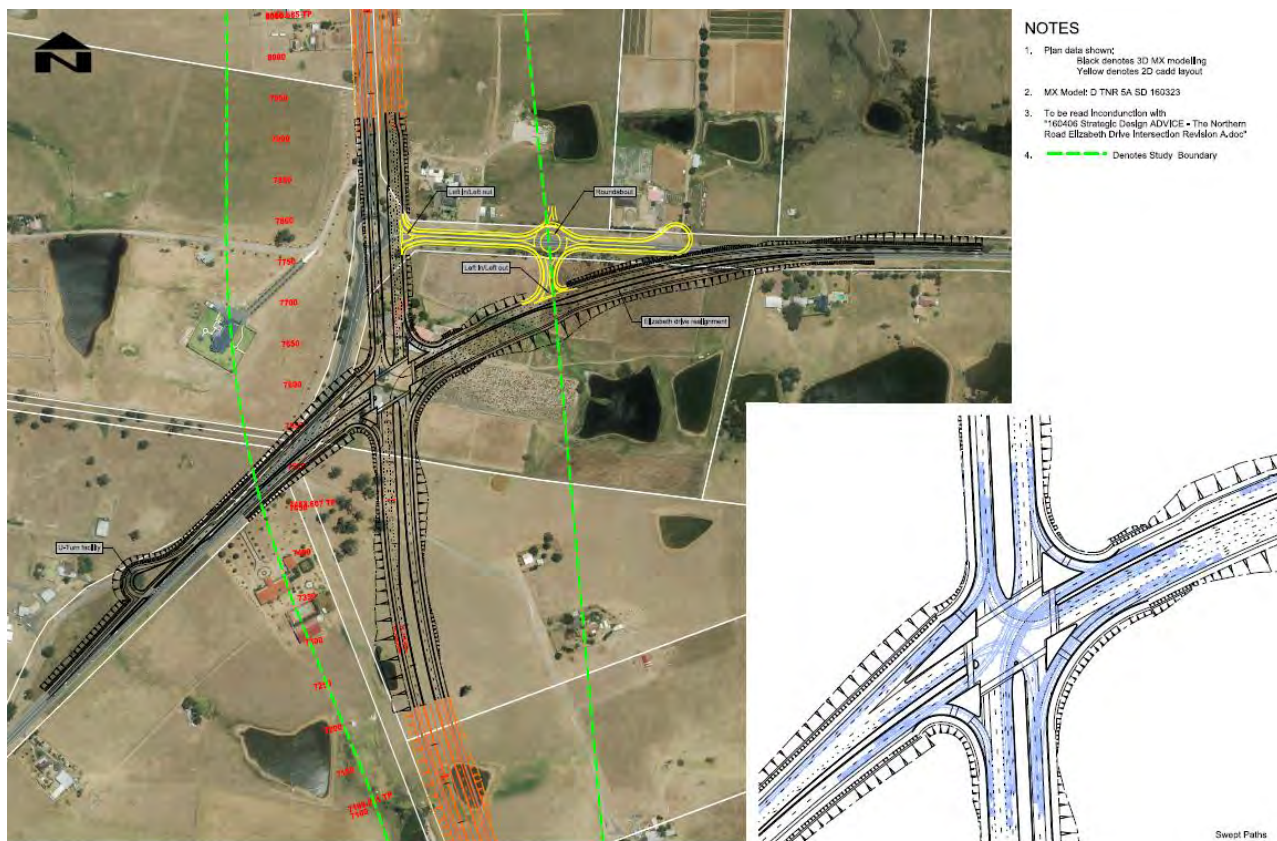


Figure 4-7 Luddenham northern access option 1: A 4-way signalised intersection

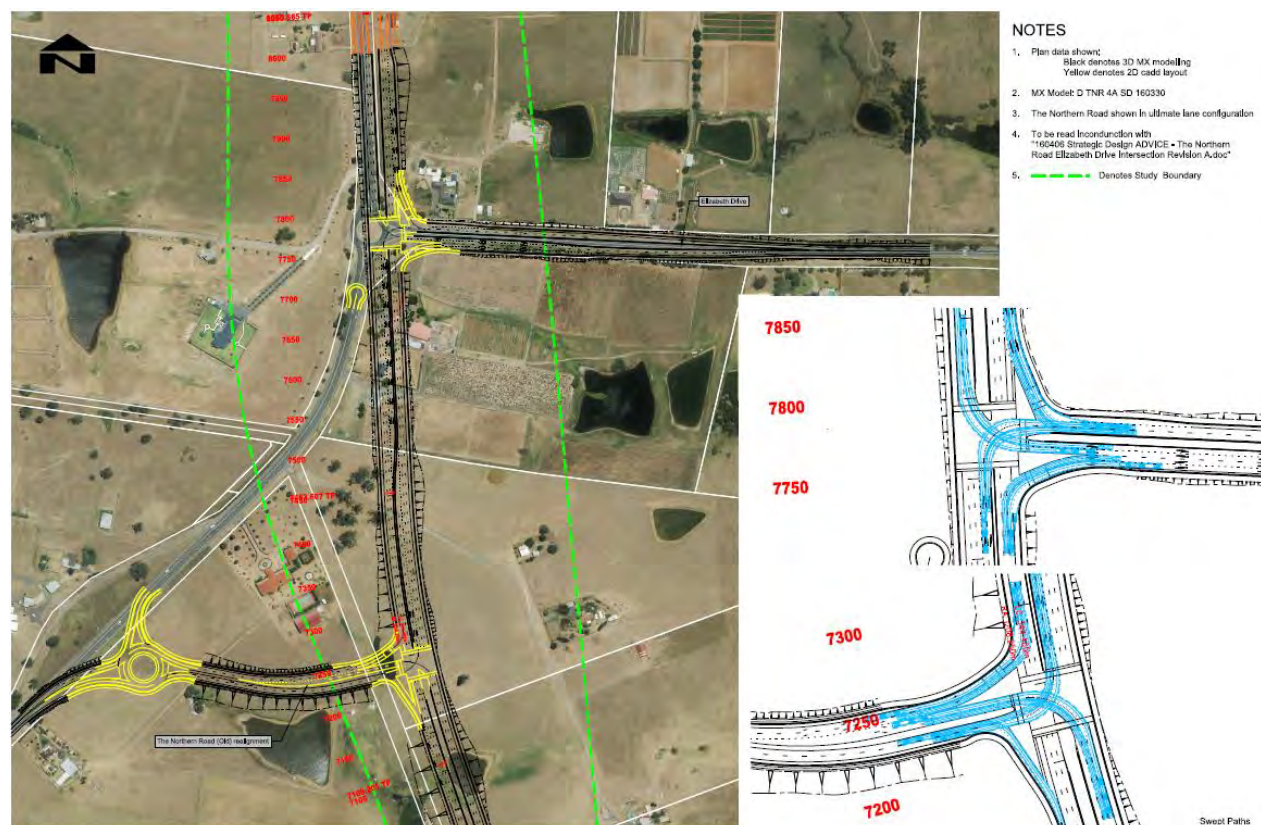


Figure 4-8 Luddenham northern access option 2: 'Staggered T' arrangement

4.4 The project

The merits of the project were considered in the context of other alternatives and a detailed route options development process was carried out early in project planning to avoid or minimise potential environmental impacts from the project where possible.

The preferred option outlined in this EIS was deemed to be in the public interest as it would provide the best outcome of supporting the Western Sydney Airport and catering for the growth in travel demand as a result of the planned land use changes in the region.

The project incorporates the preferred option and the design refinements identified in the previous sections.

Not proceeding with the project would fail to capitalise on the range of strategic and economic benefits discussed in Chapter 3. Traffic modelling has shown that the existing The Northern Road would not be capable of catering for future traffic flow and would be less likely to provide reliable journeys in the future. As such, it would not be able to provide resilient transport connections to the Western Sydney Airport site, proposed road upgrades (such as the proposed M12 Motorway) and other key surrounding developments.

An overview of the project is shown in Figure 1.2 and described in further detail in Chapter 5.

In summary, the project consists of:

- Widening and upgrading the existing The Northern Road generally to the east between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park
- Realigning The Northern Road around the Western Sydney Airport, utilising the Commonwealth land to the east of Willowdene Avenue and continuing north to the east of Luddenham (eastern option) before re-joining the existing road alignment at Elizabeth Drive
- Introducing a four-way signalised intersection and realigning Elizabeth Drive to provide access to Luddenham from the north (Luddenham northern access option 1)
- Bypassing Luddenham town centre.

The project would meet the WSIP and the project objectives, as presented in Table 4-8.

Table 4-8 How the project meets the WSIP and project objectives

Objectives	How the project meets the objectives
WSIP program objectives	
Development and demand Support the Western Sydney Airport, and land use change and residential growth; balancing functional, social, and environmental and value for money considerations	The project would largely meet this objective and provide the best solution to support the Western Sydney Airport and land use changes such as the WSPGA. While bypassing the planned airport site would have environmental impacts, these would be outweighed by the other benefits such as supporting the Western Sydney Airport and other land use changes.
Connectivity to airport Provide a resilient connection to the planned airport site for freight and people	The project would provide a direct connection to the Western Sydney Airport for freight and people.
Integrated network Provide road improvements to	The project would integrate with the proposed M12 Motorway, the existing The Northern Road through

Objectives	How the project meets the objectives
support and integrate with the broader transport network	Luddenham town centre, and other local roads.
Customer focus Provide meaningful engagement with customers and stakeholders throughout the program life	The project is the option preferred by the local community. Customer and stakeholder engagement would continue throughout the EIS, design, construction and operational phases.
The Northern Road Upgrade project objectives	
Realignment of The Northern Road around the Western Sydney Airport site to allow construction and facilitation of a Western Sydney Airport at Badgerys Creek.	The project provides for realignment around the Western Sydney Airport site, which would allow the closure of the required section of the existing The Northern Road at the earliest opportunity. The realigned road would provide sufficient capacity to serve the forecast traffic demand.
Cater for future traffic demand to improve the flow of traffic to provide reliable journeys.	The project would provide an arterial road with up to three lanes in each direction – with provision for widening into the median for a fourth lane to cater for increased traffic volumes.
Improve the transport connections from the Penrith region and M4 Western Motorway to the Western Sydney Airport and surrounding developments including the SWPGA and WSPGA.	The project would meet this objective by integrating with other planned road upgrades (including The Northern Road upgrades to the south of Mersey Road, Bringelly and to the north of Glenmore Parkway, Glenmore Park and the proposed M12 Motorway). The project would also provide a direct transport link between the south, including Campbelltown and the proposed M12 Motorway, and the Western Sydney Airport and land use changes such as the WSPGA.
Improve facilities for public and active transport to promote sustainable and efficient journeys.	The project would include road-based public transport (bus) infrastructure, including a bus lane in each direction and improved bus stops. It would also provide new shared paths and footpaths to cater for pedestrians and cyclists.

The principles of ecologically sustainable development (ESD) were considered and incorporated throughout the identification and development of route options. The ESD principles as defined by the Environmental Planning and Assessment Regulation 2000 (made under the *Environmental Planning and Assessment Act 1979*) include:

- The precautionary principle
- Intergenerational equity
- Conservation of biological diversity and ecological integrity
- Improved valuation, pricing and incentive mechanisms.

The way in which ESD principles were considered throughout route options development are outlined in Table 4-9.

Table 4-9 ESD principles considered throughout route options development

ESD principle	Definition (EP&A Act)	Recognition and application
Precautionary principle	<p>If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:</p> <ul style="list-style-type: none"> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and (ii) (ii) an assessment of the risk-weighted consequences of various options 	<p>The precautionary principle was applied throughout route options development. The project team has taken a proactive approach to identify, avoid and mitigate potential impacts associated with the project by:</p> <ul style="list-style-type: none"> • Carrying out preliminary environmental assessment early to inform the route options process • Establishing environmental goals for the project and embedding them in the multi-criteria assessment process • Avoiding or minimising ecological impacts on vegetation communities and avoiding other areas of high sensitivity. The preferred option (eastern) would directly impact marginally fewer areas of threatened vegetation and result in less vegetation loss and fragmentation than the western option • Avoiding where possible areas of cultural heritage significance • Collating and considering environmental data and impacts for the different alternatives and options. Route option assessment included environmental criteria such as impacts on biodiversity and Aboriginal heritage. <p>Mitigation measures are detailed in Chapter 7 and Chapter 8. Residual impacts have generally been reduced to acceptable levels. However, where significant impacts on biodiversity remain, a detailed biodiversity offsetting program would be implemented.</p>

ESD principle	Definition (EP&A Act)	Recognition and application
Intergenerational equity	The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations	<p>A range of environmental, social and economic aspects were assessed during route options development to ensure intergenerational equity was considered. In particular, the impact of the project has been considered for future scenarios, including:</p> <ul style="list-style-type: none"> • The capacity for the project to accommodate future growth in traffic volumes, including those associated with proposed land uses such as the Western Sydney Airport • Current and future local land uses such as Commonwealth land, agricultural land and business/commercial uses, which were considered through the multi-criteria assessment process • The need to minimise and offset impacts on biodiversity and the need to salvage and record impacts on heritage items. <p>As discussed in Chapter 3, not proceeding with the project would fail to capitalise on the range of strategic and economic benefits discussed above. Additionally, The Northern Road would be unable to accommodate the forecast growth in traffic that is expected due to the development of the Western Sydney Airport and the planned land use changes in western Sydney.</p>
Conservation of biological diversity and ecological integrity	Conservation of biological diversity and ecological integrity should be a fundamental consideration	<p>The assessment of route options and alternatives considered the selection of an option that minimises potential impacts on areas of biological diversity and ecological integrity where possible.</p> <p>This was achieved by carrying out preliminary environmental assessment early to inform the route options process and then collating and considering environmental data and impacts for the different alternatives and options. Route option assessment criteria included environmental criteria such as impacts on biodiversity and Aboriginal heritage.</p>

ESD principle	Definition (EP&A Act)	Recognition and application
Improved valuation, pricing and incentive mechanisms	<p>Environmental factors should be included in the valuation of assets and services, such as:</p> <ul style="list-style-type: none"> (i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, (iii) (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems. 	<p>The principle of internalising environmental costs into decision making requires consideration of all environmental resources that may be affected by a project, including air, water, land and living things. While it is often difficult to place a reliable monetary value on the residual, environmental and social effects of a project, the value placed on environmental resources within and around the corridor is evident in the extent of environmental investigations, planning and design of environmental management measures to prevent adverse environmental impacts as identified in this EIS.</p> <p>Additionally, the costs associated with the planning and design of measures to avoid or minimise adverse environmental impacts and the costs to implement them have been included in the overall project costs.</p>

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