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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

Prepared for
Roads and Maritime Services
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Certification

Submission of environmental impact statement: Prepared under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979*.

Submission of draft environmental impact statement: Prepared under Part 8 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Environmental impact statement prepared by:

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Responsible person / designated Proponent:

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Proposed development / title of the action:

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

Address of the land on which the infrastructure to which the statement relates / location of the action:

The Northern Road is about 45 km west of the Sydney central business district and traverses the local government areas of Penrith in the north and Liverpool in the south, as described within the environmental impact statement. The northern extent of the project is about 100 m south of Glenmore Parkway, Glenmore Park. The southern extent of the project is Mersey Road Bringelly.

Description of the infrastructure to which the statement relates:

Construction and operation of about eight kilometres of new road between Mersey Road and just south of the existing Elizabeth Drive, Luddenham, to realign the section of The Northern Road that currently bisects the Western Sydney Airport site and to bypass Luddenham. Construction and operation of about eight kilometres of upgraded and widened road between just south of the existing Elizabeth Drive intersection to about 100 m south of Glenmore Parkway.

Environmental impact statement:

An environmental impact statement is attached addressing all matters in accordance with Part 5.1 of the *NSW Environmental Planning and Assessment Act 1979*, and in accordance with Part 8 of the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*.

Declaration:

I certify that I have prepared the contents of this environmental impact statement in response to the NSW Secretary's environmental assessment requirements dated 9 March 2016, the relevant provisions of Schedule 2 of the Environmental Planning and Assessment Regulation 2000, the Commonwealth Minister's tailored environmental impact statement guidelines issued 24 August 2016, and Schedule 4 of the Environment Protection Biodiversity Conservation Regulations 2000. The environmental impact statement contains all available information that is relevant to the environmental impact of the infrastructure. To the best of my knowledge the information contained in the environmental impact statement is not false or misleading.

Signature:



Name: Damian Williams

Date: 01/06/2017

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Glossary of terms and abbreviations

Term	Meaning
AADT	Annual Average Daily Traffic: Average daily traffic on a roadway link for all days of the week during a period of one year, expressed in vpd (vehicles per day)
AAWT	Annual average weekday traffic: Similar to AADT but only includes Monday to Friday data
ABS	Australian Bureau of Statistics
Abutment	The end support of a bridge or similar structure
Access	The driveway by which vehicles and/or pedestrians enter and/or leave property adjacent to a road
ADT	Average Daily Traffic: The total traffic volume during a given time period, ranging from 2 to 364 consecutive days, divided by the number of days in that time period, and expressed in vpd (vehicles per day)
AEI	Areas of environmental interest related to potentially contaminated sites
Afflux	An increase in water level resulting from a constriction in the flow path
AHD	Australian Height Datum: The standard reference level used to express the relative height of various features. A height given in metres AHD is essentially the height above sea level. Mean sea level is set as zero elevation
AHIMS	Aboriginal Heritage Information Management System: register of NSW Aboriginal heritage information maintained by OEH
AHIP	Aboriginal Heritage Impact Permit: An Aboriginal Heritage Impact Permit is the statutory instrument that OEH issues under section 90 of the <i>National Parks and Wildlife Act 1974</i> to manage harm or potential harm to Aboriginal objects and places
Aimsun	A microsimulation tool for evaluation of road network performance
ALC	Airport lessee company: The company that is responsible for an airport site and construction of the airport
Alignment	The general route or layout (e.g. of a roadway) in plan (horizontal) and elevation (vertical)
AM peak period	6.00am – 10.00am weekdays

Term	Meaning
ANZECC	Australian and New Zealand Environment and Conservation Council
AQI	Air quality index
ARI	Average reoccurrence interval: Used to describe the frequency or probability of floods occurring (e.g. a 100 year ARI flood is a flood that occurs or is exceeded on average once every 100 years)
ASRIS	Australian Soil Resource Information System
Arterial	The main or trunk road of the State road network
ASS	Acid sulfate soils: Naturally acidic clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen and may produce acidic leachate runoff that can pollute waters and liberate toxins
B-double	A B-double is a class 2 heavy vehicle that consists of a prime mover towing two semitrailers, with the first semitrailer being attached directly to the prime mover by a fifth wheel coupling and the second semitrailer being mounted on the rear of the first semitrailer by a fifth wheel coupling on the first semitrailer
Backfill	Fill replaced in an excavation
BAR	Biodiversity assessment report
Base case / 'do nothing / do minimum	Used in evaluating projects to compare the cost and benefit of the do minimum (the base case) with another or a number of other projects or options
Batter	The side slope of embankments and cuttings which is usually expressed as a ratio of horizontal distance to vertical height value of one
BCR	Benefit cost ratio: The ratio of the monetary benefits to the costs of a project as a measure of worth to the community. The higher the number, the greater the benefits compared to the costs
Blue Book	<i>Soils and Construction, 2008 Volume 2D Main Road</i> . This document provides guidelines, principles and recommended design standards for managing erosion and sediment control during service installation
BoM	Bureau of Meteorology
BOPMP	Biodiversity Offsets Policy for Major Projects

Term	Meaning
Bored piling	A method of piling using drilling or boring
BOS	Biodiversity Offset Strategy
Bridge deck	The surface of the bridge including road and pedestrian/cyclist path
BSA	Bureau of Statistics and Analytics, Transport for NSW
BTS	Bureau of Traffic Statistics
Carriageway	The portion of roadway used by vehicles including shoulders and ancillary lanes
Casting bed	A temporary work area where concrete is placed to construct the bridge prior to launching the bridge into its final position
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location
CCHMP	Construction Cultural Heritage Management Plan
CEEC	Critically endangered ecological community
CEMP	Construction Environmental Management Plan
Chainage	Measurement at a particular point along a line as measured from a fixed starting point (in metres)
CHAR	Cultural heritage assessment report
CHL	Commonwealth Heritage List
CMA	Catchment Management Authority
CNVMP	Construction Noise and Vibration Management Plan
Collector road	A local road that moves traffic to arterial roads
Commonwealth EIS Guidelines	Refers to the <i>Guidelines for the content of a draft environment impact statement: The Northern Road Upgrade: Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park</i> (Reference: EPBC 2016/7696), issued by the Commonwealth Department of Environment and Energy on 24 August 2016
Concrete	A mixture of fine and coarse aggregate, water, cement and admixtures
CPoM	Corridor plan of management

Term	Meaning
CPSWSGTF	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
Cross-section	A vertical section, generally at right angles to the centreline showing the ground. On drawings it commonly shows the road to be constructed, or as constructed
Cryptic species	When referring to plants and animals this refers to size, shape and/or coloration or markings that serve to camouflage the plant or animal in its natural environment. Some plants may not be present above ground at certain times of the year
Cut	The depth from the natural surface of the ground to the subgrade level
Cutting	The formation resulting from the construction of the road below existing ground level. The material is cut out or excavated
CWEMP	Construction Waste and Energy Management Sub-Plan
dB(A)	Decibels using the A-weighted scale measured according to the frequency to the human ear
DEOH	Defence Establishment Orchard Hills
Design speed	A speed fixed for the design and correlation of those geometric features of a carriageway that influence vehicle operation. Design speed should not be less than the intended 85th percentile speed
Design standard	The particular standards used in the design, such as a standard lane width
DGA	Dense graded asphalt
DIRD	Commonwealth Department of Infrastructure and Regional Development
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m ³ /s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving (e.g. metres per second [m/s])
DO	Dissolved Oxygen
DoD	Department of Defence
DOEE	Commonwealth Department of Energy and Environment
DPE	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries

Term	Meaning
DRAINS Model	<p>DRAINS is a simulation program which uses hydrologic sub-models (RAFTS and ILSAX) to convert rainfall patterns to stormwater runoff and generates discharge hydrographs</p> <p>Discharge hydrographs generated by DRAINS are used as inflows to hydraulic models (such as the TUFLOW two-dimensional hydraulic modelling software) to determine flooding patterns</p>
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock
EEC	Endangered ecological community: An ecological community identified as having endangered status under the NSW <i>Threatened Species Conservation Act 1995</i>
EEO	Energy efficiency opportunities
EIS	Environmental impact statement: An environmental impact assessment document prepared for the purposes of Part 5.1 of the <i>Environmental Planning and Assessment Act 1979</i> (NSW), and written generally to comply with the requirements issued by the Secretary of the NSW Department of Planning and Environment
EIS assessment requirements	Collectively refers to the Commonwealth <i>Guidelines for the content of a draft environmental impact statement: The Northern Road Upgrade: Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park</i> (Reference: EPBC 2016/7696)
Embankment	An earthen structure where the road subgrade level is above the natural surface
EMP	Environmental Management Plan
EMS	Environmental management system: A quality system that enables an organisation to identify, monitor and control its environmental aspects. An EMS is part of an overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, reviewing and maintaining its environmental policy and performance
ENMM	RMS Environmental Noise Management Manual
EPA	NSW Environment Protection Authority
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>

Term	Meaning
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	Environmental protection license: The <i>Protection of the Environment Operations Act 1997</i> (POEO Act) establishes the NSW environmental regulatory framework and includes a licensing requirement for certain activities. Environment protection licences are a central means to control the localised, cumulative and acute impacts of pollution in NSW
ESD	Ecologically sustainable development: As defined by the <i>Protection of the Environment Administration Act 1991</i>
FBA	Framework for Biodiversity Assessment: The Framework for Biodiversity Assessment prepared by the NSW Office of Heritage and Environment underpins the Biodiversity Offset Policy for Major Projects. It contains the assessment methodology that is adopted by the policy to quantify and describe the impact assessment requirements and offset guidance that apply to Major Projects
Fill	The material placed in an embankment
Flood affected area	Land susceptible to flooding by a PMF event
Foundation	The soil or rock upon which a structure rests
GDA	Geocentric Datum of Australia
GDE	Groundwater dependent ecosystems
Girder	A type of support beam
GHG	Greenhouse gases: Greenhouse gases are those gases that reduce the loss of heat in the earth's atmosphere by absorbing infrared radiation. Six greenhouse gases are regulated by the Kyoto Protocol. These gases include carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluocarbons and perfluorocarbons
Gutter	A drain which is lined or paved (along the side of a road)
Ha	Hectare
Headstocks	A structure that sits on top of bridge piers that supports the superstructure and deck of a bridge
HRC	Healthy Rivers Commission
Hydraulic	The term given to the study of water flow in waterways, in particular the evaluation of flow parameters such as water level and velocity

Term	Meaning
Hydrograph	A graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood
Hydrology/Hydrologic	The term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods
IBRA	Interim Biogeographic Regionalisation for Australia
ICNG	NSW EPA Interim Construction Noise Guideline
ILSAX	The hydrologic sub-model used to assess the runoff characteristics of the project
INP	NSW Industrial Noise Policy
In situ	An operation carried out on a material in its final position
ISCA	Infrastructure Sustainability Council of Australia
ITS	Intelligent transport system: The use of electrical, electronic, communication, computer technologies and Information Technologies (IT) for increasing traffic flow, improving safety and reducing greenhouse gasses. Such devices and systems can be employed to gather data, control traffic and/or inform road users. The systems range from technically simple to quite complex projects in both concept and scale
Kerb	An edge stone or concrete shape used for bordering a road and defining the footway
LAeq	The equivalent continuous sound level: This is the energy average of the varying noise over the sample period and is equivalent to the level of constant noise which contains the same energy as the varying noise environment. This measure is a common measure of environmental noise and road traffic noise
LA90	The noise level which is exceeded for 90 per cent of the sample period. During the sample period, the noise level is below LA90 level for 10 per cent of the time. This measure is commonly referred to as background noise level
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features
LCZ	Landscape Character Zones
LEP	Local environmental plan

Term	Meaning
LoS	The 'Level of Service: The standard measure used to assess the operational performance of these intersections. Level of service is ranked from LoS A to LoS F, with LoS A representing the best performance and LoS F the worst. The LoS is based on the average delay experienced by vehicles driving through the intersection (in seconds)
LGA	Local government area
LPC	Leppington Pastoral Company
MNES	Matters of national environmental significance: Matters listed under the EPBC Act
Median	The central reservation which separates carriageways from traffic travelling in the opposite direction
Midblock count	The volume of vehicles crossing an arbitrary line, some distance from an intersection
Milling	Removing the surface of a pavement (typically 25 to 75 mm deep) with a machine equipped with a transverse rotating cutter drum
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NCA	Noise catchment areas
NCG	Noise Criteria Guidelines
NML	Noise management levels
Obstacle limitation surface	The Obstacle Limitation Surfaces define the volume of airspace that should ideally be kept free from obstacles in order to minimise the danger to aircraft during an entirely visual approach
OEH	NSW Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential archaeological deposits
Pavement	The portion of carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic
PCT	Plant community types

Term	Meaning
pH	A figure expressing the acidity or alkalinity of an aqueous solution on a logarithmic scale. 7 is neutral, lower values are more acid and higher values are more alkaline
Peak discharge	The maximum discharge occurring during a flood event
Pier	An intermediate support in a bridge having more than one span. Part of the substructure supporting the superstructure and transferring the loads to the foundations
Pile	A slender member driven, screwed or formed in the ground to resist loads or thrust
PM10	Particulate matter less than 10 microns in diameter
PM peak period	3.00pm–7.00pm weekdays for vehicle travel
PMF	Probable maximum flood: The largest flood that could conceivably occur at a particular location, usually estimated from the probably maximum precipitation. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain
Project footprint	The extent of impact that the project makes on the land
Open space	Space available for recreational uses
Overshadowing	The shadow cast by a structure
RAFTS	A non-linear runoff routing software. It incorporates subcatchment information such as area, slope, roughness and percentage impervious and is used to simulate the transformation of historic or design rainfall into runoff (i.e discharge hydrographs)
RBL	Rating background level: As defined by the NSW Industrial Noise Policy is it the overall single figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-h period used for the assessment background level)
Reinforced concrete	Concrete strengthened within its mass by steel bars, mesh or steel fibres
Reinforcement	Bars or mesh (usually steel) embedded in concrete, masonry or brickwork for the purpose of resisting particular stresses (e.g. tensile or temperature related stresses)

Term	Meaning
Receiver	An environmental modelling term used to describe a map reference point where the impact is predicted. A sensitive receiver is a home, work place, school or other place where people spend some time
Retaining wall	A wall constructed to resist lateral pressure from the adjoining ground or to maintain in position a mass of earth
Riparian	Relating to the banks of a natural waterway
RMS	Roads and Maritime Services NSW (formerly Roads and Traffic Authority)
RNE	Register of the National Estate
RNP	NSW Road Noise Policy
Roadwork	A general term for any work on a road for construction, repair or maintenance
Rock rip rap protection	Medium to large size rock protection, against scour, applied (usually by dumping) to the face of an embankment
Roundabout	An intersection where all traffic travels in one direction around a central island
RTA	(former) Roads and Traffic Authority (now RMS)
Safety barrier	A physical barrier separating roadside hazards or opposing traffic and the travelled way, designed to resist penetration by an out-of-control vehicle and, as far as practicable, to stop or redirect colliding vehicles
Scour	The erosion of material by the action of flowing water
SEARs	Secretary's environmental assessment requirements
Section 170 register	A register established in accordance with section 170 of the <i>Heritage Act 1977</i> to record all heritage items in the ownership or under control of Roads and Maritime (or other State government agencies)
Shared path	A path used by both cyclists and pedestrians, usually located on the side of the road
Shoulder	The portion of the carriageway beyond the traffic lanes adjacent to and flush with the surface of the pavement
SHR	NSW State Heritage Register
Site compound	Area enclosing construction machinery, stockpiles, site offices and other ancillary facilities

Term	Meaning
Span	The distance between centres of adjacent supports of a bridge
Spoil	Surplus excavated material
Stockpile	Temporarily stored materials such as soil, sand, gravel and spoil/waste
Sub-arterial	A road that supports and links State roads
Subgrade	The trimmed or prepared portion of the formation on which the pavement is constructed
Substructure	In a bridge, the piers and abutments (including wing walls) which support the superstructure
Superstructure	That part of a bridge structure which is supported by the piers and abutments
SWMP	Soil and Water Management Plan
SWPGA	South West Priority Growth Area
SWSUDS	South Western Sydney Urban Design Strategy
TMP	Traffic Management Plan
TN	Total Nitrogen
TNR	The Northern Road
TP	Total Phosphorus
Transects	A line or narrow belt along which environmental data is collected
TRAQ	Tool for Roadside Air Quality
TSC Act	NSW <i>Threatened Species Conservation Act, 1995</i>
Total Suspended Solids (TSS)	Total suspended solids (TSS) are particles that are larger than 2 microns found in the water column
TUFLOW	TUFLOW is a two-dimensional hydraulic modelling software that is used to determine flooding patterns
Underpass	A tunnel constructed for the use of pedestrians and cyclists under a carriageway
Urban design	The process and product of designing human settlements and their supporting infrastructure, in urban and rural environments
UXO	Unexploded ordnance
Vertical alignment	The longitudinal profile along the design line of a road

Term	Meaning
View point	A point in the landscape chosen to measure impacts to visual amenity
VIS	Vegetation information system
VKT	Vehicle kilometres of travel
VMS	Variable message signs
Water quality basin	An area where stormwater is ponded to be treated before entering a waterway
WSIP	Western Sydney Infrastructure Plan
WSPGA	Western Sydney Priority Growth Area

Executive summary

The Australian and NSW governments are planning to upgrade The Northern Road as part of the \$3.6 billion Western Sydney Infrastructure Plan (WSIP) to improve safety, increase road capacity and reduce travel times and congestion in the future. This environmental impact statement (EIS) considers the environmental, social and economic impacts of The Northern Road Upgrade between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park.

Roads and Maritime Services is seeking planning approval for the project under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Part 8 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This EIS describes the project and why it is needed, assesses the impacts of the project and identifies measures that would be implemented to avoid and minimise those impacts. It also includes technical papers used to inform the preparation of this assessment.

What is proposed?

Roads and Maritime is seeking approval to upgrade 16 km of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park (the project). The location and key features of the project are shown in Figure 1. The key features are:

- A six-lane divided road between Mersey Road, Bringelly and Bradley Street, Glenmore Park (two general traffic lanes and a kerbside bus lane in each direction). A wide central median would allow for an additional travel lane in each direction in the future, if required
- An eight-lane divided road between Bradley Street, Glenmore Park and just south of Glenmore Parkway, Glenmore Park (three general traffic lanes and a kerbside bus lane in each direction separated by a central median)
- About eight kilometres of new road between Mersey Road, Bringelly and just south of the existing Elizabeth Drive, Luddenham to realign the section of The Northern Road that currently runs through the Western Sydney Airport site
- About eight kilometres of upgraded and widened road between the existing Elizabeth Drive, Luddenham and just south of Glenmore Parkway, Glenmore Park
- Access to the Luddenham town centre from north of the realigned The Northern Road and the existing The Northern Road
- Twin bridges over Adams Road, Luddenham
- Four new traffic light intersections and new traffic lights at existing intersections
- Local road changes and upgrades to current access arrangements for businesses and private properties
- A new shared path for pedestrians and cyclists on the western side of The Northern Road and footpaths on the eastern side of The Northern Road where required.

The project assessed in this EIS/draft EIS does not include investigative works such as surveys, test drilling, test excavations, geotechnical investigations or other tests, surveys, sampling or investigation which inform the design or assessment of the project.

A detailed description of the project's key features can be found in Section 1.1.

What are the project objectives?

Program objectives for the WSIP were developed in February 2015 by Roads and Maritime, Transport for NSW and the Australian Government. The four key focus areas for WSIP and associated program objectives are:

- Development and demand – support the Western Sydney Airport, land use change and residential growth; balancing functional, social, environmental and value for money considerations
- Connectivity to airport – provide a resilient connection to the Western Sydney Airport site for freight and people
- Integrated network – provide road improvements to support and integrate with the broader transport network
- Customer focus – provide meaningful engagement with customers and stakeholders throughout the program life.

As a key part of WSIP, the project would deliver a combination of new, additional and renewed infrastructure. In consideration of the broader objectives for the WSIP, specific objectives were developed for the project. They are to:

- Realign The Northern Road around the Western Sydney Airport site to allow construction and facilitation of the Western Sydney Airport at Badgerys Creek
- Cater for future traffic demand to improve the flow of traffic to provide reliable journeys
- Improve transport connections to the Western Sydney Airport site and surrounding developments including the South West Priority Growth Area (SWPGA) (previously known as the South West Growth Centre) and Western Sydney Priority Growth Area (WSPGA) (previously known as the Broader Western Sydney Employment Area)
- Improve facilities for public and active transport to promote sustainable and efficient journeys.

Supporting project assessment criteria were also developed to support the justification of a preferred option. The supporting project assessment criteria are:

- Minimise environmental impacts
- Deliver a cost effective project
- Improve road safety
- Maintain arterial road function
- Accommodate access to the south-western end of the Western Sydney Airport.

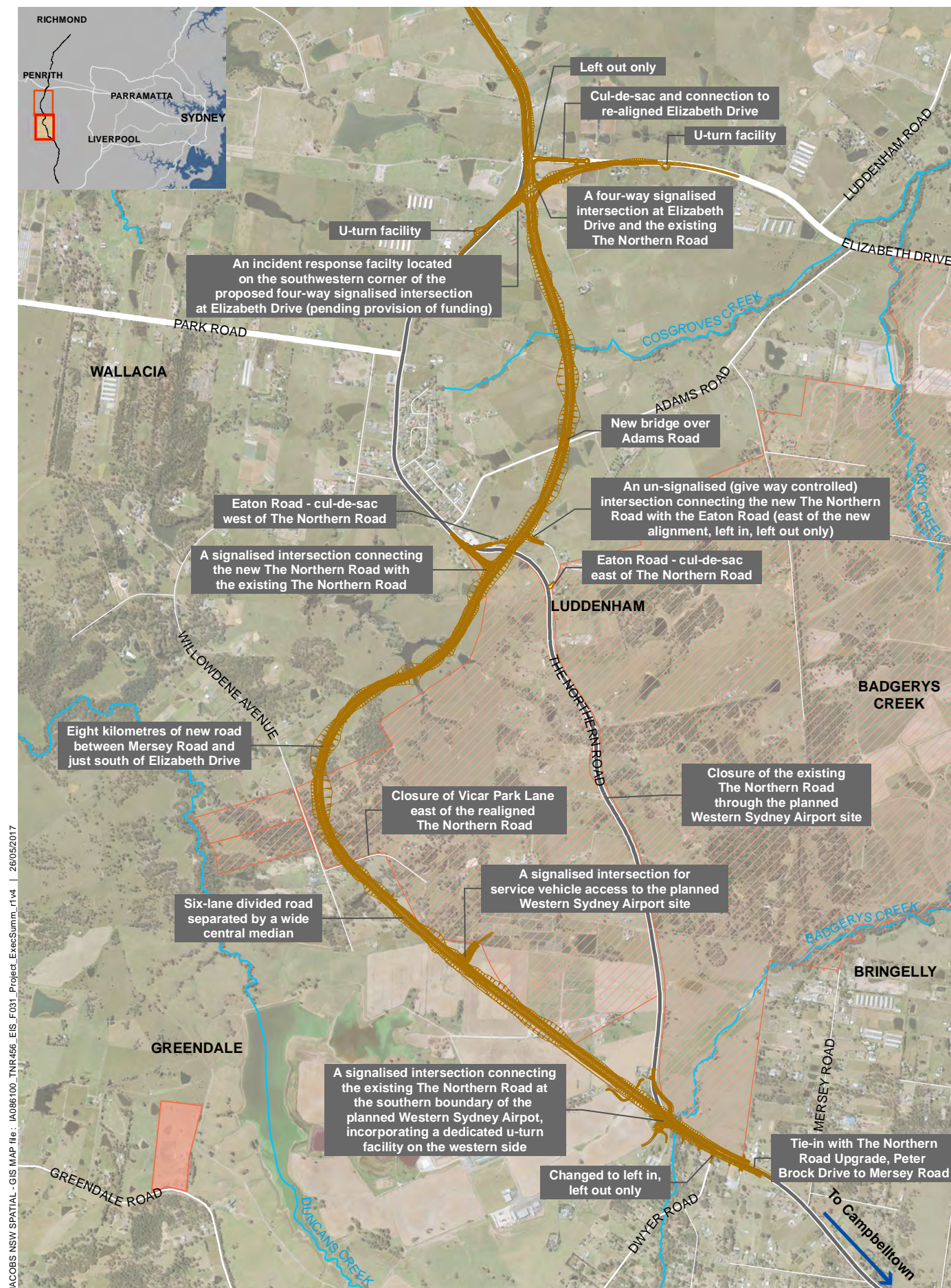
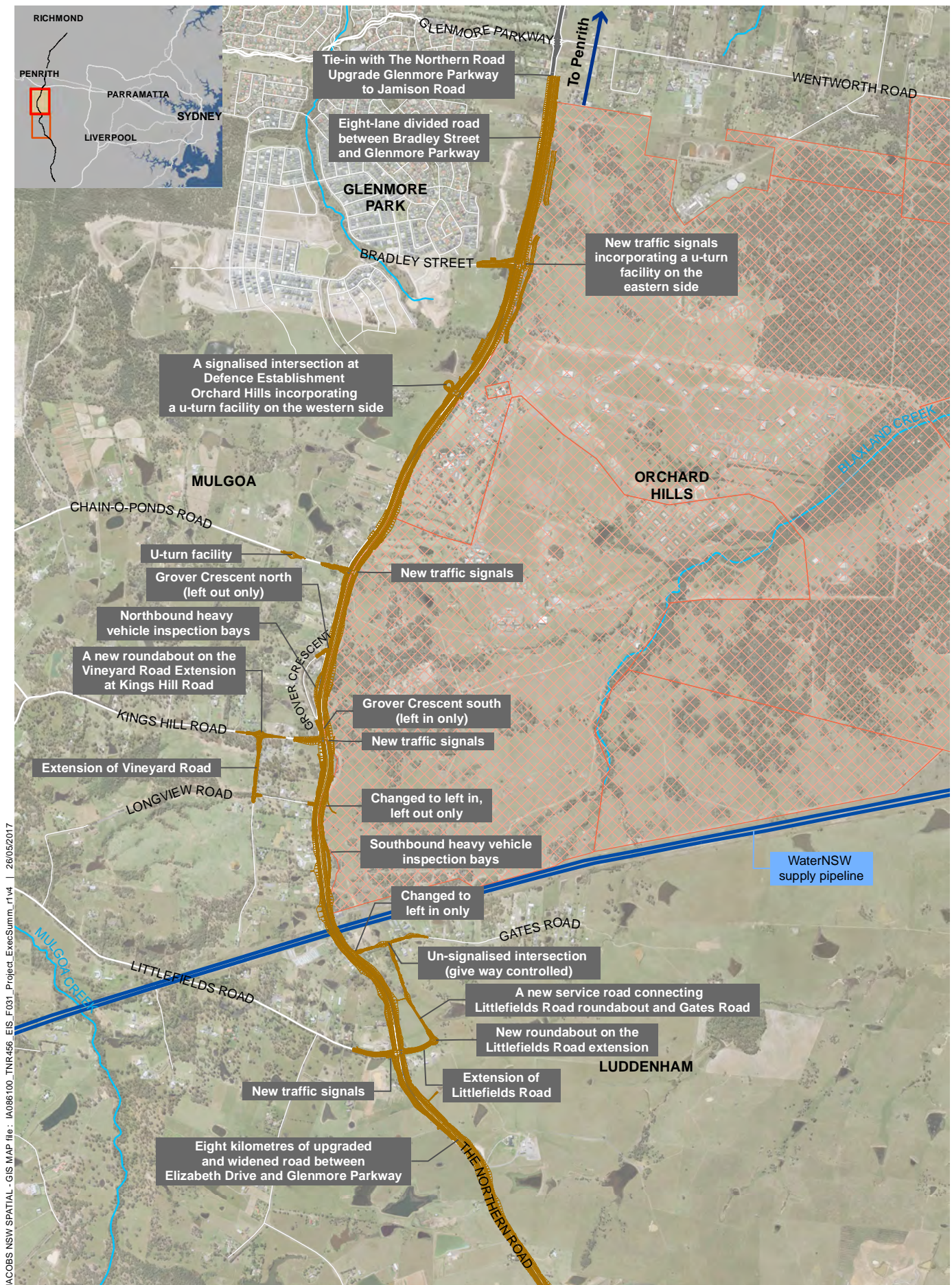


Figure 1 | Overview of the project



Why is it needed?

The project is located in western Sydney, which has a population of about two million people. This is expected to increase by around one million people by 2031 (NSW Government, 2014).

To cater for this expected growth, WSIP would deliver major road infrastructure upgrades to support an integrated transport solution for the region and to capitalise on the economic benefits from developing Western Sydney Airport. The project, as part of the WSIP, is the Australian and NSW governments' commitment to facilitate the Australian Government's timetable and transport functionality for the Western Sydney Airport construction and operation.

Additionally, a substantial amount of development is planned over the next 30 years and "transforming the productivity of western Sydney through growth and investment" is a key direction of the NSW Government's plan for the future of the Sydney Metropolitan Area – *A Plan for Growing Sydney*.

Connecting to The Northern Road via Elizabeth Drive, the WSPGA would open up over 10,000 ha of land to employment, with a focus on freight and logistics. The Western Sydney Airport at Badgerys Creek would provide a new activity hub and provide an international gateway to western Sydney. The SWPGA connecting to The Northern Road corridor from the south and east, will add some 300,000 new residents to the area, with schools, shops and other facilities.

These major land use changes, together with natural growth in the regional centres of Penrith and Campbelltown, will drive a dramatic increase in traffic demand in the region.

Currently The Northern Road, between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park, is a two-lane rural road on a single carriageway for the majority of its length. Its performance is largely dependent on the operating performance of key intersections, which can form traffic pinch points.

The 'Level of Service' (LoS) is the standard measure used to assess the operational performance of these intersections. Level of Service is ranked from LoS A to LoS F, with LoS A representing the best performance and LoS F the worst. The LoS is based on the average delay experienced by vehicles driving through the intersection (in seconds).

Currently, intersections along The Northern Road generally experience good operation (LoS A to B) or at least good operation with acceptable delays and spare capacity.

However, testing of the performance of The Northern Road under future year scenarios (2021 and 2031) shows that there would be insufficient capacity along The Northern Road under existing road network conditions. It is likely that under the existing network conditions, future traffic demand would reach a level where delays across a number of intersections become unacceptable (generally LoS D to F) and no further growth in traffic would be possible.

The pressures placed on the surrounding road network by the planned growth in western Sydney, as well as the predicted passenger and freight traffic generated by the Western Sydney Airport would exceed the capacity of the current The Northern Road, particularly at existing priority intersections along the corridor.

How would the project satisfy this need?

Once complete, the project would cater for the substantial forecast traffic growth and provide connectivity to and from the Western Sydney Airport – connecting the M4 Western Motorway and the proposed M12 Motorway. The project would also improve road safety and public and active transport facilities, promoting more sustainable and efficient journeys.

Analysis of the intersection performance along The Northern Road with the project (refer Table 1) shows that most of the intersections within the study area would operate satisfactorily under the 2021 and 2031 future year scenarios with LoS C or better. The only exception would be the intersection of The Northern Road and Elizabeth Drive, which would be operating near capacity in the evening peak hour at LoS D by 2021. This is due to the large volumes of conflicting traffic movements that are forecast to travel through this intersection by 2021.

Table 1: Intersection performance summary 'with the project'

Intersection	2015		2021		2031	
	Av. delay (sec)	LoS	Av. delay (sec)	LoS	Av. delay (sec)	LoS
Morning peak						
The Northern Road / Bradley Street	27	B	30	C	36	C
The Northern Road / DEOH Access	10	A	22	B	31	C
The Northern Road / Chain-O-Ponds Road	8	A	11	A	17	B
The Northern Road / Kings Hill Road	11	A	15	B	27	B
The Northern Road / Littlefields Road	13	A	17	B	33	C
The Northern Road / M12 Motorway	¹	¹	¹	¹	27	B
The Northern Road / Elizabeth Road	24	B	41	C	41	C
The Northern Road / Park Road	26	B	-	-	-	-
The Northern Road Existing / The Northern Road Realigned (southern Luddenham access)	-	-	21	B	26	B
The Northern Road / Western Sydney Airport Access	¹	¹	¹	¹	30	C
Evening peak						
The Northern Road / Bradley Street	34	C	33	C	42	C
The Northern Road / DEOH Access	16	B	20	B	25	B
The Northern Road / Chain-O-Ponds Road	10	A	14	A	22	B
The Northern Road / Kings Hill Road	10	A	26	B	32	C
The Northern Road / Littlefields Road	13	A	15	B	18	B
The Northern Road / M12 Motorway	¹	¹	¹	¹	33	C
The Northern Road / Elizabeth Road	19	B	44	D	45	D
The Northern Road / Park Road	19-	B-	-	-	-	-
The Northern Road Existing / The Northern Road Realigned (southern Luddenham access)	-	-	18	B	22	B
The Northern Road / Western Sydney Airport Access	¹	¹	¹	¹	40	C

1. M12 Motorway and Western Sydney Airport would be built after 2021

Additionally, the project would provide connectivity to the Western Sydney Airport through the provision of high capacity traffic and freight links between the airport and the M4 Western Motorway (via The Northern Road Upgrade) and south-western Sydney including Campbelltown and the proposed M12 Motorway. The project would also improve road safety and provide improvements to public and active transport facilities, promoting sustainable and efficient journeys.

What is the approval process for the project?

Roads and Maritime has formed the opinion that the project is likely to significantly affect the environment; and has prepared an EIS seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) and approval from the Australian Government Department of Environment and Energy in accordance with the requirements of Part 8 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The project was declared to be State significant infrastructure under Schedule 5 of the State Environmental

Planning Policy (State and Regional Development) 2011) on 5 July 2016. The Secretary's Environmental Assessment Requirements (SEARs) for the project were issued on 28 July 2015 and re-issued on 9 March 2016. The re-issued SEARs were in response to the decision by Roads and Maritime to assess and deliver the upgrade work between Glenmore Parkway, Glenmore Park and Jamison Road, Penrith as a separate, stand-alone activity.

The Australian Government Department of Environment and Energy has formed the view that a part of the project may have a significant impact on Matters of National Environmental Significance (MNES), including a significant impact on Commonwealth land (i.e. Defence Establishment Orchard Hills (DEOH) and the Western Sydney Airport site). Hence, the NSW Assessment Bilateral Agreement would not apply to the project. As such, a separate environmental assessment process under the EPBC Act is required for the project.

Therefore, following provision of preliminary information, the delegate for the Federal Minister for the Environment and Energy determined on 21 July 2016 that the project be assessed by an EIS. In making this determination the delegate for the Minister issued to Roads and Maritime, on 24 August 2016, Guidelines for the Content of a draft Environmental Impact Statement (Commonwealth EIS Guidelines).

To streamline the environmental assessment requirements under Part 5.1 of the EP&A Act and Part 8 of the EPBC Act, one EIS (this document) has been prepared that addresses both the environmental assessment requirements of the Secretary of the NSW Department of Planning and Environment (SEARs) and the Commonwealth EIS Guidelines. A copy of the SEARs is contained in Appendix B and a copy of the Commonwealth EIS Guidelines is contained in Appendix C.

For the purpose of this planning application for the project, Roads and Maritime is the proponent.

What alternatives were considered?

The following alternatives to the project were considered:

- Alternative 1 – the base case or do nothing / do minimum ('do minimum')
- Alternative 2 – realignment and upgrading of The Northern Road.

These alternatives were assessed based on the extent to which they could meet the WSIP objectives, project objectives and assessment criteria as well as how they performed with reference to other transport, environmental, engineering, social and economic factors.

After considering feedback from stakeholders (including Australian, NSW and local government agencies, specialist engineering and environmental consultants and the community), Roads and Maritime concluded that Alternative 2 (realignment and upgrade of The Northern Road) is preferred. This is because it would provide the best outcome by 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.

Route options development

The project was divided into two key segments to facilitate the development and assessment of route options for Alternative 2. These segments were:

- Segment 1 – The Northern Road corridor between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park
- Segment 2 – Realignment of The Northern Road between Mersey Road, Bringelly and Littlefields Road, Luddenham to bypass the Western Sydney Airport.

Segment 1 generally involved options to widen the existing road corridor to either the east or the west. During the Options and Scoping Value Management Workshop held in March 2015, 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. Upgrading the road within the existing road corridor and widening to the east was chosen as the preferred option as it would result in

substantially less private property acquisition compared to Option 1 and because this has a lower project cost and higher overall performance against WSIP and project objectives.

Segment 2 includes a substantial portion of the existing The Northern Road within the Western Sydney Airport site. As such, options were developed to facilitate a bypass of the Western Sydney Airport site. In developing options, consideration was also given to whether or not to bypass the township of Luddenham due to the impacts that road widening would have on the township.

An initial list of 12 options was subsequently reduced to four shortlisted options following desktop assessments, field studies, value management workshops held in April and May 2015 and community and stakeholder consultation.

Of the four shortlisted options, the eastern option (option 9) was chosen as the preferred route for Segment 2 as it performed best against the WSIP and project objectives and was generally favoured by the community, particularly the residents of Luddenham.

How did the community participate in selecting the preferred project?

An extensive community consultation program for the project and other WSIP projects has been carried out.

In July and August 2015, Roads and Maritime released a preliminary design and access strategy for The Northern Road Upgrade between Mersey Road, Bringelly and Littlefields Road, Luddenham and route options for the proposed realignment of The Northern Road to bypass Luddenham and the Western Sydney Airport for community and stakeholder comment.

In November 2015, Roads and Maritime announced the preferred route for The Northern Road Upgrade between Mersey Road, Bringelly and Littlefields Road, Luddenham (Segment 2). The four shortlisted route options in Segment 2 were placed on public display for community feedback. A number of submissions were received during the consultation period.

After considering early studies and community feedback, the eastern option that provides a bypass of Luddenham town centre and avoids homes along the existing The Northern Road was selected as the preferred route.

In February and March 2016, Roads and Maritime displayed the preliminary design and access strategy between Mersey Road, Bringelly and Adams Road, Luddenham. At that time, the community was informed that more information on The Northern Road Upgrade, between Adams Road and Littlefields Road, would be presented to the community in mid-2016, following further investigations of other transport projects in the area.

In May 2016, Roads and Maritime released a Consultation Report detailing stakeholder and community feedback following consultation of the preliminary design and access strategy between Mersey Road, Bringelly and Adams Road, Luddenham.

In July 2016, Roads and Maritime announced the preliminary design and access strategy between Eaton Road and Littlefields Road, Luddenham and alternative access arrangements for Littlefields Road and Gates Road, Luddenham. Roads and Maritime also issued responses to the 22 submissions received from community members, stakeholders and property owners. The submissions received from the community members, stakeholders and property owners were considered in the preparation of this EIS.

What are the main project benefits?

As a key component of The Northern Road Upgrade and WSIP, the project would provide greater connectivity and cater for future traffic from planned residential and commercial developments in time for the opening of the Western Sydney Airport.

The development of this project would:

- Facilitate the construction and ongoing operation of the Western Sydney Airport

- Address existing road safety and intersection performance
- Accommodate future traffic growth and improve accessibility for road users accessing the WSPGA, SWPGA and other development projects in western Sydney
- Develop new infrastructure for public and active transport modes
- Support regional benefits related to the broader program of upgrades proposed under WSIP, such as the provision of high capacity traffic and freight links
- Support the development and operation of the Western Sydney Airport and WSPGA.

This EIS also assesses the potential direct and indirect beneficial impacts of the project during construction and operation. Additional benefits of the project would be:

- Socio-economic benefits such as:
 - improved access and connectivity to community services and facilities within or near the project area
 - improved access and connectivity to employment areas in the project area and the western Sydney region
 - improved amenity of the Luddenham town centre through the removal of heavy vehicles
 - the creation of direct and indirect employment opportunities during construction
 - increased expenditure by construction workers on local goods and services
- New and upgraded drainage infrastructure
- Improved active transport facilities (walking and cycling paths).

What are the main impacts expected?

The route options development process was used to avoid or minimise potential environmental impact from the project where possible. Notwithstanding, the project would have impact during construction and operation.

The total construction footprint (including compound and laydown sites) is estimated at about 278 ha. Within this footprint, the following impacts on biodiversity are expected:

- Removal of up to 39.6 ha of remnant native vegetation as assessed under the Framework for Biodiversity Assessment (FBA), including about:
 - 29.14 ha of Cumberland Plain Woodland in the Sydney Basin Bioregion ecological community, which is listed as critically endangered under the *Threatened Species Conservation Act* (TSC Act)
 - 4.29 ha of the TSC Act listed River-Flat Eucalypt Forest on Coastal Floodplains
- Removal of about 16.37 ha of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community, listed as critically endangered under the EPBC Act
- Removal of about 9.68 ha of native vegetation associated with the Orchard Hills Cumberland Plain Woodland Commonwealth Heritage Place (this is equivalent to 1.3 per cent of the native vegetation on the Heritage Place). However, these impacts would be limited to areas of low to moderate natural heritage significance with a reasonable to low tolerance for change. No areas of high natural heritage significance would be impacted by the project
- Removal of about 39 threatened plants consisting of:
 - Four individuals of *Pultenaea parviflora* (EPBC Act and TSC Act)
 - 35 individuals of *Marsdenia viridiflora* subsp *viridiflora* (listed as an endangered population under TSC Act)
- Removal of threatened fauna species habitat and habitat features, minor edging effects and the potential for the spread of weeds, pests, pathogens and disease.

During construction, the other impacts expected include:

- Generation of additional traffic to support construction of the project. Based on arrivals to and departures from site at peak periods each working day, traffic generation is likely to be in the order of 230 additional light vehicle movements per day and about 12 to 13 truck movements per hour in the peak hours. The likely increase in average daily traffic volume as a result of construction activities would be less than five per cent, which is likely to have a negligible impact on the LoS along The Northern Road and Elizabeth Drive
- Temporary adverse changes to traffic conditions such as active traffic controls and temporary lane closures, which would reduce traffic speeds and increase travel times
- Temporary effects on access to some properties, particularly in areas where construction would occur along the existing The Northern Road corridor. Where access is affected, alternative arrangements would be made in consultation with land owners
- Temporary, adverse changes to local amenity from construction related air emissions such as dust from stockpiles and construction plant and vehicle emissions
- Noise impact at 29 residences within the study area (two per cent) the worst case noise exceedance may be more than 20 dB(A). At such times of peak impact, construction noise would be highly intrusive. (However, the noise management level – or NML – would not be exceeded at any time for most receivers (more than 60 per cent) within NCAs 1, 6 and 8; and across the entire study area, noise from even the loudest works would comply with the NML at 80 per cent of all residences)
- A requirement for temporary leases of land to accommodate ancillary construction facilities such as work sites, compounds and laydown areas. Properties identified for temporary leases would mainly comprise areas of rural or vacant land, but would also include residential and commercial uses. Use and access to those areas affected by temporary leases would be temporarily disrupted during construction
- Removal of 28 Aboriginal archaeological heritage sites. Of these, 20 sites are assessed as having moderate significance and would be salvaged, while eight sites are assessed as having low significance and would be destroyed
- Direct impact on three non-Aboriginal historical heritage sites: Miss Lawson's Guesthouse, Lawson's Inn and the Orchard Hills Cumberland Plain Woodland Commonwealth Heritage Place, including the Chaffey Brothers Irrigation Scheme Canal.

During operation, impacts would include:

- The acquisition of 10 houses, and the partial acquisition of land from about 83 owners across 142 lots
- Changes to some land uses including the transfer of about 45 ha of land currently owned by the Commonwealth consisting of:
 - About 25 ha of land within the DEOH
 - About 20 ha of land purchased for the Western Sydney Airport
- Changes to access to some properties, generally due to the provision of a wide central median that would remove existing right turns at some intersections and property accesses
- The bypassing of Luddenham town centre, which may impact on local businesses that rely on passing trade
- 'High' visual impact at 13 selected viewpoints that have limited capacity to absorb the proposed changes
- A small increase in traffic noise for most receivers in the study area. For receivers close to the alignment, the increase may result in an exceedance of the operational noise criteria. At-property treatments are considered the most reasonable form of noise mitigation for the 77 receivers housed within 74 buildings for which exceedances of the operational noise criteria are predicted

- Changes to peak flows and flood behaviour at some locations and scour impacts at downstream locations.

In accordance with the requirements of the EPBC Act and the Commonwealth EIS Guidelines, specific impacts on matters of national environmental significance (MNES) and Commonwealth land have been assessed. The project has the potential to significantly impact on MNES including EPBC listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. The project would also significantly impact areas of Commonwealth Land associated with the DEOH (about 25 ha) and land purchased by the Australian Government for the Western Sydney Airport (about 20 ha). Potential impacts on MNES are identified in Chapter 7 and Chapter 8.

How would the likely impacts be managed?

The EIS identifies comprehensive environmental management measures to avoid, manage, mitigate, offset and/or monitor impacts during construction and operation of the project.

These include best practice construction environmental planning and management techniques, urban design and landscaping treatments and noise mitigation measures. Key environmental planning and management mitigations outlined in this EIS include:

- Traffic control plans prepared to address safety risks and construction related delays
- A Construction Noise and Vibration Management Plan that identifies requirements for minimising night-time construction traffic and including out-of-hours work procedures
- Operational road noise mitigation measures that include at-property noise treatments
- A Biodiversity Offset Strategy (BOS) developed for the project. It includes details of offsets to be implemented to compensate for residual significant impacts associated with the project in accordance with the Biodiversity Offsets Policy for Major Projects (BOPMP) and Framework for Biodiversity Assessment (FBA) which have been endorsed by the Commonwealth
- Property acquisition consistent with the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991*
- Ongoing consultation with affected community members in accordance with the Draft Community Involvement Plan
- Urban design and landscaping treatments
- A detailed transverse drainage strategy, which would continue to be developed during detailed design to minimise potential impacts related to afflux and flooding
- Aboriginal and non-Aboriginal heritage salvage programs completed prior to activities which may harm heritage objects.

Further mitigation opportunities are likely to be identified during detailed design and construction planning and in consultation with communities and relevant stakeholders.

Roads and Maritime has developed, through its contract specifications, a model specification that requires construction contractors to implement an environmental management system in the form of a Construction Environmental Management Plan (CEMP) during construction of the project. The CEMP provides a structured approach to the management of environmental issues identified in the EIS. Implementing the CEMP would effectively ensure that the project meets regulatory and policy requirements in a systematic manner and continually improves its performance. The strategies defined in the CEMP would be developed in consideration of the project approval requirements, and the safeguards and mitigation measures presented in the EIS. The CEMP establishes the system for implementation, monitoring and continuous improvement to minimise impacts of the project on the environment.

The design, construction and operation of the project would be carried out in accordance with the management measures identified in this EIS, as well as any additional measures identified in conditions of approval for the project.

How can I comment on the proposal and/or the Environmental Impact Statement/draft Environmental Impact Statement?

Environmental Impact Statement

The NSW Department of Planning and Environment will make the EIS available for a minimum period of 30 days. During this period, it will be available for review at the Department of Planning and Environment website: (www.majorprojects.planning.nsw.gov.au/page/on-exhibition) and on the Roads and Maritime project website www.rms.nsw.gov.au/thenorthernroad.

The EIS will also be available in hard copy for review at:

Penrith City Library,

601 High Street, Penrith
Monday to Friday 9am to 8pm
Saturday 9am to 5pm
Sunday 10am to 5pm

Liverpool Library

170 George Street, Liverpool
Monday to Friday 9.30am to 8pm
Saturday 9.30am to 4pm
Sunday 12pm to 4pm

Camden Council

70 Central Avenue, Oran Park
Monday to Friday 8.30am to 5pm

Narellan Library

Cnr Queen and Elyard St, Narellan
Monday, Wednesday 9:30am to 8:00pm
Tuesday, Thursday, Friday 9:30am to 5:00pm
Saturday 9:00am to 3:00pm

Nature Conservation Council:

14/338 Pitt Street, Sydney
Monday to Friday 8.30am to 5pm

The EIS, draft EIS and other accompanying documents may be viewed electronically at the Department of Planning and Environment at 320 Pitt Street, Sydney or on the Department's website (www.majorprojects.planning.nsw.gov.au/page/on-exhibition/). You may also view an electronic copy at a NSW Service Centre located near you (www.service.nsw.gov.au/service-centre/service-nsw). All online documents are web accessible and can be accessed free of charge or inspected from Wednesday 21 June 2017 until Wednesday 2 August 2017.

Roads and Maritime will also be hosting community information sessions. A project information line will be available throughout the exhibition period to answer questions from the community relating to the project 1800 703 457 (toll free).

To provide feedback on the project, a person may make written submissions to the Secretary of the NSW Department of Planning and Environment during the exhibition period. All submissions received will be placed on the NSW Department of Planning and Environment website. Submissions should be made to www.majorprojects.planning.nsw.gov.au/page/on-exhibition.

Written submissions may also be directed to:

Director Transport Assessments
Department of Planning and Environment

Draft Environment Impact Statement

The draft environmental impact statement will be placed on public exhibition concurrently for duration to be determined by the Federal Minister for the Environment and Energy. During the public exhibition period any person, group, corporation or agency can submit comment on the environmental impact statement to the Department of the Environment and Energy. A copy of all comments received on the environmental impact statement will be forwarded to the Commonwealth Department of the Environment and Energy.

Specific instructions regarding publication requirements will be provided as part of the Australian Minister's direction to publish.

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1 Introduction

This chapter introduces the project and provides a brief outline of its need, scope and location. It also outlines the structure of this environmental impact statement (EIS). The general requirements for the form and contents of an EIS under clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment (EP&A) Regulation 2000 are shown in Table 1-1. Table 1-1 also presents the Commonwealth EIS Guidelines, as they relate to this chapter of the EIS and where they are addressed in this EIS.

Table 1-1 EIS assessment requirements

Requirement	Where addressed in EIS
Environmental Planning and Assessment Regulation 2000 (clauses 6 and 7 of Schedule 2)	
6 Form of environmental impact statement An environmental impact statement must contain the following information: <ul style="list-style-type: none"> a) the name, address and professional qualifications of the person by whom the statement is prepared, b) the name and address of the responsible person, c) the address of the land: d) in respect of which the development application is to be made, or e) on which the activity or infrastructure to which the statement relates is to be carried out, f) a description of the development, activity or infrastructure to which the statement relates, g) an assessment by the person by whom the statement is prepared of the environmental impact of the development, activity or infrastructure to which the statement relates, dealing with the matters referred to in this Schedule, h) a declaration by the person by whom the statement is prepared to the effect that: <ul style="list-style-type: none"> (i) the statement has been prepared in accordance with this Schedule, and (ii) the statement contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure to which the statement relates, and (iii) that the information contained in the statement is neither false nor misleading. 	EIS Certification EIS Certification EIS Certification EIS Certification EIS Certification EIS Certification
7 Content of environmental impact statement (1) An environmental impact statement must also include each of the following: <ul style="list-style-type: none"> a) a summary of the environmental impact statement, b) a statement of the objectives of the development, activity or infrastructure, c) an analysis of any feasible alternatives to the carrying out of the development, activity or infrastructure, having regard to its objectives, including the consequences of not carrying out the development, activity or infrastructure, d) an analysis of the development, activity or infrastructure, including: <ul style="list-style-type: none"> (i) a full description of the development, activity or infrastructure, and 	Chapter 13 Section 3.4 Chapter 4 Chapter 5 Chapter 7 and

Requirement	Where addressed in EIS
<ul style="list-style-type: none"> (ii) a general description of the environment likely to be affected by the development, activity or infrastructure, together with a detailed description of those aspects of the environment that are likely to be significantly affected, and (iii) the likely impact on the environment of the development, activity or infrastructure, and (iv) a full description of the measures proposed to mitigate any adverse effects of the development, activity or infrastructure on the environment, and (v) a list of any approvals that must be obtained under any other Act or law before the development, activity or infrastructure may lawfully be carried out, e) a compilation (in a single section of the environmental impact statement) of the measures referred to in item (d) (iv), f) the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development set out in subclause (4). 	<p>Chapter 8</p> <p>Chapter 7 and Chapter 8</p> <p>Chapter 7 and Chapter 8</p> <p>Chapter 2</p> <p>Chapter 12</p> <p>Chapter 3 and Chapter 13</p>
Commonwealth EIS Guidelines (<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act))	
<p>1 General Information</p> <p>Provide the background and context of the action including:</p> <ul style="list-style-type: none"> a) The title of the action; b) the full name and postal address of the designated Proponent; c) a clear outline of the objective of the action; d) the location of the action; e) the background to the development of the action; f) how the action relates to any other actions (of which the Proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action; g) the current status of the action; and h) (h) the consequences of not proceeding with the action 	<p>EIS Certification</p> <p>EIS Certification</p> <p>EIS Certification</p> <p>EIS Certification and Section 1.2</p> <p>Chapter 9</p> <p>Chapter 2</p> <p>Section 3.5</p>

1.1 The project

Roads and Maritime is seeking approval to upgrade 16 km of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park (the project). The location and key features of the project are shown in Figure 1-2. The key features are:

The project generally comprises the following key features:

- A six-lane divided road between Mersey Road, Bringelly and Bradley Street, Glenmore Park (two general traffic lanes and a kerbside bus lane in each direction). The wide central median would allow for an additional travel lane in each direction in the future, if required
- An eight-lane divided road between Bradley Street, Glenmore Park and 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)

- About eight kilometres of new road between Mersey Road, Bringelly and just south of the existing Elizabeth Drive, Luddenham, to realign the section of The Northern Road that currently bisects the Western Sydney Airport site and to bypasses Luddenham
- About eight kilometres of upgraded and widened road between the existing Elizabeth Drive, Luddenham and about 100 m south of Glenmore Parkway, Glenmore Park
- Closure of the existing The Northern Road through the Western Sydney Airport site
- Tie-in works with the following projects:
 - The Northern Road Upgrade, between Peter Brock Drive, Oran Park and Mersey Road, Bringelly (to the south)
 - The Northern Road Upgrade, between Glenmore Parkway, Glenmore Park and Jamison Road, South Penrith (to the north)
- New intersections including:
 - A traffic light intersection connecting the existing The Northern Road at the southern boundary of the Western Sydney Airport, incorporating a dedicated u-turn facility on the western side
 - A traffic light intersection for service vehicles accessing the Western Sydney Airport, incorporating 160 m of new road connecting to the planned airport boundary
 - A traffic light intersection connecting the realigned The Northern Road with the existing The Northern Road (west of the new alignment) south of Luddenham
 - A 'give way' controlled intersection (that is, no traffic lights) connecting the realigned The Northern Road with Eaton Road (east of the new alignment, left in, left out only)
 - A four-way traffic light intersection formed from the realigned Elizabeth Drive, the realigned The Northern Road and the existing The Northern Road, north of Luddenham
 - A traffic light intersection at the Defence Establishment Orchard Hills entrance, incorporating a u-turn facility
- New traffic lights at four existing intersections:
 - Littlefields Road, Luddenham
 - Kings Hill Road, Mulgoa
 - Chain-O-Ponds Road, Mulgoa
 - Bradley Street, Glenmore Park incorporating a u-turn facility
- Modified intersection arrangements at:
 - Dwyer Road, Bringelly (left in, left out only)
 - Existing Elizabeth Drive, Luddenham (left out only)
 - Gates Road, Luddenham (left in only)
 - Longview Road, Luddenham (left in, left out only)
 - Grover Crescent south, Mulgoa (left in only)
 - Grover Crescent north, Mulgoa (left out only)
- Dedicated u-turn facilities at:
 - The existing The Northern Road at Luddenham, south-west of Elizabeth Drive
 - The existing Elizabeth Drive, Luddenham around 800 m east of The Northern Road
 - Chain-O-Ponds Road, Mulgoa
- Twin bridges over Adams Road, Luddenham
- Local road changes and upgrades, including:
 - Closure of Vicar Park Lane, east of the realigned The Northern Road, Luddenham
 - Eaton Road cul-de-sac, west of the realigned The Northern Road, Luddenham
 - Eaton Road cul-de-sac, east of the realigned The Northern Road, Luddenham
 - Elizabeth Drive cul-de-sac, about 300 m east of The Northern Road with a connection to the realigned Elizabeth Drive, Luddenham
 - Extension of Littlefields Road, east of The Northern Road, Mulgoa

- A new roundabout on the Littlefields Road extension, Mulgoa
- A new service road between the Littlefields Road roundabout and Gates Road, including a 'give way' controlled intersection (that is, no traffic lights) at Gates Road, Luddenham
- Extension of Vineyard Road, Mulgoa between Longview Road and Kings Hill Road
- A new roundabout on the Vineyard Road extension at Kings Hill Road, Mulgoa
- A new shared path on the western side of The Northern Road and footpaths on the eastern side of The Northern Road
- A new shared path on the western side of The Northern Road and footpaths on the eastern side of The Northern Road where required
- The upgrading of drainage infrastructure
- Operational ancillary facilities including:
 - Heavy vehicle inspection bays for both northbound and southbound traffic, adjacent to Grover Crescent, Mulgoa and Longview Road, Mulgoa respectively
 - An incident response facility on the south-western corner of the proposed four-way traffic light intersection at Elizabeth Drive, Luddenham
- New traffic management facilities including variable message signs (VMS)
- Roadside furniture and street lighting
- The relocation of utilities and services
- Changes to property access along The Northern Road (generally left in, left out only)
- Establishment and use of temporary ancillary facilities and access tracks during construction
- Property adjustments as required
- Clearance of undetonated explosive ordinance (UXO) within the Defence Establishment Orchard Hills as required.

The project assessed in this EIS does not include surveys, test drilling, test excavations, geotechnical investigations or other tests, surveys, sampling or investigation for the purposes of the design or assessment of the project.

1.2 Location and context of the project

The project is part of an overall initiative to upgrade The Northern Road in six stages, as described in Table 1-2. The location and context of the project are shown in Figure 1-1.

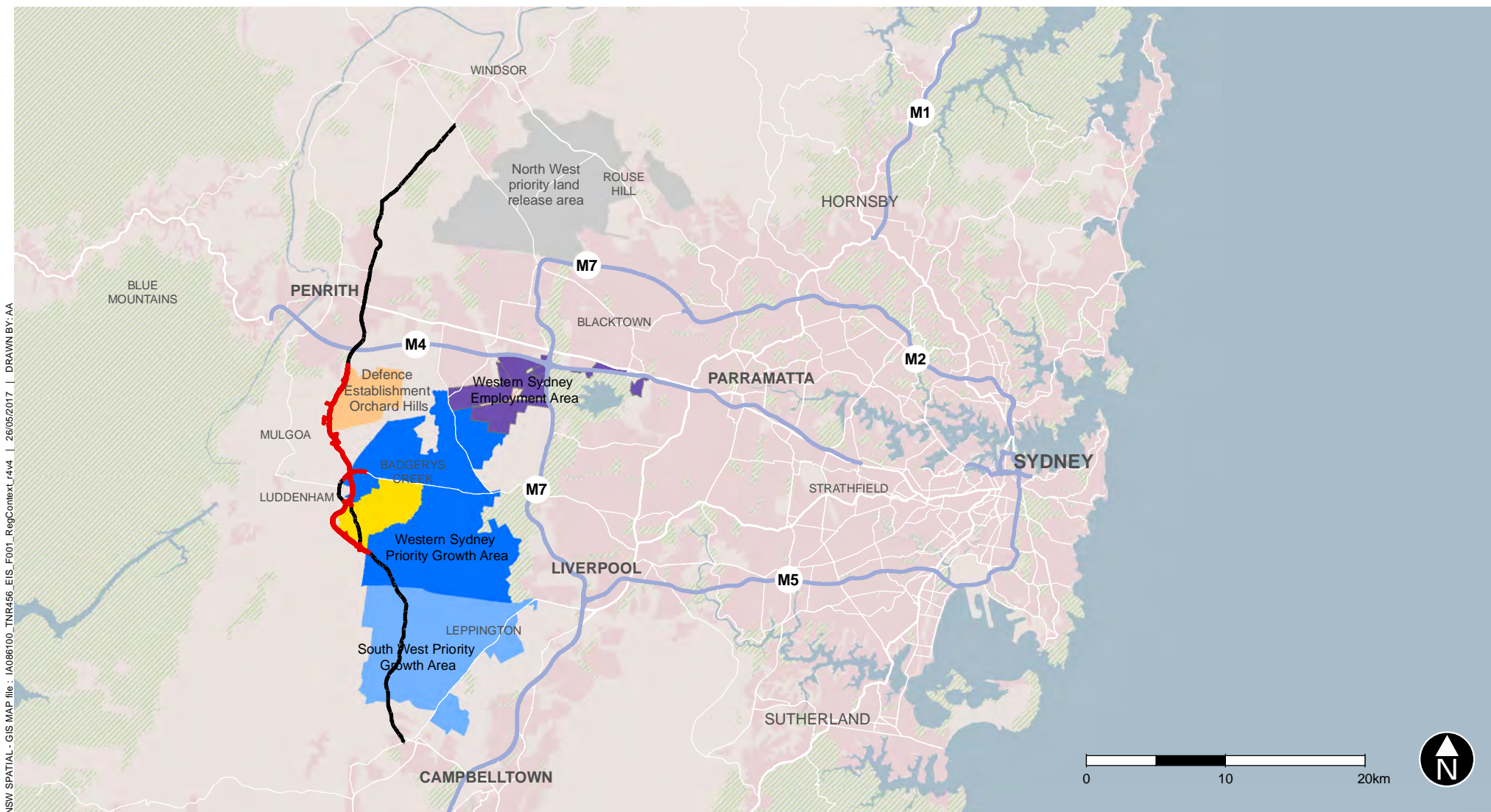
The upgrade of The Northern Road is part of the Western Sydney Infrastructure Plan (WSIP), which is jointly funded by the Australian and NSW governments. The WSIP is a 10 year, \$3.6 billion plan which involves major road and transport linkages to capitalise on the economic gains from developing the Western Sydney Airport at Badgerys Creek and the Western Sydney Priority Growth Area (WSPGA) whilst boosting the local economy and liveability of western Sydney.

The project is an integral element in the many changes either planned or already underway in western Sydney.

The upgrade of The Northern Road, including the other projects that make up the overall staged upgrade of The Northern Road between Narellan and South Penrith, is needed to:

- Support the development of the Western Sydney Airport at Badgerys Creek
- Support the planned expansion of the South West Priority Growth Area (SWPGA) (formerly known as the South West Growth Centre), and the WSPGA (see Chapter 3)
- Connect directly to the proposed M12 Motorway, which would meet The Northern Road in the vicinity of Elizabeth Drive.

During the preliminary design and route options assessment, the project was referred to as The Northern Road Upgrade Stage 3 and Stage 4, which encompassed the area between Mersey Road, Bringelly and Jamison Road, Penrith. Roads and Maritime has since reviewed the delivery model and planning pathway for The Northern Road Upgrade program of works. As a result, the section of The Northern Road between about 100 m south of Glenmore Parkway and Jamison Road no longer forms part of the project and is being progressed separately as a stand-alone activity under Part 5 of the EP&A Act. Throughout this EIS, reference may be made to Stage 3 (Littlefields Road, Mulgoa to Jamison Road, Penrith) and Stage 4 (Mersey Road, Bringelly to Littlefields Road, Mulgoa) when discussing previous assessments, route options evaluation and consultation activities already carried out.



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Legend










- | | | | |
|---|---|---|--|
|  The Northern Road upgrade - Mersey Road to Glenmore Parkway |  Western Sydney Airport site (Commonwealth Land) |  Western Sydney Employment Area |  Reserves and parklands |
|  The Northern Road |  Defence Establishment Orchard Hills |  South West Priority Growth Area |  Growth centres |
| | |  Western Sydney Priority Growth Area |  Built areas |

Figure 1-1 | Location of the project

The Northern Road upgrade - Mersey Road to Glenmore Parkway

Table 1-2 Stages of The Northern Road upgrade

The Northern Road upgrade	Location	Project status
The Northern Road Upgrade, Old Northern Road Narellan, to Peter Brock Drive, Oran Park (Stage 1)	Between The Old Northern Road, Narellan and Peter Brock Drive, Oran Park	Construction of Stage 1 started in February 2016 and the road upgrade is expected to be open to traffic in early 2018, weather permitting
The Northern Road Upgrade, Peter Brock Drive, Oran Park to Mersey Road, Bringelly (Stage 2)	Between Peter Brock Drive, Oran Park and Mersey Road, Bringelly and Bringelly Road Upgrade between The Northern Road, Bringelly and King Road, Rossmore	Construction of Stage 2 started in mid-2016 and the road upgrade is expected to be open to traffic in mid-2019, weather permitting. Subject to approval, construction of the Bringelly Road Interchange is expected to start by early 2017 and the road is expected to be open to traffic in late 2019
The Northern Road Upgrade, Glenmore Parkway, Glenmore Park to Jamison Road, Penrith	Between Glenmore Parkway, Glenmore Park and Jamison Road, Penrith	The concept design and environmental impact assessment will be displayed for public comment in the second half of 2016. Construction is expected to start in late 2017 and the road upgrade is expected to be open to traffic in late 2019
Mersey Road to Glenmore Parkway (this project)	Between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park (16 km)	The concept design and environmental impact assessment are presented in this EIS. Subject to approval, construction is expected to start late-2017 to mid-2018, and the road upgrade is likely to be open to traffic between late-2019 and mid-2020

The estimated project cost is about \$800 million with about \$640 million contributed by the Australian Government and about \$160 million by the New South Wales Government.

Construction of the project is likely to occur in stages (refer to Section 5.5 for details of construction staging). Construction is expected to start from late-2017 to mid-2018, with the project delivered in three stages. The road is likely to open to traffic between late-2019 and mid-2020.

1.3 Project location

The Northern Road is about 45 km west of the Sydney central business district and traverses the local government areas of Penrith in the north and Liverpool in the south.

The Northern Road is a key north–south road between Narellan and Richmond, connecting the North West and South West Priority Growth Area (see Figure 1-1). The corridor intersects with the

M4 Western Motorway and arterial and collector roads such as (north to south) Richmond Road, Great Western Highway, Elizabeth Drive, Bringelly Road, and Camden Valley Way.

South of Glenmore Parkway, the project is surrounded by rural residential zoned land as well as pastures and grasslands. Land to the east of The Northern Road in this section is occupied by the Defence Establishment Orchard Hills (DEOH). Further south, The Northern Road passes through the village of Luddenham (including a small number of residential and commercial properties), before continuing through agricultural grasslands to its junction with Mersey Road.

About three kilometres of the existing The Northern Road alignment bisects Commonwealth land purchased for the Western Sydney Airport site south-east of the Luddenham town centre. The location and regional context of The Northern Road Upgrade is provided on Figure 1-1.

1.4 Structure of this environmental impact statement

This EIS has been prepared to address:

- The amended Secretary's Environmental Assessment Requirements (SEARs) issued by the Secretary of the NSW Department of Planning and Environment (DPE) on 9 March 2016
- The relevant provisions of Schedule 2 of the EP&A Regulation 2000
- The Australian Environment Minister's EIS Guidelines under the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) issued for the project on 24 August, 2016
- Schedule 4 of the Environment Protection Biodiversity Conservation Regulation 2000.

The EIS is divided into five volumes. **Volume 1** has the following structure:

Volume 1 Part 1

- Introduction – provides a broad overview of the project and where it is located (**Chapter 1**)
- Assessment process – outlines the statutory requirements and explains the steps in the assessment and approval process (**Chapter 2**)
- Strategic justification and project need – provides the strategic context, explains the need for the project and identifies the project objectives (**Chapter 3**)
- Project development and alternatives – reviews the alternatives and options considered in developing the project, including the consequences of not proceeding (**Chapter 4**)
- Project description – provides a detailed description of the project including the route alignment, design standards, key design features and construction methodologies and staging (**Chapter 5**)
- Consultation – outlines the consultation activities undertaken, issues raised and how these have been addressed (**Chapter 6**)
- Assessment of key issues – identifies the existing environment of the project area, key environmental issues, assesses the impacts and proposes environmental management measures for the following key environmental issues (**Chapter 7**)
 - Traffic and transport (Section 7.1)
 - Noise and vibration (Section 7.2)
 - Biodiversity (Section 7.3)
 - Socio-economic and land use (Section 7.4)

Volume 1 Part 2

- Assessment of other issues – identifies the existing environment of the project area, assesses the impacts and proposes environmental management measures for the following environmental issues (**Chapter 8**)
 - Hydrology and flooding (Section 8.1)

- Soils, water and contamination (Section 8.2)
- Aboriginal heritage (Section 8.3)
- Non-Aboriginal heritage (Section 8.4)
- Urban design and visual impact (Section 8.5)
- Air quality (Section 8.6)
- Resources and waste management (Section 8.7)
- Climate change and greenhouse gas (Section 8.8)
- Hazard and risk (Section 8.9)
- Assessment of cumulative impacts – assesses cumulative impacts of the project and other key developments in the region (**Chapter 9**)
- Sustainability – discusses how sustainability principles relate to the design, construction, and operation of the project (**Chapter 10**)
- Environmental risk analysis – details the risk analysis process that were used to identify the potential environmental issues for assessment (**Chapter 11**)
- Environmental management – outlines the framework for environmental management during construction and operation including a summary of the environmental management measures outlined for the project (**Chapter 12**)
- Project justification and conclusion – presents the justification of the project, including the objects of both the EPBC Act, and the EP&A Act (**Chapter 13**)
- References (**Chapter 14**).

Volume 2 contains the following appendices in support of the EIS:

- Appendix A – Proponent details and environmental performance of the proponent
- Appendix B – Secretary's environmental assessment requirements
- Appendix C – Commonwealth EIS Assessment requirements
- Appendix D – Environmental Planning and Assessment Regulation 2000 checklist
- Appendix E – EPBC Checklist
- Appendix F – Persons and agencies contacted during the EIS
- Appendix G – Technical working paper: Traffic and transport
- Appendix H – Technical working paper: Noise and vibration

Volume 3 contains the following appendices in support of the EIS:

- Appendix I – Technical working paper: Biodiversity
- Appendix J – Technical working paper: Socio-economic

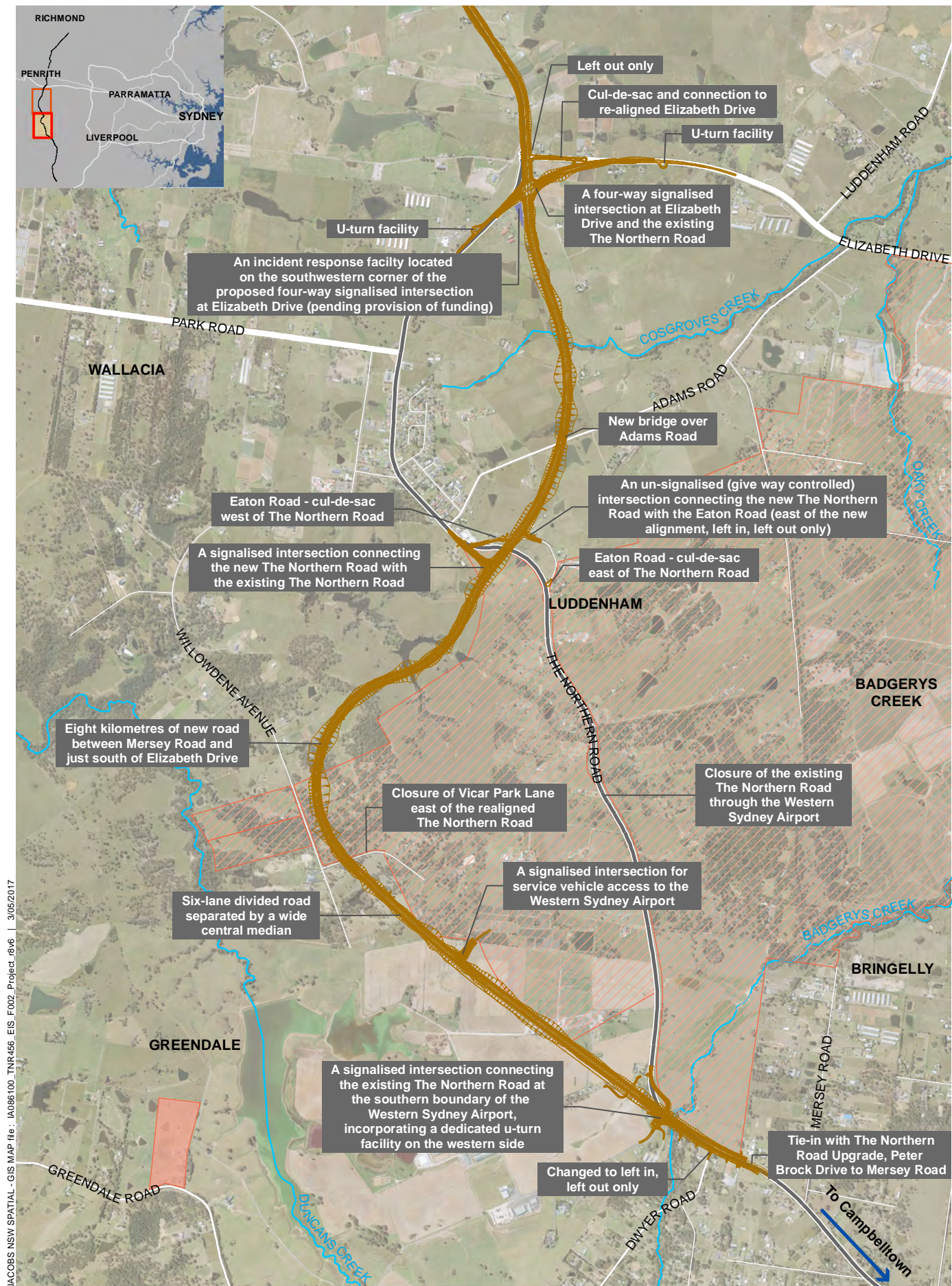
Volume 4 contains the following appendices in support of the EIS:

- Appendix K – Technical working paper: Flood risk assessment
- Appendix L – Technical working paper: Soils, water and contamination
- Appendix M – Technical working paper: Aboriginal cultural heritage assessment

Volume 5 contains the following appendices in support of the EIS:

- Appendix N – Technical working paper: Non-Aboriginal heritage
- Appendix O – Technical working paper: Urban design, landscape character and visual impact assessment
- Appendix P – Technical working paper: Air quality
- Appendix Q – Technical working paper: Greenhouse gas assessment and climate change risk assessment

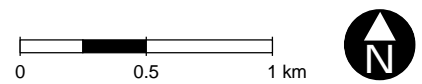
- Appendix R – Draft Community Involvement Plan
- Appendix S – EIS Team
- Appendix T – Roads and Maritime Services Environmental Policy Statement.



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- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)

- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Lands



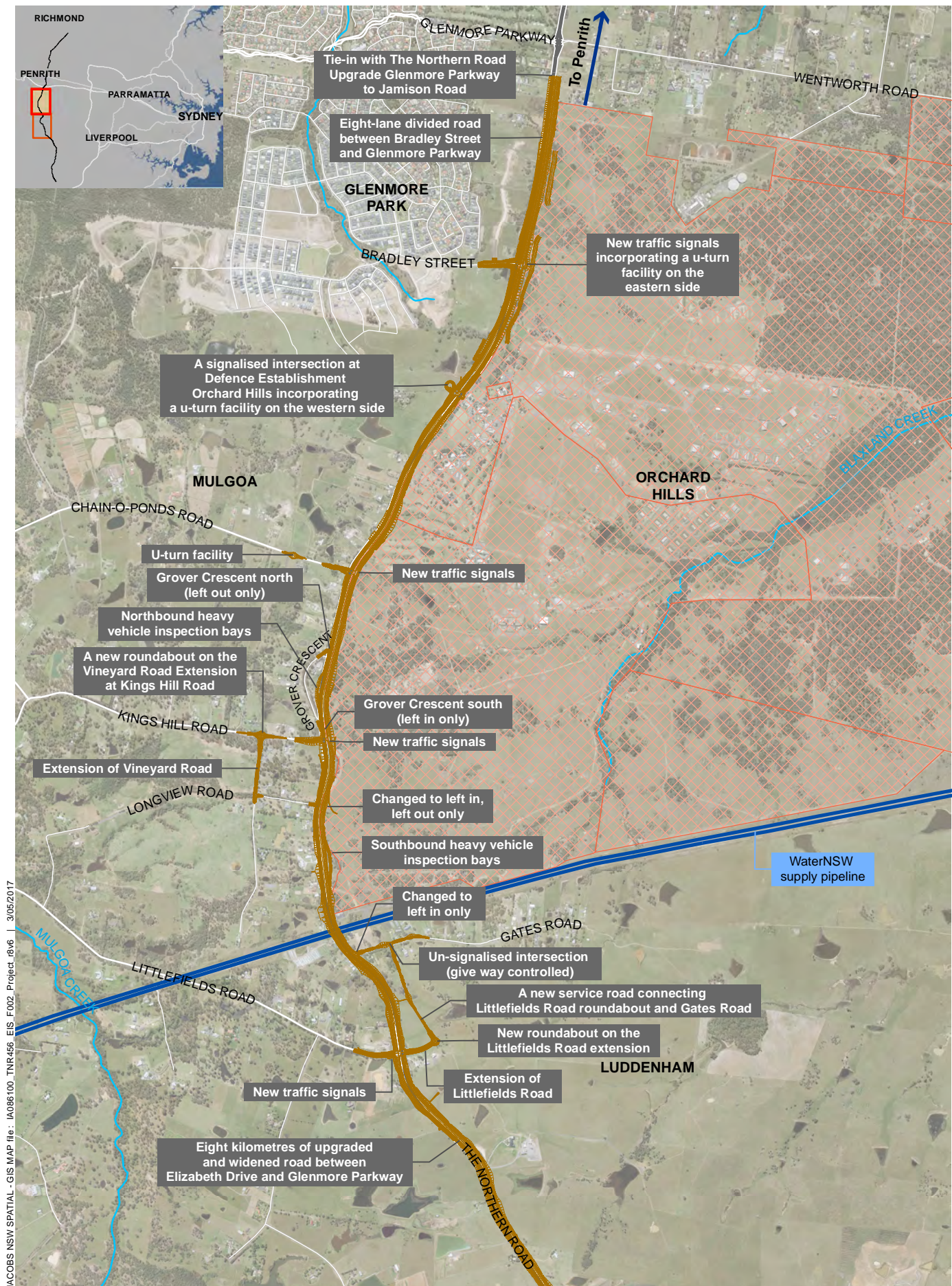


Figure 1-2 | Overview of the project

2 Assessment process

This chapter describes the planning approval process for the project and the environmental planning and statutory approval requirements. Table 2-1 outlines the requirements of the Commonwealth EIS Guidelines as they relate to the assessment process for the project. While no specific environmental assessment requirements (SEARs) were issued by the Secretary of the Department of Planning and Environment in relation to the assessment process, there is a requirement for this EIS to meet the minimum form and content in clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment (EP&A) Regulation, which includes, which includes a list of approvals that must be obtained under any other Act.

Table 2-1 EIS assessment requirements – Environmental approvals

Requirement	Where addressed in EIS
Commonwealth EIS Guidelines (Commonwealth EPBC Act)	
The EIS must include information on any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action. This must include:	Chapter 2
<ul style="list-style-type: none"> Details of any local or State Government planning scheme, or plan or policy under any local or State Government planning system that deals with the proposed action, including: <ul style="list-style-type: none"> What environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy How the scheme provides for the prevention, minimisation and management of any relevant impacts. 	Section 2.1.1
<ul style="list-style-type: none"> A description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action. 	No approvals have been obtained for the action.
<ul style="list-style-type: none"> A statement identifying any additional approval that is required. 	Section 2.1.1 Section 2.2.1 Section 2.2.2
<ul style="list-style-type: none"> A description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action. 	Where relevant, the requirements for monitoring of relevant impacts is outlined in Chapter 7 and Chapter 8 and summarised in Chapter 12. Chapter 12 also outlines the review procedures that apply to the project. Should the project be approved, any conditions of approval would also set out any monitoring, enforcement and review procedures.

2.1 Approval framework

2.1.1 NSW Environmental Planning and Assessment Act 1979

Roads and Maritime is seeking project approval for the upgrade of The Northern Road between Mersey Road, Bringelly and about 100 m south of Glenmore Parkway, Glenmore Park under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Clause 94 of the *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP) applies to development for the purpose of a road or road infrastructure facilities and provides that these types of works are development which is permissible without consent (except land authorised under the *National Parks and Wildlife Act 1974*). As the project would not be carried out on land reserved under the *National Parks and Wildlife Act 1974*, the project is appropriately classified as being for the purpose of a 'road' and a 'road infrastructure facility' under the Infrastructure SEPP.

Clause 14 of the *State Environmental Planning Policy (State and Regional Development) 2011* declares development as State significant infrastructure if it is permissible without consent and specified in Schedule 3.

Clause 1 of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011* specifies infrastructure or other development that would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent, require an EIS to be obtained under Part 5 of the EP&A Act.

Roads and Maritime formed the opinion that the project is likely to significantly affect the environment and would require an EIS to be obtained and consequently the project is State significant infrastructure under Part 5.1.

Clause 16 of the *State Environmental Planning Policy (State and Regional Development) 2011* enables the Minister to declare a project to be critical State significant infrastructure development. The project was declared to be critical State significant infrastructure (Schedule 5 of the *State Environmental Planning Policy (State and Regional Development) 2011*).

The SEARs for the project were issued on 28 July 2015 and amended SEARs were issued on 9 March 2016. The amended SEARs were in response to the decision by Roads and Maritime to assess and deliver the upgrade works between Glenmore Parkway, Glenmore Park and Jamison Road, Penrith as a separate, stand-alone activity to the project. A copy of the SEARs is provided in Appendix B. That component of the program of works has been prepared under Part 5 of the EP&A Act.

Other than the EIS, no other environmental assessment has been, or is being carried out for the project for the purpose of any local or state plan or policy.

The approval process under Part 5.1 of the EP&A Act is illustrated in Figure 2-1.

Further information on the assessment process is available on the NSW Department of Planning and Environment (DPE) website (www.planning.nsw.gov.au).

2.1.2 Commonwealth Environment Protection and Biodiversity Conservation Act

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act) proposed 'actions' that have the potential to significantly impact on matters of national environmental significance (MNES), the environment of Commonwealth land or that are being carried out by a Commonwealth agency must be referred to the Australian Government. If the Australian Minister for the Environment and Energy determines that a referred project is a 'controlled action', the approval of that Minister would be required for the project in addition to the NSW Minister for Planning's approval.

The project has the potential to significantly impact on MNES including EPBC listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. The project would also significantly

impact upon areas of Commonwealth Land associated with the Defence Establishment Orchard Hills (DEOH) and land purchased by the Australian Government for the Western Sydney Airport.

Accordingly, the project was referred to the then Australian Government Department of the Environment (now Department of the Environment and Energy) on 13 May, 2016. On 21 July, 2016, the Australian Minister for the Environment and Energy decided that the project has the potential to significantly impact on MNES and Commonwealth Land and is therefore a 'controlled action' and it be assessed by an EIS. In making this determination the delegate for the Minister issued to Roads and Maritime, on 24 August 2016, Guidelines for the Content of a draft Environment Impact Statement (Commonwealth EIS Guidelines).

To streamline the environmental assessment requirements under Part 5.1 of the EP&A Act and Part 8 of the EPBC Act, one EIS has been prepared that addresses both the SEARs and the Commonwealth EIS Guidelines. A copy of the SEARs and the Commonwealth EIS Guidelines are contained in Appendix B and Appendix C respectively. For the purpose of this planning application for the project, Roads and Maritime is the proponent.

Figure 2-1 outlines how the EPBC Act approval process would work in conjunction with the EP&A Act approval process outlined in Section 2.1.1. Further information on the assessment process is available on the Department of the Environment and Energy website (<https://www.environment.gov.au/epbc>).

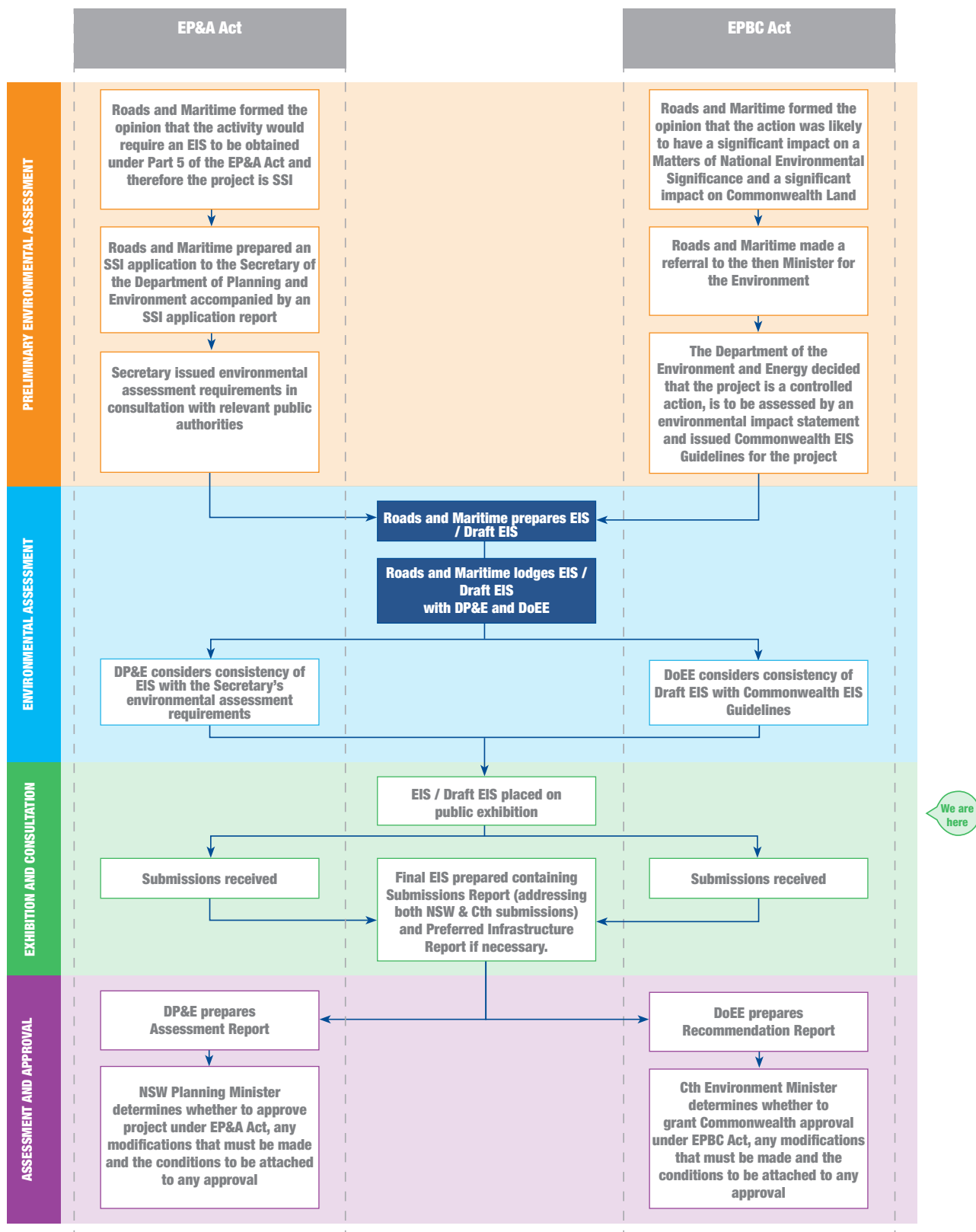


Figure 2-1 Approvals process under Part 5.1 of the EP&A Act and the EPBC Act

2.2 Other legislation

2.2.1 NSW legislation

A number of approvals are not required for a project approved under Part 5.1 of the EP&A Act (refer to section 115ZG of the EP&A Act). Those approvals not required for the project are:

- Permits under sections 201, 205 and 219 of the *Fisheries Management Act 1994*
- Approvals under Part 4 and excavation permits under section 139 of the *Heritage Act 1977*
- Aboriginal heritage permits under section 90 of the *National Parks and Wildlife Act 1974*
- Authorisations under the *Native Vegetation Act 2003* to clear native vegetation or State protected land
- Various approvals under the *Water Management Act 2000*, including water use approvals under section 89, water management work approvals under section 90, and activity approvals (other than aquifer interference approvals) under section 91.

Approvals under other NSW legislation that may apply to the project include:

- An environmental protection licence for road construction under Chapter 3 of the *Protection of the Environment Operations Act 1997*. An environment protection licence would be required for the scheduled activity of road construction, as the project involves the construction of a main road greater than three kilometres long in a metropolitan area. In accordance with section 115ZH of the EP&A Act, such a licence cannot be refused for an approved project and is to be substantially consistent with the Part 5.1 approval
- An aquifer interference approval under the *Water Management Act 2000* if construction requires intersection of a groundwater source. This is further discussed in Section 8.2
- An approval under the *Crown Lands Act 1989* to grant a relevant interest (ie licence, permit, easement or right of way) over a Crown Reserve.

Other legislation that may apply to the project includes:

- *Land Acquisition (Just Terms Compensation) Act 1991* – applies to the acquisition of any land required for the project. Acquisitions are further discussed in Section 7.4 of this report
- *Contaminated Land Management Act 1997* – outlines the circumstances in which notification of the (NSW) Environment Protection Authority (EPA) is required in relation to the contamination of land
- *Crown Lands Act 1989* – applies to the acquisition of land reserved under this Act. This is further discussed in Section 5.2.14.

Given the project has been declared critical State significant infrastructure, sections 115ZG(2) and 115ZG(3) of the EP&A Act preclude the following directions, orders or notices being made to prevent or interfere with the carrying out of the project once approved:

- Division 8 of Part 6 of the *Heritage Act 1977* does not apply to prevent or interfere with the carrying out of approved State significant infrastructure
- An interim protection order (within the meaning of the *National Parks and Wildlife Act 1974* (NSW) or the *Threatened Species Conservation Act 1995* (NSW))
- An order under Division 1 (Stop work orders) of Part 6A of the *National Parks and Wildlife Act 1974* (NSW), Division 1 (Stop work orders) of Part 7 of the *Threatened Species Conservation Act 1995* (NSW) or Division 7 (Stop work orders) of Part 7A of the *Fisheries Management Act 1994* (NSW)
- A remediation direction under Division 3 of Part 6A of the *National Parks and Wildlife Act 1974* (NSW)

- An environment protection notice under Chapter 4 of the *Protection of the Environment Operations Act 1997* (NSW)
- An order under section 124 of the *Local Government Act 1993* (NSW).

Certain third party appeal provisions are also precluded (refer to section 115ZK of the EP&A Act).

2.2.2 Commonwealth legislation

Airports Act 1996

The Western Sydney Airport is planned to be located on land owned by the Commonwealth Government. In April 2014 the Commonwealth Government announced its decision to develop a Western Sydney Airport at Badgerys Creek. The Commonwealth Department of Infrastructure and Regional Development (DIRD) is now seeking approval of an Airport Plan under the *Airports Act 1996* (Airports Act) for the Stage 1 development.

Until such time the Commonwealth Government has granted an Airport Lessee Company (ALC) for the airport site, and a Master Plan has been prepared by the ALC in accordance with the Airports Act, the provisions relating to controlled activities in prescribed airspaces do not apply.

The portion of the planned airport site that the project traverses is not currently deemed prescribed airspace. Despite this, Roads and Maritime have held discussions with DIRD and AirServices Australia and future prescribed airspace requirements have been considered in the project design.

3 Strategic justification and project need

This chapter outlines the relationship of the project and the strategic planning framework. It also identifies the need for the project and states the project objectives. Table 3-1 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 strategic justification and need for the project.

Table 3-1 EIS assessment requirements – strategic justification and project need

Requirements	Where addressed in EIS
Secretary's Environmental Assessment Requirements (NSW EP&A Act)	
a statement of the objectives of the project,	Section 3.4 Section 3.5 Chapter 13
including a description of the strategic need, justification, objectives and outcomes for the proposal,	Section 3.4 Section 3.5 Chapter 13
and as relevant the outcomes and objectives of relevant strategic planning and transport policies, including, but not limited to, NSW 2021, NSW Government State Infrastructure Strategy, NSW Long Term Transport Master Plan (December 2012), A Plan for Growing Sydney (December 2014) and any other relevant plans;	Section 3.1 Section 3.2
Commonwealth EIS Guidelines (Commonwealth EPBC Act)	
This should provide the background and context of the action including: <ul style="list-style-type: none">• A clear outline of the objective of the action• The background to the development of the action.	Section 3.4 (objectives) Section 3.3 and Chapter 4 (background)

3.1 NSW strategic planning and policy framework

This section describes the compatibility of the project with key strategic planning and policy documents.

3.1.1 Western Sydney Infrastructure Plan

The Western Sydney Infrastructure Plan (WSIP) is a 10 year, \$3.6 billion investment program to improve and upgrade road infrastructure in western Sydney. It is being jointly funded by the Australian and NSW governments.

The WSIP will deliver major road infrastructure upgrades to support an integrated transport solution for the region and to capitalise on the economic benefits from developing Western Sydney Airport. The WSIP will improve road transport capacity ahead of future traffic demand, as planned residential and employment development comes online in Western Sydney Priority Land Release Areas and the Western Sydney Priority Growth Area (WSPGA).

The WSIP program of works includes:

- The Northern Road Upgrade – refer Table 1-2
- Werrington Arterial Road – a two kilometre road to provide a high quality link between the Great Western Highway and the M4 Western Motorway. Construction began in March 2015 and is expected to finish in late 2016
- Bringelly Road Upgrade – an upgrade of Bringelly Road between Camden Valley Way, Leppington and The Northern Road, Bringelly. It would be delivered in two stages
 - Stage 1 – 5.7 km from Camden Valley Way, Leppington to King Street, Rossmore. Construction is currently underway and expected to be completed in late 2017
 - Stage 2 – 4.3 km from King Street, Rossmore to The Northern Road, Bringelly. Detailed design is being finalised for Stage 2. Construction is expected to start in early 2017 and be completed in mid-2019
- Proposed M12 Motorway – a motorway standard east–west link between the Westlink M7 Motorway and The Northern Road. The proposed route options were displayed for community comment in February 2016. The preferred corridor was announced in early 2017
- A grade-separated interchange of The Northern Road and Bringelly Road – this would be delivered as part of the upgrades to The Northern Road and Bringelly Road. Subject to approval, construction is expected to start by early 2017 with the new interchange open to traffic in late 2019
- The Local Roads Package – this would allow councils to deliver targeted road improvements and provide better transport connections, such as Glenbrook Intersection Upgrade – this would improve safety and manage congestion at the intersection of Ross Street and the Great Western Highway, Glenbrook.

A map of the WSIP projects is shown on Figure 3-1.

The project, as part of the WSIP, is the NSW Government's commitment to facilitate the Australian Government's timetable and transport functionality for construction and operation of the Western Sydney Airport. The objectives of the WSIP are incorporated into the overall project objectives and are outlined in Section 3.5.

Options considered for the project were assessed against the WSIP objectives as outlined in Chapter 4 – Project development and alternatives.

The project is a critical component of this program to ensure adequate transport infrastructure is available for construction and operation of key surrounding land uses such as the Western Sydney Airport. Failure to complete the project may also compromise the benefits of other road upgrades in the region and a Western Sydney Airport.

3.1.2 Premier's Priorities and State Priorities (2015)

There are 30 State Priorities to grow the State's economy, deliver infrastructure, protect the vulnerable, and improve health, education and public services across NSW. They include 12 priorities identified as the Premier's Priorities, which will allow the government to measure and deliver projects that create a stronger, healthier and safer NSW.

Building infrastructure is one of the priorities. Under this priority, the NSW Government is committed to improving road travel reliability (noting that congestion across metropolitan Sydney is estimated to already cost up to \$5 billion per annum, and will rise to \$8 billion by 2021 if nothing is done). To ensure the consistency of journey times on key roads continues to improve, the NSW Government is working to make better use of existing road infrastructure, build extra road capacity and encourage commuters to use public transport and to undertake off-peak travel more often.

The project would contribute to achieving this priority by: delivering key road infrastructure identified by the NSW Government, helping business and the community to move around western

Sydney with greater ease, reducing travel times, improving travel reliability, boosting productivity and reducing business costs.

3.1.3 NSW 2021

NSW 2021: A Plan to Make NSW Number One (NSW Department of Premier and Cabinet 2011) (NSW 2021) is the NSW Government's 10 year strategic business plan which sets priorities for action and guides resource allocation to deliver economic growth and critical infrastructure throughout NSW. The NSW 2021 Performance Report (NSW Department of Premier and Cabinet 2012) sets baselines and provides information on how the NSW Government intends to measure and deliver on the goals, targets and measures outlined in NSW 2021.

NSW 2021 emphasises investing in and delivering an efficient and effective transport system including delivering road infrastructure that will relieve congestion, improve travel times, improve road safety and enhance and expand capacity on key road corridors. Within the context of the goals identified in NSW 2021, the project, and the WSIP, would help to achieve priority actions within NSW 2021 by delivering key road infrastructure identified by the NSW Government which would enhance and expand capacity on the motorway network. Specifically, the project would help achieve the following NSW 2021 goals:

- Goal 1 – Improve the performance of the NSW economy by supporting the development of employment zones and growth centres in the western and south-western Sydney
- Goal 4 – Increase the competitiveness of doing business in NSW by providing more efficient movement of freight, increasing productivity, reducing maintenance and thereby reducing operational freight costs
- Goal 5 – Place downward pressure on the cost of living by providing better connections for the SWPGA and other growth areas in western and south-western Sydney
- Goal 7 – Reduce travel times by providing additional lanes and upgraded intersections that would adequately service the road network in the future
- Goal 10 – Improve road safety by providing additional lanes and a divided carriageway, removing the need for opposing-lane overtaking and the associated risk of head-on crashes
- Goal 19 – Invest in critical infrastructure. The project is part of WSIP, which would deliver major road infrastructure upgrades to support an integrated transport solution for the region and to capitalise on the economic benefits from developing Western Sydney Airport.

The project would be a key link in the transport network to support Sydney's growth and has been designed to reduce travel times along the project corridor, which would increase productivity, reduce the cost of doing business and help to increase the competitiveness of businesses in NSW.

The project would also enhance connections between key housing and employment areas (as described in Section 3.3.4).

3.1.4 NSW State Infrastructure Strategy

The *State Infrastructure Strategy 2012–2032* (Infrastructure NSW, 2012) (State Infrastructure Strategy) is a 20 year strategy which identifies and prioritises the delivery of critical public infrastructure to drive productivity and economic growth. Infrastructure NSW's assessment of the State's existing infrastructure has highlighted critical deficiencies in urban road capacity. The State Infrastructure Strategy identifies strategic infrastructure options to meet the challenges of population growth and substantial increases in freight volumes.

The report was updated in November 2014 in the *State Infrastructure Strategy Update* (Infrastructure NSW, 2014a). The Strategy Update recognises the requirement for improved road infrastructure around the Western Sydney Airport site with connections to the surrounding growth centres and expanding employment area. The Strategy Update outlines these projects as part of The Western Sydney Roads Plan (now known as WSIP) (see Section 3.1.1).

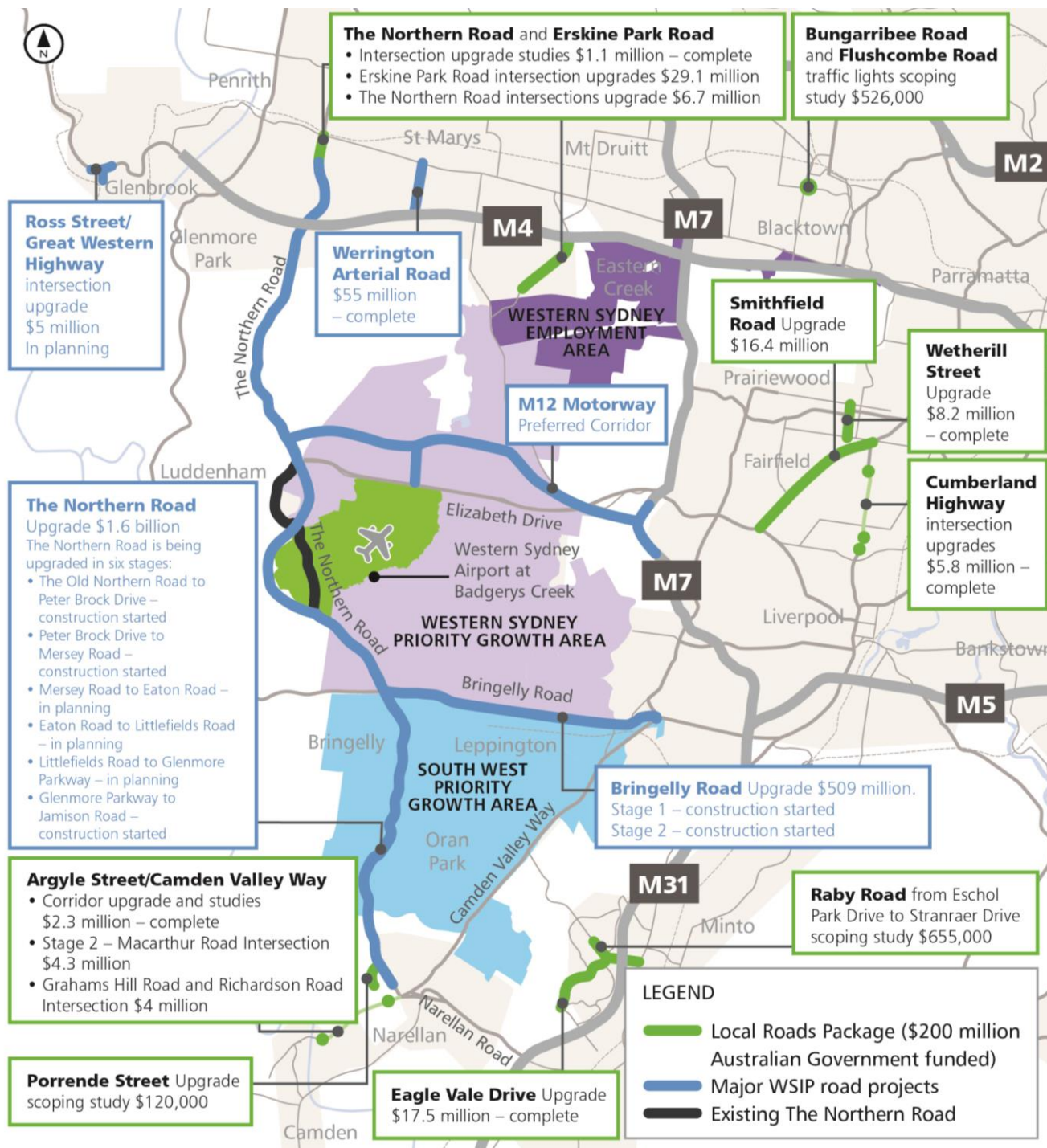


Figure 3-1 Western Sydney Infrastructure Plan

3.1.5 NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (Transport for NSW, 2012) (the Transport Master Plan) sets the direction for transport planning to 2031, providing a framework for transport policy and investment decisions. The Transport Master Plan is linked to *NSW 2021: A Plan to Make NSW Number One* (NSW Government, 2012) and integrates transport planning with wider economic, infrastructure, social, housing and land use planning strategies, including *A Plan for Growing Sydney* (see Section 3.1.5).

Consultations for the Transport Master Plan highlighted community concern around public transport access, road congestion, commuting times, and local access to services.

Chapter 4 of the Transport Master Plan identifies the major transport challenges facing Sydney as:

- Keeping the city's most important transport corridors moving
- Providing travel options that support and enhance the strength and success of the CBD
- Improving connections across an expanded Sydney CBD
- Building a fully integrated city-wide transport system
- Sustaining growth in Greater Sydney
- Providing better connections and services to Sydney's growth areas
- Adopting a customer focus and adapting to the changing needs of customers.

Chapter 5 of the Transport Master Plan focuses on the transport challenges in Greater Sydney including:

- Improving public transport and cutting congestion to improve the liveability of Greater Sydney and meet growing demand by improving transport services and minimising travel times
- Equipping Greater Sydney for jobs growth to support the development of Sydney's regional economies with sustainable transport solutions nearer to population centres
- Developing new transport connections for greenfield areas as they grow to support the North West and South West Growth Centres (now known as Priority Land Release Areas) and the Western Sydney Employment Area (now WSPGA)
- Protecting critical corridors to ensure the transport system develops in tandem with communities in Greater Sydney and to tackle congestion.

The project is identified as part of the Transport Master Plan and is considered to align with Government strategic transport plans and objectives. The project would address one of the major challenges identified in Chapter 4 – providing better connections and services to Sydney's growth areas – by providing a high capacity modern road link for new development areas in south-western and western Sydney.

The project would also deliver a number of actions identified in Chapter 5 of the Transport Master Plan. In particular, it would:

- Expand and upgrade roads in growth centres, including bus priority measures
- Complete the WSPGA arterial road network
- Upgrade major arterial roads in western and south-western Sydney
- Plan for pedestrian, cycling and bus networks as part of new land releases and developments in Greater Sydney.

Overall, the project would help meet the key transport challenges presented in the Transport Master Plan by:

- Upgrading The Northern Road to meet future growth in Greater Sydney
- Providing a sustainable transport network to support jobs growth in the area and the Western Sydney Airport
- Providing better connections for the South West Priority Growth Area (SWPGA) by completing the upgrade of The Northern Road from Narellan to Glenmore Park
- Protecting and enhancing a critical transport corridor that would service the WSPGA for many years
- Upgrading connections between key road networks in western Sydney to the Western Sydney Airport
- Upgrading the road network, which would facilitate connection to the WSPGA from Penrith

- Enhancing public transport connections between Penrith and the Western Sydney Airport
- Providing pedestrian and cycling facilities along the upgraded The Northern Road corridor.

3.1.6 A Plan for Growing Sydney

A Plan for Growing Sydney (DPE, 2014) aims to guide land use planning decisions, and presents a strategy for accommodating Sydney's population growth over the next 20 years.

The NSW Government's vision for Sydney is to be 'A strong global city, a great place to live'. The Government has four goals to achieve this vision. The goals are for Sydney to be:

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

The plan includes development strategies to enhance the capacity at Sydney's gateways, including Port Botany, Sydney Airport and a Western Sydney Airport.

Direction 1.4 of the plan is to 'Transform the productivity of western Sydney through growth and investment'. A number of actions are presented as ways of achieving this direction and include Action 1.4.2, to 'Develop new strategic employment corridors along transport infrastructure investments that would service Western Sydney Airport'. As part of this action, upgrades to The Northern Road and other existing roads in the area are identified.

Sub-regional planning

A Plan for Growing Sydney also guides sub-regional planning by identifying the metropolitan priorities for each of the sub-regions across Sydney. Sub-regional planning demonstrates how the growth of the city will be closely integrated with long-term transport and infrastructure planning, as major renewal and growth programs capitalise on existing and planned transport. The project is located in the West Sub-region and South West Sub-region under *A Plan for Growing Sydney*.

The project is consistent with a number of key priorities for the West and South West sub-regions such as:

- Improving transport connections to provide better access between centres in the sub-region and centres in other sub-regions and with regional NSW (including freight connections)
- Improving transport connections to eastern Sydney to capitalise on the sub-region's increasing role in Sydney's manufacturing, construction and wholesale/logistics industries in the WSPGA
- Leveraging investment and economic development opportunities arising from the development of western Sydney
- Improving pinch-point connections between north-south and east-west road links
- Strengthen the diverse benefits to the economy proposed by the Western Sydney Airport
- Provide a transport gateway focused on the Western Sydney Airport as part of the WSPGA/Western Sydney Airport precinct transformational place.

Greater Sydney Districts

The Greater Sydney Commission's District Plans help set out how *A Plan for Growing Sydney* will apply to each of its six Districts, including draft District Plans for the West and South West Districts in which the project is located. The goal of these Plans is to have well-coordinated, integrated and effective planning for land use, transport and infrastructure.

A separate document *Towards our Greater Sydney 2056* is an ambitious future plan for a growing Greater Sydney and forms a draft amendment to *A Plan for Growing Sydney*. The draft District

Plans draw on this emerging new vision for Greater Sydney's future. This includes a strategy for a metropolis of three cities and will provide a framework that can better underpin strategic planning for a more productive, liveable and sustainable city.

The project supports the implementation of A Plan for Growing Sydney, including the draft amendment Towards our Greater Sydney 2056 and the relevant draft District Plans once approved by directly improving transport connections between a Western Sydney Airport at Badgerys Creek, the SWPGA and existing key transport infrastructure such as the M4 Western Motorway.

3.1.7 NSW Freight and Ports Strategy

The aim of the *NSW Freight and Ports Strategy* (Transport for NSW, 2013e) (the Freight Strategy) is to provide a transport network in NSW that enables the efficient flow of goods to the market.

The Freight Strategy identifies that the NSW road network carried 63 per cent of the total freight volume in 2011, with 33 per cent of freight carried by rail in the same year. The role of heavy vehicles in moving freight across NSW is substantial and will continue to be for the foreseeable future. The Freight Strategy identifies the challenge of increasing the capacity of NSW roads to support the forecast growth in freight task.

The project is consistent with the following strategic action programs identified in the Freight Strategy:

- Network efficiency – the project would improve network efficiency, delivering travel time savings. This would provide more efficient movement of freight, which would increase productivity, reduce maintenance and, thereby, reduce operational freight costs
- Network capacity – the project would increase road capacity along The Northern Road corridor and provide greater access to the M4 Western Motorway, a key section of road for freight movement which is currently heavily congested
- Network sustainability – the provision of travel time savings and reduced vehicle hours travelled would also lead to long-term savings in greenhouse gas emissions
- The project would provide investment and planning to support freight movement to efficiently address the growing freight task in western Sydney. Additionally, the project would provide connectivity to the Western Sydney Airport through the provision of high capacity traffic and freight links between the airport and the M4 Western Motorway and south-western Sydney, including Campbelltown and the proposed M12 Motorway.

3.1.8 Transport mode-specific strategies

Sydney's Bus Future

Sydney's Bus Future (Transport for NSW, 2013a) was developed to complement the Transport Master Plan by redesigning the city's bus network to meet current and future customer needs through identifying short and longer term priorities for bus services across Sydney.

The strategy identifies the need to provide new bus connections and routes to support growing demand in Sydney's south-west, north-west and west, including Western Sydney growth areas.

The project would support this strategy by providing a kerbside bus lane in each direction.

Sydney's Cycling Future

The Transport Master Plan sets the strategic policy direction for transport and transport infrastructure for NSW. It is supported by *Sydney's Cycling Future* (Transport for NSW, 2013b), which provides the long-term plan to prioritise and provide for cycling in Sydney. These two documents identify a policy direction to ensure that the needs of bike riders are built into the planning of new transport and infrastructure projects and that bicycle infrastructure is delivered through major transport and development projects.

The project would support the objectives of *Sydney's Cycling Future* by providing pedestrian and cyclist facilities to encourage the future use of these facilities for local trips. In particular, a three metre wide shared path would be provided for the length of the project.

Sydney's Walking Future

Sydney's Walking Future (Transport for NSW, 2013c) is the NSW Government's long-term plan to promote walking as an active transport mode throughout Sydney and an integral component in the planning of urban growth precincts and new transport infrastructure.

The project would support the objectives of *Sydney's Walking Future* by providing pedestrian and cyclist facilities to encourage the future use of these facilities for local trips. In particular, a three metre wide shared path and a footpath would be provided for the length of the project.

3.1.9 Action for Air

Action for Air (Department of Environment, Climate Change and Water, 2009a) aims to improve air quality in the greater metropolitan region. *Action for Air* identifies ozone and particulates as the biggest air quality challenges for the region, and nominates actions and objectives specifically targeted to reduce motor vehicles emissions. The project would help to meet this goal by reducing travel times and congestion, and improving road conditions for heavy vehicles. These benefits would, in turn, reduce vehicle emissions.

3.2 National strategic planning and policy framework

3.2.1 Our Cities Our Future – A National Urban Policy

In 2011, the Australian Government released *Our Cities Our Future – A National Urban Policy for a productive, sustainable and liveable future* (Australian Government, 2011). An update was released in June 2012. *Our Cities Our Future* outlines the Australian Government's vision to deliver prosperity and wellbeing for city communities, and identifies four goals to achieve this based around economic growth and productivity, sustainability, liveability and governance.

The project would support the goal of economic growth and productivity by improving freight, commercial and business efficiency. It would achieve this by reducing congestion and providing better access to social and economic infrastructure and the Western Sydney Airport.

Additionally, the project is consistent with the governance objective of improving the planning and management of our cities, as it would facilitate an integrated approach to planning systems, infrastructure delivery and management.

3.2.2 National Land Freight Strategy

The National Land Freight Strategy (Commonwealth of Australia, 2012) is a partnership between the Commonwealth, State, Territory, local governments and industry to deliver a streamlined, integrated and multimodal transport and logistics system capable of efficiently moving freight throughout Australia.

The objective of this Strategy is to improve the efficiency of freight movements across infrastructure networks, minimise the negative impacts associated with such freight movements and influence policy making relevant to the movement of freight. The strategy identifies the six major challenges facing freight today. These include 'investing in the right infrastructure', 'planning for the future' and 'better access, investment and charging for heavy vehicles'.

The project would provide investment and planning to support freight movement to efficiently address the growing freight task in western Sydney. Additionally, the project would provide connectivity to the Western Sydney Airport through the provision of high capacity traffic and freight links between the airport and the M4 Western Motorway and south-western Sydney including Campbelltown and the proposed M12 Motorway.

3.2.3 National Road Safety Strategy for Australia 2011–2020

The *National Road Safety Strategy for Australia 2011–2020* (Road Safety Strategy) (Australian Transport Council, 2011) is based on the Safe Systems approach to improving road safety. This is an inclusive approach that caters for all road users, including drivers, motorcyclists, passengers, pedestrians, cyclists and commercial and heavy vehicle drivers. The fundamental tenet of the Safe Systems approach is that people make mistakes, but the system should be forgiving, and crashes should not result in death or serious injury.

The Road Safety Strategy indicates that infrastructure improvements can have a major influence in preventing crashes or minimising the consequences of a crash; and given that road infrastructure has a life of 25 years or more, the investment in infrastructure improvement continues to save lives and avoid serious injuries well into the future.

The project would relieve road congestion, and thereby improve the speed, reliability and safety of travel along The Northern Road. The delivery of the project is consistent with the overarching road safety directions identified in the *National Road Safety Strategy*.

3.3 Project need

3.3.1 Regional growth and development

The project is located within the western Sydney region, which has a population of about two million people. The population of the Sydney metropolitan area is expected to grow by around 1.6 million people by 2031 with the majority of this growth expected to be in western Sydney, which is expected to experience a population increase of around one million people (NSW Government, 2014).

Specific to the area surrounding The Northern Road corridor, a substantial amount of development is planned over the next 30 years, and a key direction of the State Government's *A Plan for Growing Sydney* is "Transforming the productivity of western Sydney through growth and investment".

These major land use changes, together with natural growth in the regional centres of Penrith and Campbelltown, will drive a dramatic increase in traffic demand in the region.

Transport for NSW has developed updated land use scenarios that reflect the latest planning for western Sydney. The key large-scale planning developments that will substantially increase traffic demand over the next 30 years include:

- Development of the SWPGA
- Establishment of the WSPGA
- Development of Western Sydney Airport at Badgerys Creek.

The Northern Road forms the western boundary of these three developments and acts as a major collector road for the priority growth areas. The latest forecasts for population and employment for these priority growth areas has been updated with Transport for NSW's Sydney Strategic Travel Model (STM) resulting in updated forecast traffic generation for western Sydney.

Traffic modelling carried out for the project indicates that traffic volumes along The Northern Road (north of Bringelly Road) are anticipated to reach and exceed carrying capacity in peak hours by 2021. This is consistent with The Northern Road Corridor Strategy (RTA 2009), which forecasts that the majority of intersections will provide inadequate service by 2026, resulting in severe local congestion.

This forecast indicates the need for substantial upgrades along The Northern Road to provide sufficient capacity to serve forecast traffic demand. In addition to the need to serve increased traffic demand, the construction of both the Western Sydney Airport and the proposed M12 Motorway creates the need for a high-capacity route to and from the Sydney Motorway Network for construction traffic generated by these developments.

The upgrade of The Northern Road would cater for this construction traffic and minimise the impacts of these large construction projects on commuter and freight travel along The Northern Road.

Western Sydney Airport

In April 2014, the Australian Government announced its decision to develop a Western Sydney Airport at Badgerys Creek, with passenger flight operations starting in 2025 catering for about three to five million passengers per year (Department of Infrastructure and Regional Development (DIRD), 2015). The airport would be located south-east of the existing junction of The Northern Road and Elizabeth Drive and would substantially increase traffic volumes along these arterial roads and other roads in the area. As such, an upgrade of The Northern Road is required to support improved road infrastructure to, and around, the Western Sydney Airport site.

A three kilometre section of the existing The Northern Road alignment bisects the Western Sydney Airport site south-east of the Luddenham town centre. This section of road would require realignment around land identified by the DIRD as required for operation of the Western Sydney Airport. The realignment would allow for the construction of the airport, while ensuring the road maintains north–south connectivity for communities in western Sydney.

According to the recently released *Western Sydney Airport Environmental Impact Statement* (DIRD, 2016), the operation of Stage 1 of the airport is expected to result in about 43,118 vehicles entering and leaving the airport site each day by 2030.

The pressures placed on the surrounding road network by the airport, as well as the associated passenger and freight traffic generated by the surrounding airport-related land use, would exceed the capacity of the current The Northern Road, particularly at existing priority intersections along the corridor. Although the main access to the Western Sydney Airport site would be from the proposed M12 Motorway, a secondary access for airport operational vehicles only is also planned to the south from The Northern Road. The existing The Northern Road, in addition to requiring realignment generally outside of the Western Sydney Airport site, would also need to be upgraded to provide safe and efficient access for passengers and freight.

South West Priority Growth Area (SWPGA)

The NSW Government established the SWPGA (formerly known as the South West Growth Centre) in 2015 to streamline the supply of greenfield land for urban development, and coordinate the sustainable delivery of infrastructure through the NSW DPE over the next 25 to 30 years. The SWPGA comprises 18 precincts and covers about 17,000 ha. It is expected to accommodate about 110,000 new dwellings for 300,000 people (DPE, 2015). To date, seven precincts within the SWPGA have been rezoned to allow urban development. These have the potential for about 42,560 new homes.

Detailed planning for stage 1 of Leppington Precinct (south-east of the project area) has recently been finalised. Upon rezoning, it is expected the Leppington Precinct will provide land for about 2,500 additional homes.

The project, and the other upgrades of The Northern Road, are being planned and developed in parallel with the development of the SWPGA. The project would cater for the substantial traffic growth predicted along The Northern Road corridor arising from increased residential and commercial development in the SWPGA and nearby areas.

The substantial traffic generated by this development is likely to place substantial pressure on the existing The Northern Road, which currently does not have sufficient capacity to support a large increase in traffic volumes during peak periods. Upgrade of The Northern Road between Mersey Road and Glenmore Parkway is necessary to ensure that residents of the SWPGA have efficient access to employment and other services in the surrounding regional centres.

Western Sydney Priority Growth Area (WSPGA)

The WSPGA (formerly known as the Broader Western Sydney Employment Area) is identified in *A Plan for Growing Sydney* (DPE, 2014). It extends from the intersection of the M4 Western

Motorway and Westlink M7 Motorway, to south of The Northern Road/Elizabeth Drive intersection. It is the largest planned employment area in greater Sydney.

The WSPGA identifies about 10,000 ha of currently low intensity rural activity lands to be developed as a diverse employment centre, providing businesses in the region with land for industry and employment, catering for transport and logistics, warehousing and office space. It is anticipated to provide over 57,000 jobs over the next 30 years and over 200,000 jobs once it is fully established. The redevelopment of this area will involve substantial changes to the local road network, and place significant pressure on arterial roads that will service the employment area.

The project is located partly within the WSPGA. The project would support the NSW Government's plans for the WSPGA by improving transport connections from the north (Penrith region and M4 Western Motorway) and south (Western Sydney Airport and SWPGA) to the WSPGA.

The existing The Northern Road currently does not have sufficient capacity to support the travel demand that these developments would generate. Therefore, upgrading The Northern Road between Mersey Road and Glenmore Parkway is essential to support the growth of the WSPGA.

It is considered that The Northern Road's current performance (see Section 7.1) and its strategic long-term importance support the need to develop the project.

3.3.2 Existing road network conditions

The Northern Road is a State road within Sydney's road network and is one of the main north-south connections in south-western Sydney. It stretches from Narellan, west of Campbelltown, via Penrith to Bligh Park south-east of Richmond.

For the majority of its length between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park, The Northern Road is a two-lane rural road on a single carriageway. North of Glenmore Parkway, on approach to the M4 Western Motorway, The Northern Road widens to two lanes in each direction. The Northern Road has a posted speed limit of 80 km/h between Mersey Road and Glenmore Parkway, dropping to 60 km/h through Luddenham town centre.

Traffic volumes along The Northern Road and on adjacent roads have been derived from traffic surveys undertaken between November 2014 and July 2015. A detailed breakdown of existing traffic volumes in the project area is provided in Appendix G – Traffic and Transport. Existing traffic volumes (vehicles per day) along The Northern Road are shown in Table 3-2.

Table 3-2 Existing traffic volumes on The Northern Road

Road	Between	AADT (vehicles per day)	AM peak 1 hour (8– 9am)	PM peak 1 hour (4.30– 5.30pm)
The Northern Road	Park Road and Blaxland Avenue	13,233	878	1,184
	Elizabeth Drive and Park Road	15,737	1,096	1,397
	Littlefields Road and Elizabeth Drive	15,206	1,097	1,371
	Chain-O-Ponds Road and Kings Hill Road	17,499	1,285	1,563
	Glenmore Parkway and Bradley Street	21,982	1,601	1,878

Car-based journeys are the predominant mode of travel for people living and working within suburbs surrounding The Northern Road. The data shown in Table 3-3 indicates that car journeys to work, whether as passenger or driver, make up about 90 per cent of the total trips in the study area.

The performance of the existing The Northern Road network is largely dependent on the operating performance of intersections which form critical capacity control points. The 'Level of Service' (LoS) is the standard measure used to assess the operational performance of the network and

intersections. Currently, intersections along The Northern Road generally experience good operation or at least good operation with acceptable delays and spare capacity.

However, testing of the forecast traffic flows on The Northern Road under future year scenarios shows that there would be insufficient capacity along The Northern Road under the existing arrangement. The forecast level of congestion indicates that future traffic demand cannot be adequately served by the road network. It is likely that under the existing network conditions future traffic demand will reach a level where delays become unacceptable and no further growth in traffic is possible. A detailed discussion of the LoS of the key intersections along The Northern Road is provided in Section 7.1.

Table 3-3 Journey to Work mode share

Mode	Destination (trips to the study area)	Origin (trips from the study area)
Car driver	84%	83%
Car passenger	6%	5%
Mode not stated	2%	2%
Train	1%	7%
Bus	1%	1%
Other	6%	2%

Source: BTS Journey to Work 2011 – TZ – 3626,4971,3625,4969,4970,4967,4965,4964,4963,4937

3.3.3 Crash statistics

A total of 121 crashes were recorded on The Northern Road between Mersey Road and Glenmore Parkway between July 2009 and June 2014. Of these:

- Five crashes resulted in fatality (4 per cent)
- 57 crashes resulted in injury (47 per cent)
- 56 crashes were rear-end crashes (40 per cent)
- 19 crashes were head-on crashes – not overtaking (13 per cent).

The observed crash rate was 1.5 crashes per km of road per year with a crash rate frequency of 25.9 crashes per 100 million VKT (vehicle kilometres travelled). The majority of these crashes were rear-end crashes occurring during the day, with a peak in the afternoon between 3–6pm. The observed casualty crash rate per kilometre of road per year is substantially lower than the average for similar roads in NSW.

The project would improve road safety by providing additional lanes and a divided carriageway, removing the need for opposing-lane overtaking and the associated risk of head-on crashes. It would also reduce congestion at intersections, which would reduce the likelihood of vehicle crashes at intersections, especially rear-end crashes. Further details regarding crash statistics and analysis are provided in Appendix G – Traffic and Transport.

3.4 Project objectives

Program objectives for the WSIP were developed in February 2015 by representatives of Roads and Maritime, Transport for NSW and the Commonwealth Department of Infrastructure and Regional Development (DIRD). The four key focus areas for the WSIP and associated program objectives are:

- Development and demand – support the Western Sydney Airport, land use change and residential growth; balancing functional, social, environmental and value for money considerations
- Connectivity to airport – provide a resilient connection to the Western Sydney Airport site for freight and people
- Integrated network – provide road improvements to support and integrate with the broader transport network
- Customer focus – provide meaningful engagement with customers and stakeholders throughout the program life.

As a key part of the WSIP, the project would deliver a combination of new, additional and renewed infrastructure. In consideration of the broader objectives for WSIP, specific objectives were developed for the project. The Northern Road Upgrade, Glenmore Parkway to Mersey Road project objectives are as follows:

- Realignment of The Northern Road around the Western Sydney Airport site to allow construction and facilitation of a Western Sydney Airport at Badgerys Creek
- Cater for future traffic demand to improve the flow of traffic to provide reliable journeys
- Improve transport connections to the Western Sydney Airport site and surrounding developments including the SWPGA (previously known as the South West Growth Centre) and WSPGA (previously known as the Broader Western Sydney Employment Area)
- Improve facilities for public and active transport to promote sustainable and efficient journeys.

Supporting project assessment criteria was also developed in conjunction with the objectives for the project to support the justification of a preferred option. The supporting project assessment criteria are to:

- Minimise environmental impacts
- Deliver a cost effective project
- Improve road safety
- Maintain arterial road function
- Accommodate access to the south-western end of the airport.

3.5 Statement of strategic need

Testing of the performance of The Northern Road under future year scenarios shows that there would be insufficient capacity along The Northern Road under the existing arrangement. The level of congestion indicates that the forecast traffic demand in 2021 and 2031, without the project, cannot be adequately served by the road network under these conditions. It is likely that under the existing network conditions, future traffic demand would reach a level where delays become unacceptable and no further growth in traffic would be possible.

Once completed, the project would enhance the road corridor between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park.

The project is needed for the following reasons:

- The project would support the region's significant population and economic growth, which would emanate from a number of major urban and infrastructure developments including the SWPGA and WSPGA. Western Sydney is expected to experience record growth, with around one million additional people living in the region by 2031

- The project is part of the WSIP, which is a package of major road infrastructure upgrades funded by the Australian and NSW governments to enable the development of a Western Sydney Airport at Badgerys Creek, and employment zones and growth centres in the western and south-western regions
- The project would provide connectivity to the Western Sydney Airport by providing high capacity traffic and freight links between the airport and the M4 Western Motorway (via The Northern Road Upgrade) and south-western Sydney including Campbelltown and the proposed M12 Motorway
- The project would improve road safety
- The project would improve public and active transport facilities, promoting sustainable and efficient journeys
- The project would improve road and intersection capacity, and thereby cater for the substantial traffic growth forecast along The Northern Road – arising from increased residential and commercial development in the SWPGA and WSPGA and nearby areas.

The project would provide a number of benefits that are in the public interest, which include:

- Facilitate the construction and ongoing operation of a planned airport at Badgerys Creek
- Address existing road safety and intersection performance issues
- Accommodate future traffic growth and improve accessibility for road users accessing the WSPGA, SWPGA and other development projects in western Sydney
- Develop new infrastructure for public and active transport modes
- Support regional benefits related to the broader program of upgrades proposed under the WSIP, such as the provision of high capacity traffic and freight links.

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

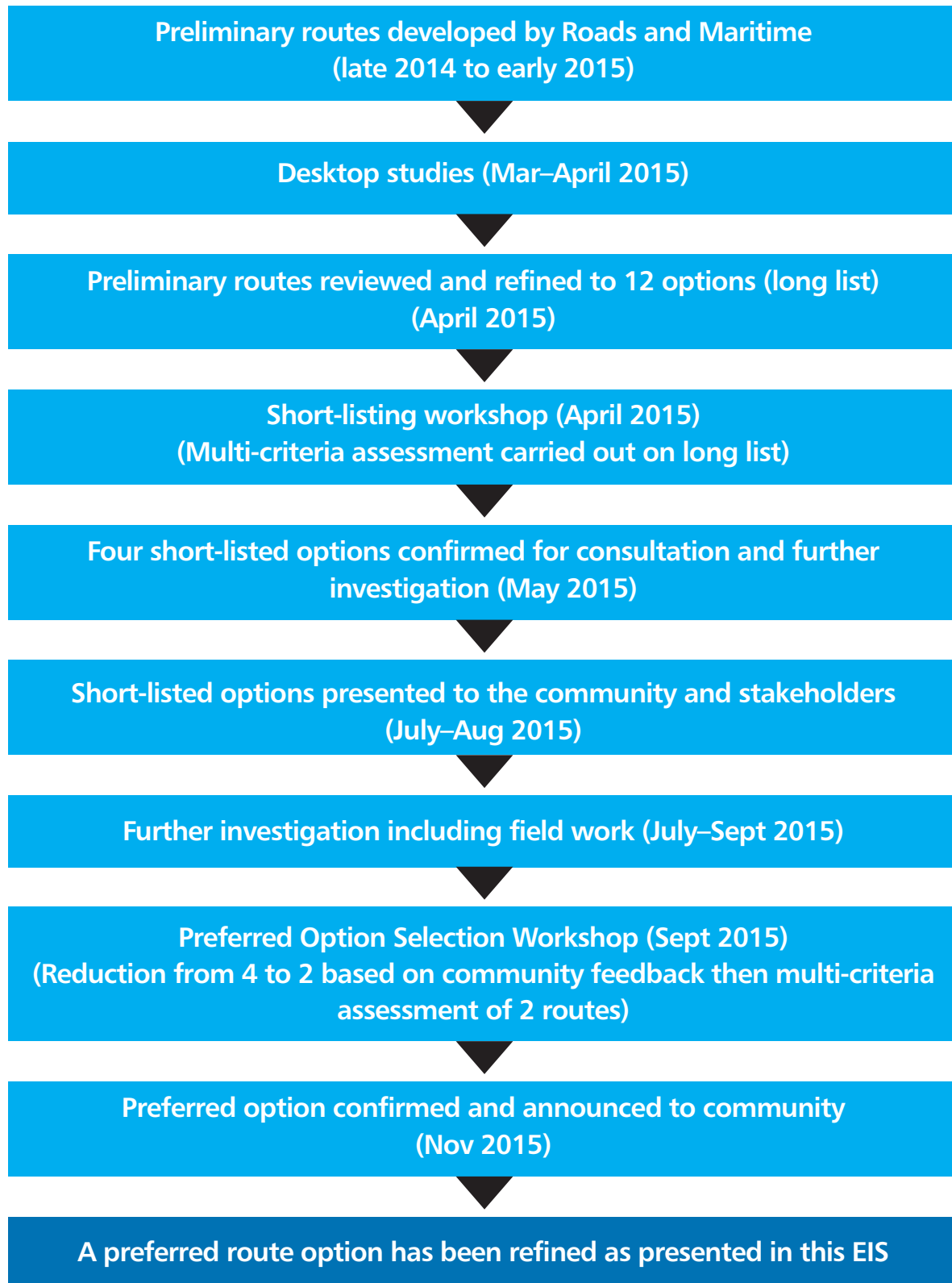


Figure 4-1 The Northern Road realignment options process for Segment 2 – Western Sydney Airport bypass

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.

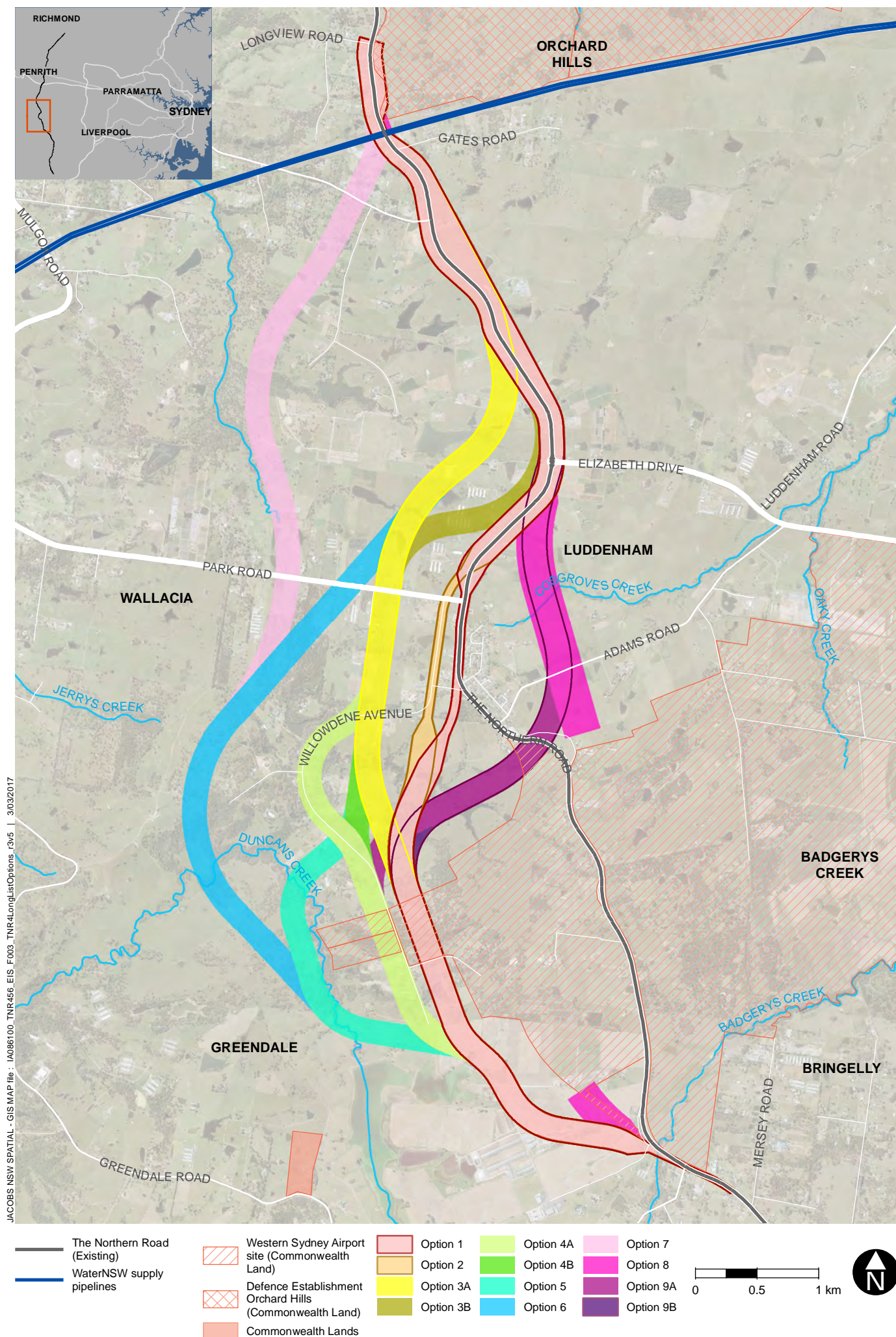


Figure 4-2 | The Northern Road Upgrade Luddenham and Western Sydney Airport bypass – longlisted route options

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.

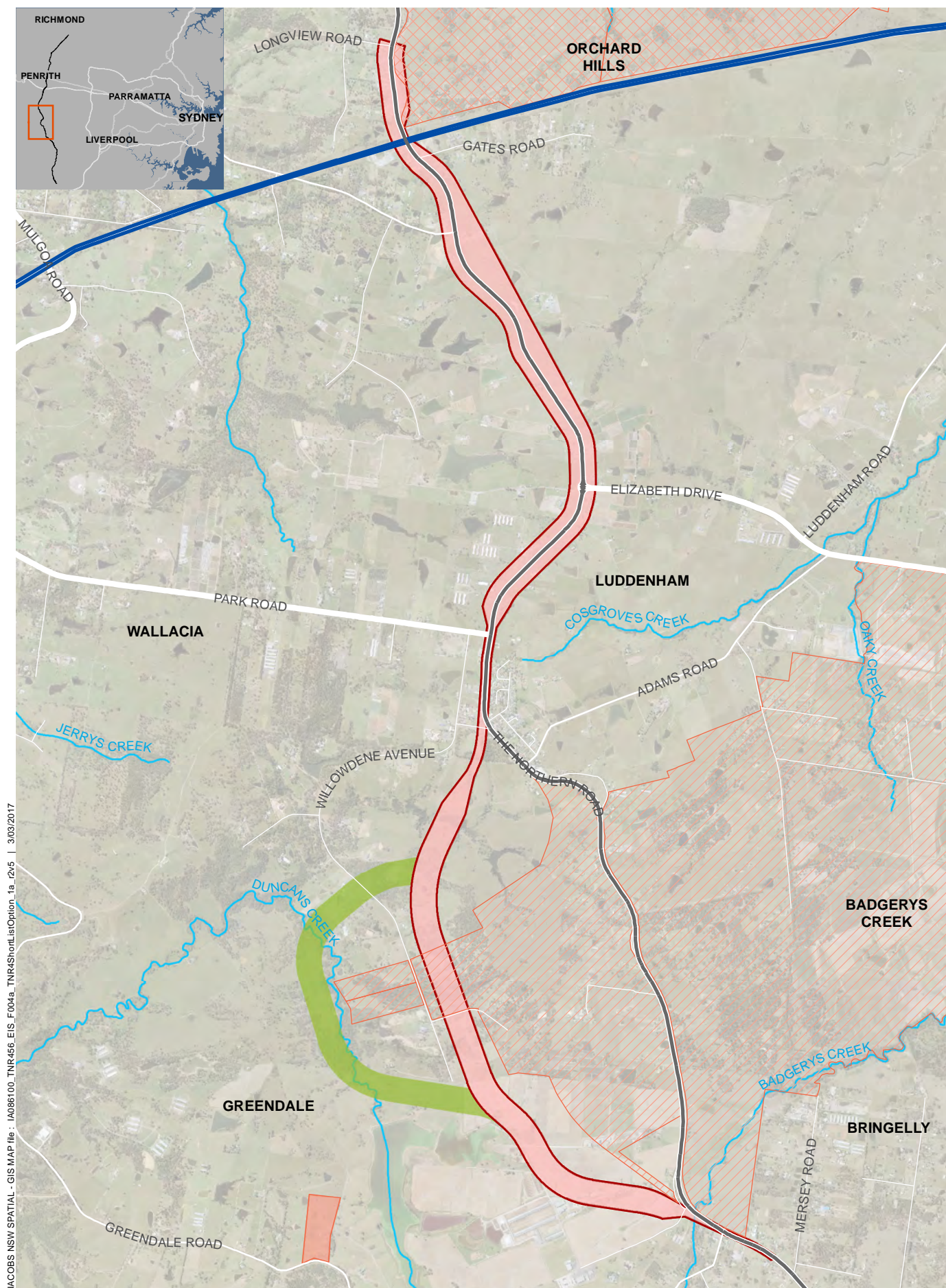
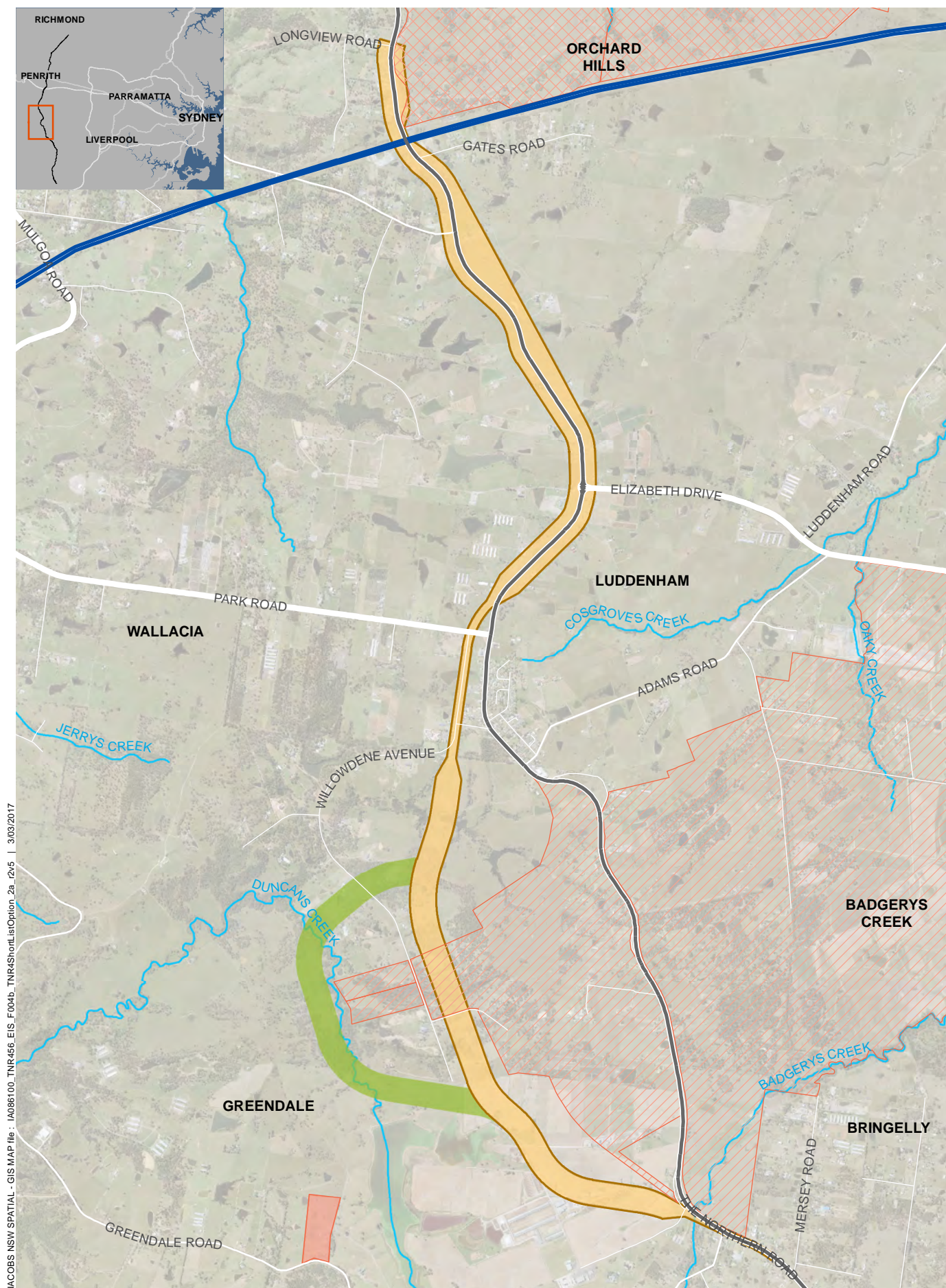


Figure 4-3 | The Northern Road Upgrade – central option



JACOBS NSW SPATIAL - GIS MAP file : IA086100_TNR456_EIS_F004b_TNR4ShortListOption_2a_r2v5 | 3/03/2017

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

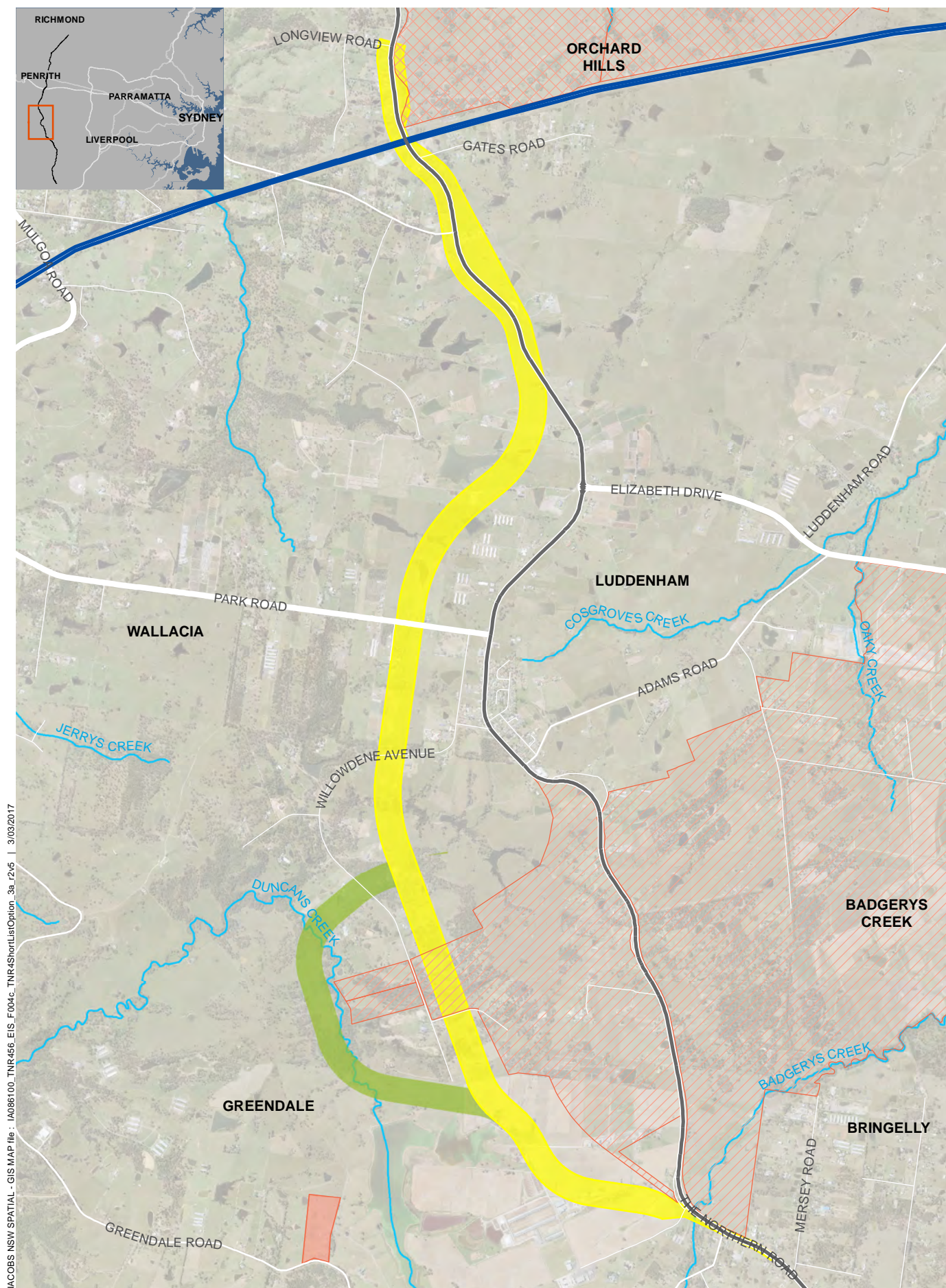
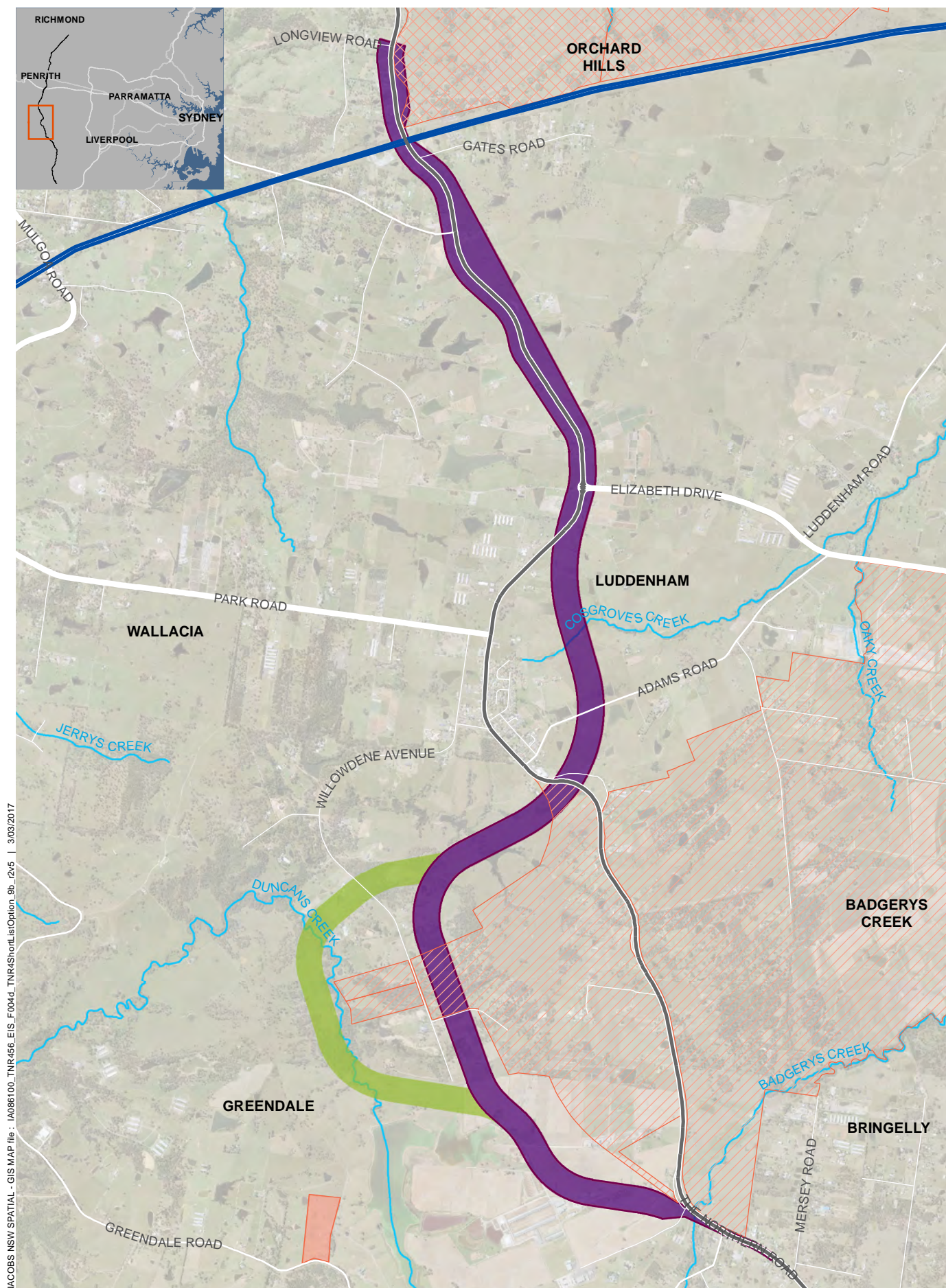


Figure 4-5 | The Northern Road Upgrade – western option



JACOBS NSW SPATIAL - GIS MAP file : IA086100_TNR456 EIS_F004d_TNR4ShortListOption_9b_r2v5 | 3/03/2017

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.

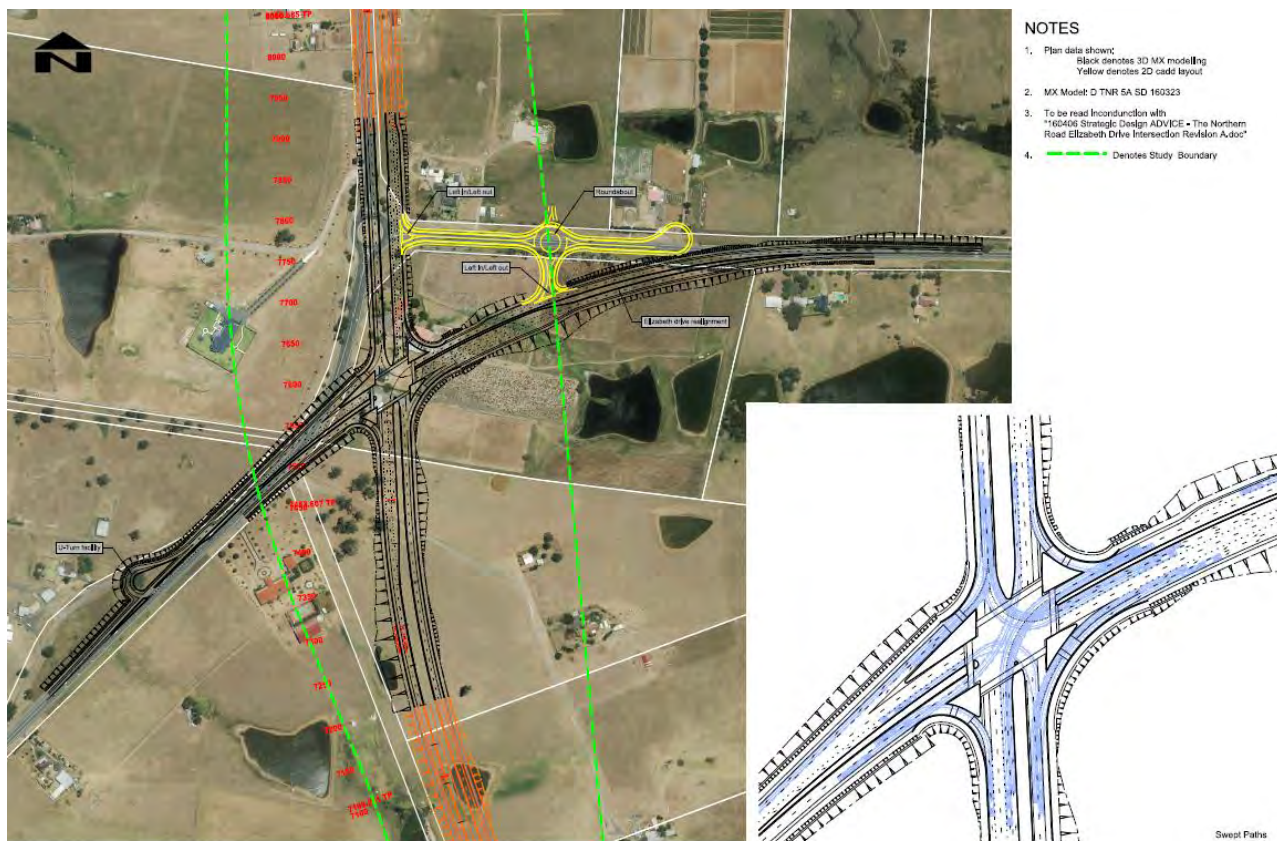


Figure 4-7 Luddenham northern access option 1: A 4-way signalised intersection

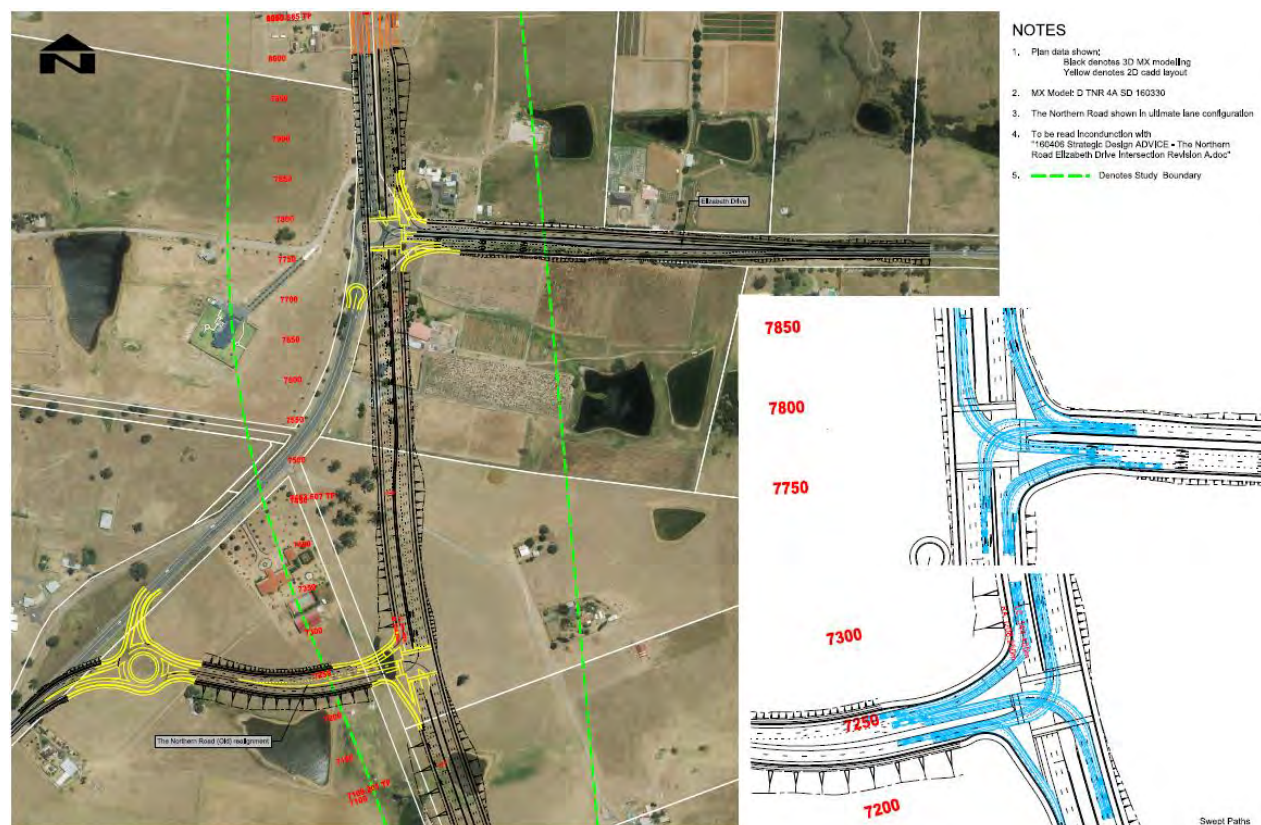


Figure 4-8 Luddenham northern access option 2: 'Staggered T' arrangement

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>

5 Project description

This chapter describes the proposed scope of work, including the route alignment, corridor width, main project elements, ancillary facilities, design standards and construction activities.

Table 5-1 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 describing the project.

Table 5-1 EIS assessment requirements – project description

Requirements	Where addressed in EIS
Secretary's Environmental Assessment Requirements (NSW EP&A Act)	
a detailed description of the proposal, including:	Chapter 5
the proposed route,	Section 5.1 Section 5.2
design of the alignment (vertical and horizontal), associated structures (such as bridges, arches and culverts), interchanges, and road user, pedestrian and cyclist facilities (including street furniture, lighting and intersection crossing treatments),	Section 5.1 Section 5.2 Section 5.3
land use changes, including resumption of residential, commercial, industrial and recreational lands, and impacts to Crown land,	Section 5.2.15 Section 7.4
interactions with key utilities and services,	Section 5.2.14 Section 5.4.14
location and operational requirements of construction ancillary facilities and access tracks,	Section 5.4.13
relationship and/or interaction with existing public and freight transport services (including air, rail, and bus services);	Chapter 7-1 and Appendix G
an analysis of the proposal, including an identification of how relevant planning, land use and development matters (including relevant strategic and statutory matters) have been considered in the impact assessment (direct, indirect and cumulative impacts) and/or in developing management / mitigation measures;	Chapter 2
details of how the proposal integrates with approved and proposed infrastructure projects, including consideration of the Western Sydney Airport at Badgerys Creek and future (M9) Outer Sydney Orbital; and...	Section 5.2
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

Requirements	Where addressed in EIS
Commonwealth EIS Guidelines (Commonwealth EPBC Act)	
All construction, operational and (if relevant) decommissioning components of the action should be described in detail. This should include the precise location (including coordinates) of all works to be undertaken, structures to be built or elements of the action that may have impacts on matters of National Environmental Significance.	Chapter 5
The description of the action must also include details on how the works are to be undertaken (including stages of development and their timing) and design parameters for those aspects of the structures or elements of the action that may have relevant impacts.	Section 5.3 Section 5.4 Section 5.5.1

5.1 Project scope

5.1.1 The project

The project involves upgrading the 16 km section of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park.

The project generally comprises the following key features:

- A six-lane divided road between Mersey Road, Bringelly and Bradley Street, Glenmore Park (two general traffic lanes and a kerbside bus lane in each direction). The wide central median would allow for an additional travel lane in each direction in the future, if required
- An eight-lane divided road between Bradley Street, Glenmore Park and 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)
- About eight kilometres of new road between Mersey Road, Bringelly and just south of the existing Elizabeth Drive, Luddenham, to realign the section of The Northern Road that currently bisects the Western Sydney Airport site and to bypasses Luddenham
- About eight kilometres of upgraded and widened road between the existing Elizabeth Drive, Luddenham and about 100 m south of Glenmore Parkway, Glenmore Park
- Closure of the existing The Northern Road through the Western Sydney Airport site
- Tie-in works with the following projects:
 - The Northern Road Upgrade, between Peter Brock Drive, Oran Park and Mersey Road, Bringelly (to the south)
 - The Northern Road Upgrade, between Glenmore Parkway, Glenmore Park and Jamison Road, South Penrith (to the north)
- New intersections including:
 - A traffic light intersection connecting the existing The Northern Road at the southern boundary of the Western Sydney Airport, incorporating a dedicated u-turn facility on the western side
 - A traffic light intersection for service vehicles accessing the Western Sydney Airport, incorporating 160 m of new road connecting to the planned airport boundary
 - A traffic light intersection connecting the realigned The Northern Road with the existing The Northern Road (west of the new alignment) south of Luddenham

- A ‘give way’ controlled intersection (that is, no traffic lights) connecting the realigned The Northern Road with Eaton Road (east of the new alignment, left in, left out only)
- A four-way traffic light intersection formed from the realigned Elizabeth Drive, the realigned The Northern Road and the existing The Northern Road, north of Luddenham
- A traffic light intersection at the Defence Establishment Orchard Hills entrance, incorporating a u-turn facility
- New traffic lights at four existing intersections:
 - Littlefields Road, Luddenham
 - Kings Hill Road, Mulgoa
 - Chain-O-Ponds Road, Mulgoa
 - Bradley Street, Glenmore Park incorporating a u-turn facility
- Modified intersection arrangements at:
 - Dwyer Road, Bringelly (left in, left out only)
 - Existing Elizabeth Drive, Luddenham (left out only)
 - Gates Road, Luddenham (left in only)
 - Longview Road, Luddenham (left in, left out only)
 - Grover Crescent south, Mulgoa (left in only)
 - Grover Crescent north, Mulgoa (left out only)
- Dedicated u-turn facilities at:
 - The existing The Northern Road at Luddenham, south-west of Elizabeth Drive
 - The existing Elizabeth Drive, Luddenham around 800 m east of The Northern Road
 - Chain-O-Ponds Road, Mulgoa
- Twin bridges over Adams Road, Luddenham
- Local road changes and upgrades, including:
 - Closure of Vicar Park Lane, east of the realigned The Northern Road, Luddenham
 - Eaton Road cul-de-sac, west of the realigned The Northern Road, Luddenham
 - Eaton Road cul-de-sac, east of the realigned The Northern Road, Luddenham
 - Elizabeth Drive cul-de-sac, about 300 m east of The Northern Road with a connection to the realigned Elizabeth Drive, Luddenham
 - Extension of Littlefields Road, east of The Northern Road, Mulgoa
 - A new roundabout on the Littlefields Road extension, Mulgoa
 - A new service road between the Littlefields Road roundabout and Gates Road, including a ‘give way’ controlled intersection (that is, no traffic lights) at Gates Road, Luddenham
 - Extension of Vineyard Road, Mulgoa between Longview Road and Kings Hill Road
 - A new roundabout on the Vineyard Road extension at Kings Hill Road, Mulgoa
- A new shared path on the western side of The Northern Road and footpaths on the eastern side of The Northern Road
- A new shared path on the western side of The Northern Road and footpaths on the eastern side of The Northern Road where required
- The upgrading of drainage infrastructure
- Operational ancillary facilities including:
 - Heavy vehicle inspection bays for both northbound and southbound traffic, adjacent to Grover Crescent, Mulgoa and Longview Road, Mulgoa respectively
 - An incident response facility on the south-western corner of the proposed four-way traffic light intersection at Elizabeth Drive, Luddenham
- New traffic management facilities including variable message signs (VMS)
- Roadside furniture and street lighting
- The relocation of utilities and services

- Changes to property access along The Northern Road (generally left in, left out only)
- Establishment and use of temporary ancillary facilities and access tracks during construction
- Property adjustments as required
- Clearance of undetonated explosive ordinance (UXO) within the Defence Establishment Orchard Hills as required.

This EIS seeks approval for the project elements above. The EIS has been prepared based on a concept design. If approved, a further detailed design process would follow which may include variations to the concept design. Flexibility is provided in the concept design to allow for refinement of the project during detailed design or in response to any submissions received following the exhibition of the EIS.

The project assessed in this EIS does not include surveys, test drilling, test excavations, geotechnical investigations or other tests, surveys, sampling or investigation for the purposes of the design or assessment of the project.

The location and key components of the project are shown in Figure 5-1. Diagrams of the proposed intersection arrangements and local road changes are provided in Table 5-2, Table 5-3 and Table 5-7.

5.2 The completed project

5.2.1 Alignment

The project can be divided into two sections and described generally from south to north as follows:

- Mersey Road, Bringelly to Elizabeth Drive, Luddenham (about eight kilometres between chainage 0 and chainage 7500 – refer Figure 5-1)
- Elizabeth Drive, Luddenham to about 100 m south of Glenmore Parkway, Glenmore Park (about eight kilometres between chainage 7,500 and chainage 16,100 – refer Figure 5-1).

The following sections describe the alignment of the project.

Mersey Road, Bringelly to Elizabeth Drive, Luddenham (Luddenham and Western Sydney Airport bypass)

Between Mersey Road, Bringelly and Elizabeth Drive, Luddenham, the project would comprise a six-lane divided road (two general traffic lanes and a kerbside bus lane in each direction separated by a wide central median). The median would allow for an additional lane in each direction in the future, if required.

The project would tie into The Northern Road Upgrade, Peter Brock Drive, Oran Park to Mersey Road, Bringelly (Stage 2) at a point just north of Mersey Road. The existing road would be upgraded until diverting from the existing alignment around 300 m north of Mersey Road. At this location, a traffic light intersection would be provided, connecting the existing The Northern Road at the southern boundary of the Western Sydney Airport, incorporating a dedicated u-turn facility on the western side near the Leppington pastoral company entrance.

The new road alignment would primarily be located on agricultural land, with a small section (about 400 m), on land purchased for the Western Sydney Airport (Commonwealth land). The main service entry to the airport would be provided by a traffic light intersection at the western edge of the planned airport, about one kilometre north of Mersey Road. Roads and Maritime is currently in discussion with the Australian Department of Infrastructure and Regional Development (DIRD) to acquire portions of Commonwealth land, purchased for the airport, for the purpose of the project. In accordance with the *Western Sydney Airport revised draft Airport Plan 2016*, and as confirmed during consultation with DIRD, these portions of land do not form part of the operational requirements of the airport.

The new alignment would continue north and run generally parallel with the eastern side of Willowdene Avenue, along the western edge of the Western Sydney Airport site, before turning to the north-east where a new connection to the existing The Northern Road would be provided south of Luddenham. Eaton Road would be separated by the new alignment and would require a minor realignment to the west of the new intersection. Access to Eaton Road (west) would not be possible from the new alignment as the local road would terminate in a cul-de-sac. Access would instead be provided via the existing The Northern Road. Access to the eastern side of Eaton Road would be provided via a left in/left out arrangement with the eastern extent of Eaton Road terminating in a cul-de-sac. Refer to Table 5-7 for further details of local road changes.

The new alignment would continue across pastoral land, with the alignment bridging over Adams Road. A new four-way intersection with the realigned Elizabeth Drive and the existing The Northern Road would provide a northern connection to Luddenham. Elizabeth Drive would be realigned to enable the creation of the new intersection. Elizabeth Drive would be restricted to left out access onto The Northern Road in order to reduce conflicts with the new intersection. A new shared path would be provided on the western side of The Northern Road and footpaths on the eastern side of The Northern Road, as required.

The alignment and key features of this section of the project are presented in Figure 5-1. A typical cross section of the six-lane divided road configuration is presented in Figure 5-2.

Elizabeth Drive, Luddenham to Glenmore Parkway, Glenmore Park

North of the realigned Elizabeth Drive intersection, the project has been aligned to consider tie-ins with future motorway infrastructure such as the proposed M12 Motorway and the planned M9 Motorway (Outer Sydney Orbital, or OSO). The alignment largely follows the existing road corridor, and the project would involve upgrading and widening the existing road on both sides. New traffic lights would be installed at Littlefields Road to provide access to the proposed extension of Littlefield Road. A north-south service road would also be provided connecting Gates Road to the Littlefields Road extension to provide northbound access to The Northern Road for residents living on Gates Road east of the project.

North of Littlefields Road, the project would generally follow the existing road alignment, crossing the WaterNSW Supply Pipelines between Gates Road and Longview Road.

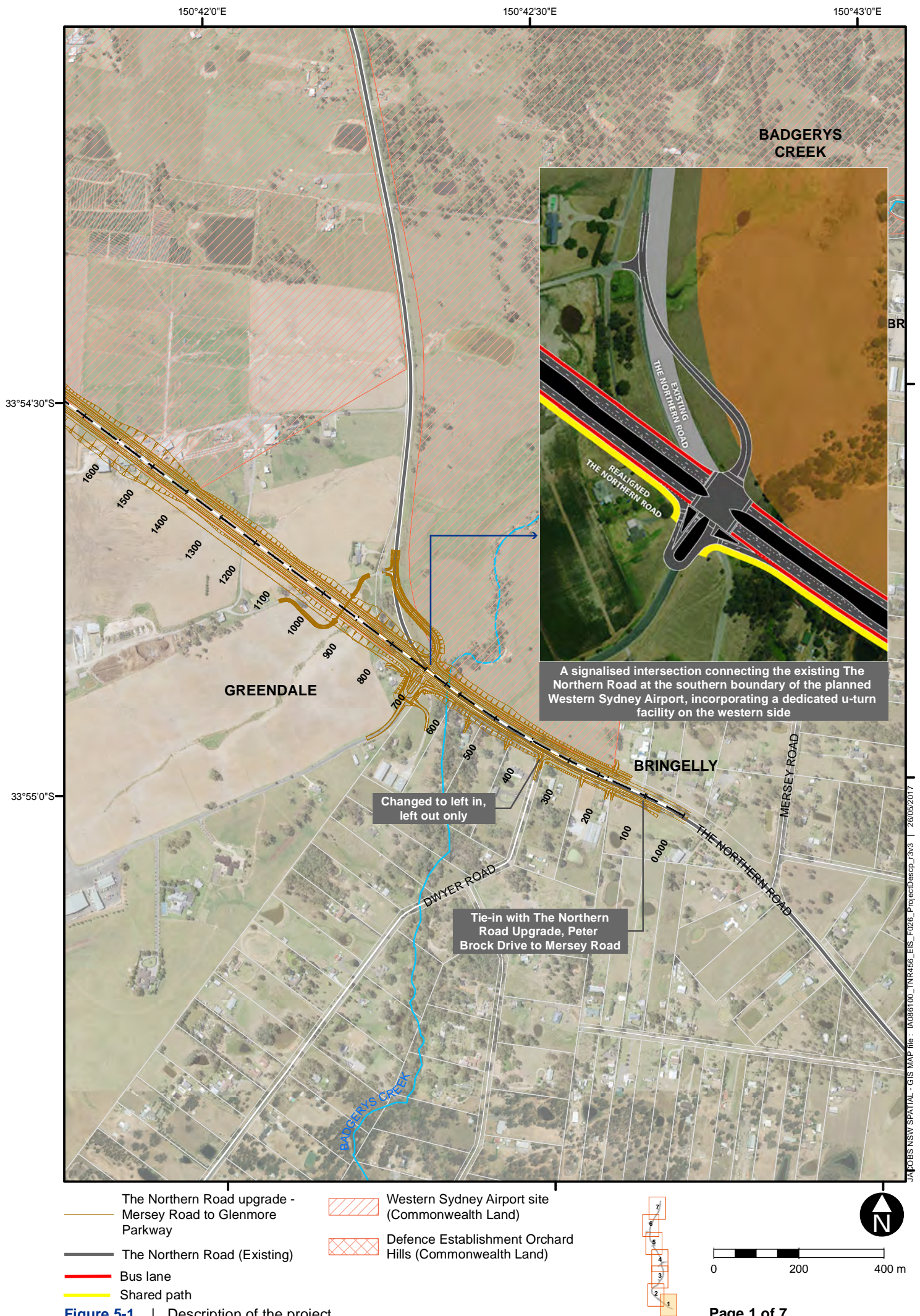
Heavy vehicle inspection bays would be provided southbound along this section of the alignment and northbound adjacent to Grover Crescent. New intersection arrangements would be provided for Gates Road, Longview Road and Grover Crescent. New traffic lights would be installed at Kings Hill Road, Chain-O-Ponds Road, Defence Establishment Orchard Hills (DEOH) main gate and Bradley Street. Vineyard Road would also be extended between Longview Road and Kings Hill Road with a new roundabout located on the Vineyard Road extension at Kings Hill Road. This extension would provide southbound access to The Northern Road (via Kings Hill Road) as Longview Road would be altered to left in, left out only.

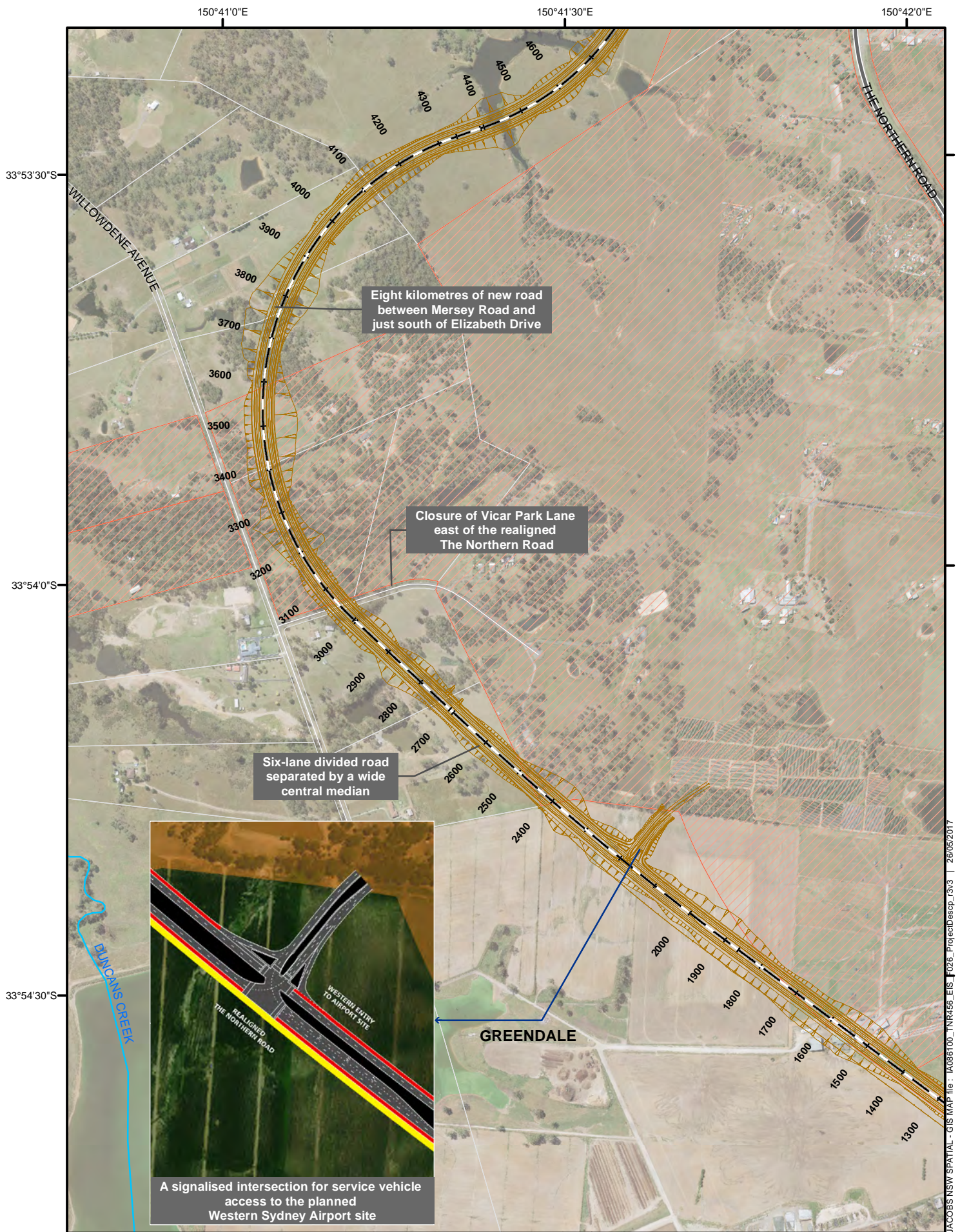
From the southern boundary of the DEOH, the upgrade would generally occur on the eastern side of The Northern Road within Commonwealth land. The wide central median would allow for additional lanes in each direction in the future, when required. However, there would be some acquisition of land on the western side of the existing corridor.

Between Elizabeth Drive and Bradley Street, the project would comprise a six-lane divided road (two general traffic lanes and a kerbside bus lane in each direction separated by a wide central median). North of Bradley Street, The Northern Road would be upgraded to an eight-lane divided road (three general traffic lanes and a kerbside bus lane in each direction separated by a median) until the tie-in with the proposed The Northern Road Stage 3 project about 100 m south of Glenmore Parkway.

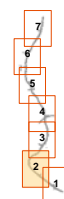
A new shared path would be provided on the western side of The Northern Road and footpaths on the eastern side of The Northern Road, as required.

The alignment and key features of this section of the project are presented in Figure 1-2 (sheet 2) and Figure 5-1 in further detail. A typical cross section of the eight-lane divided road configuration is presented in Figure 5-3.





- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- Bus lane
- Shared path
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)



0 200 400 m



Figure 5-1 | Description of the project

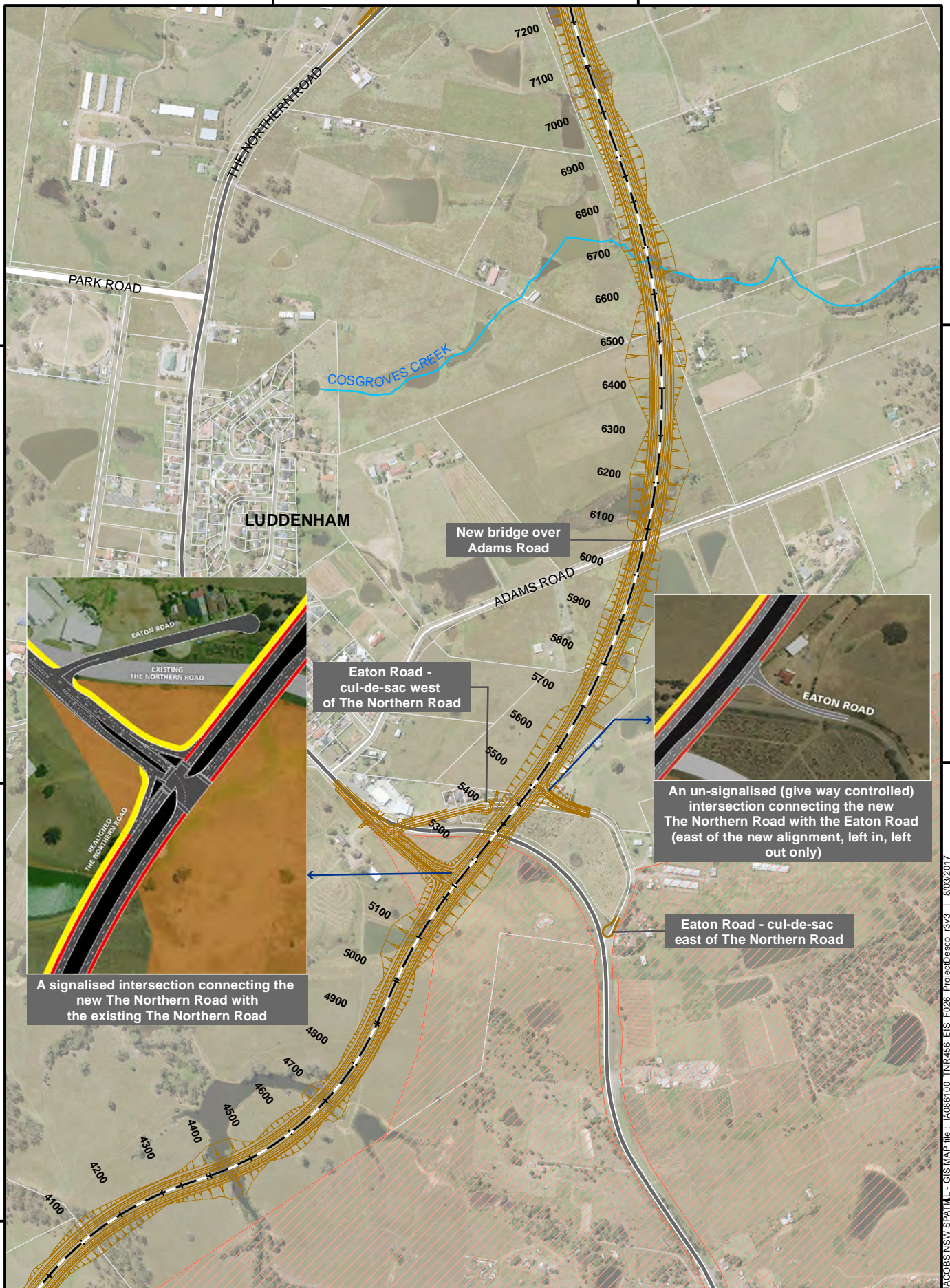
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150°42'0"E

33°52'30"S

33°53'0"S

33°53'30"S



— The Northern Road upgrade - Mersey Road to Glenmore Parkway

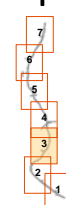
— The Northern Road (Existing)

— Bus lane

— Shared path

Western Sydney Airport site (Commonwealth Land)

Defence Establishment Orchard Hills (Commonwealth Land)



0 200 400 m



Figure 5-1 | Description of the project

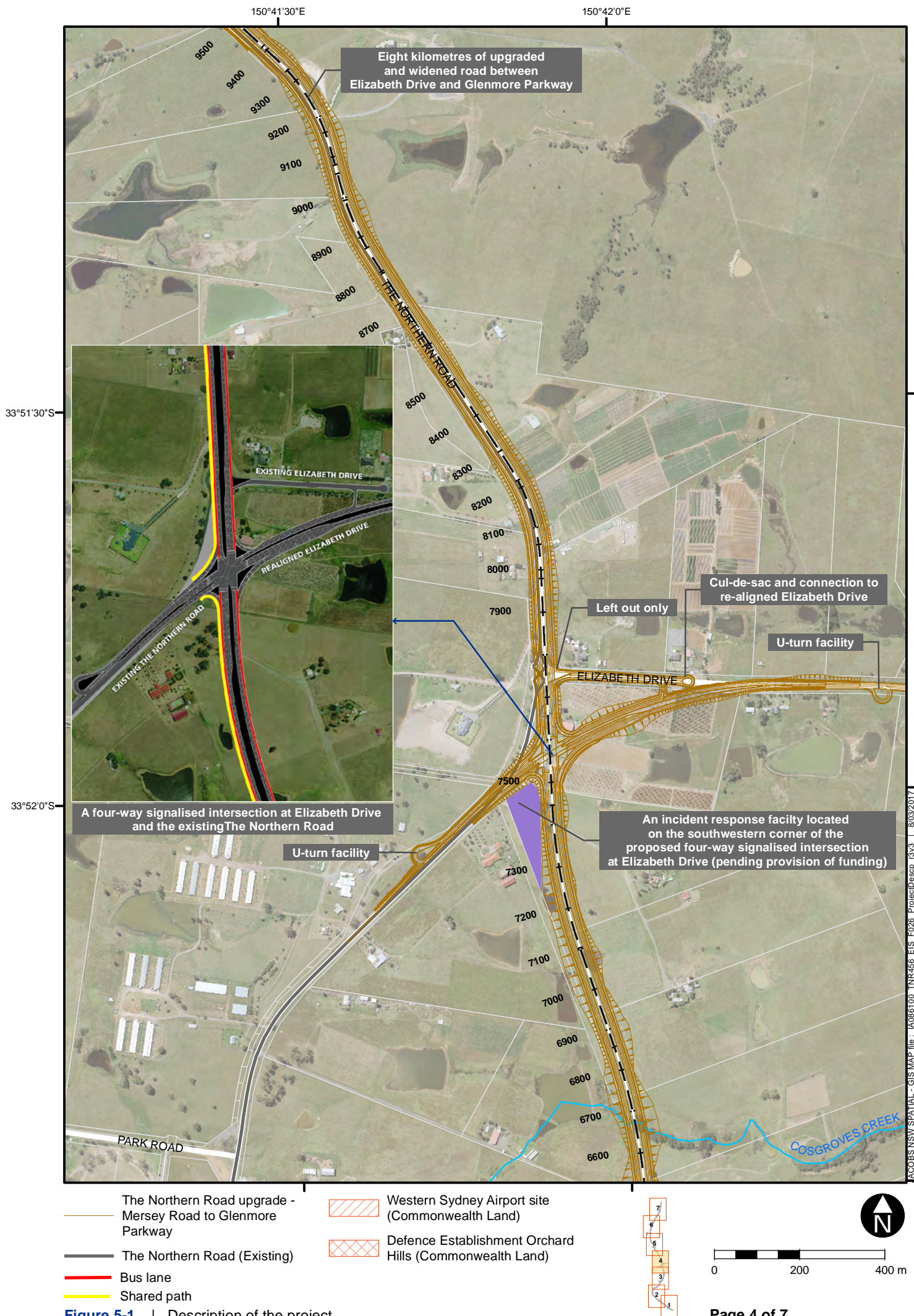
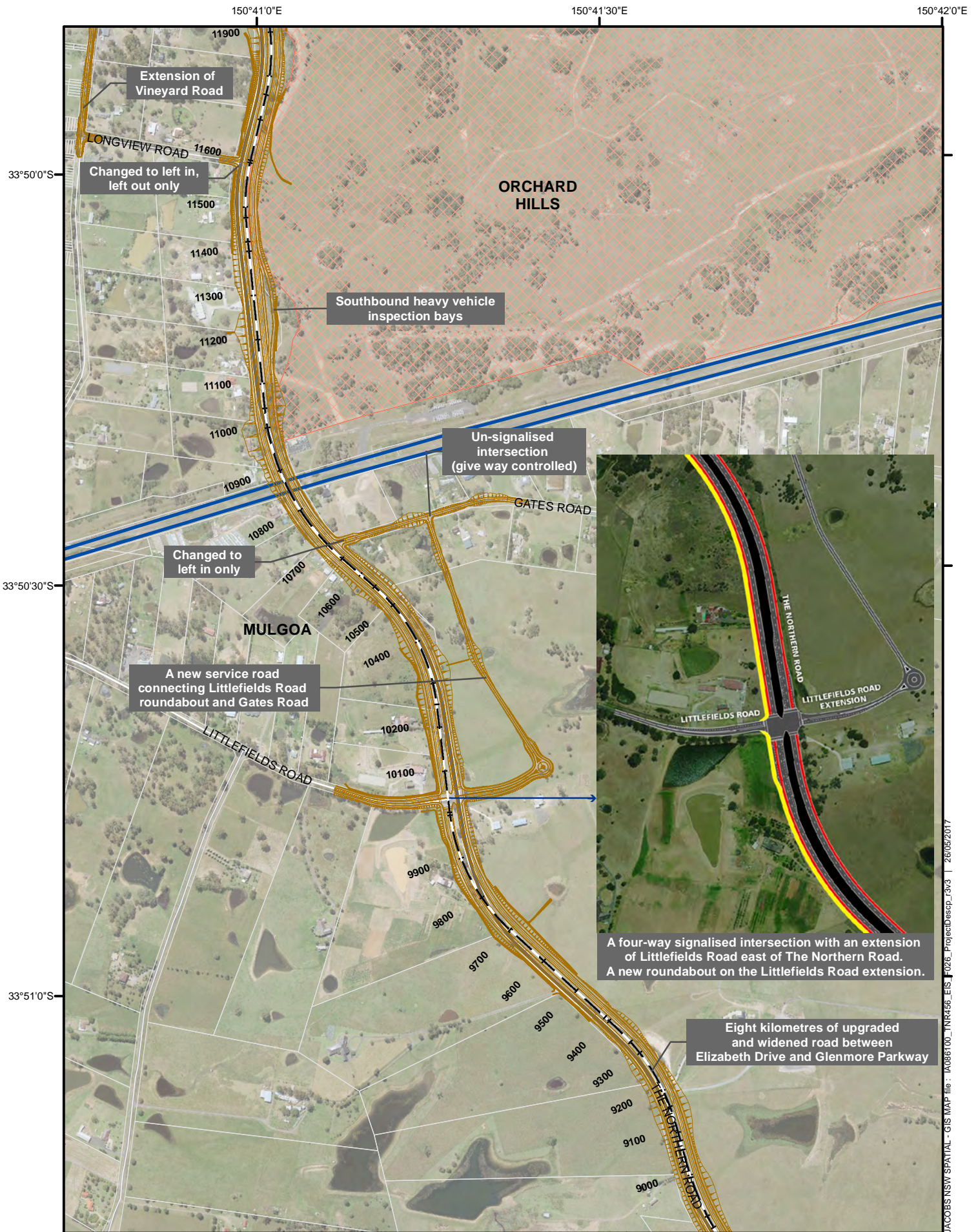


Figure 5-1 | Description of the project



- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- Bus lane
- Shared path

- ▨ Western Sydney Airport site (Commonwealth Land)
- ▩ Defence Establishment Orchard Hills (Commonwealth Land)
- WaterNSW supply pipelines

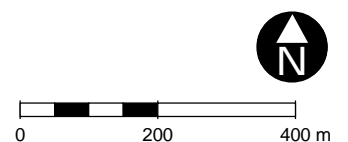
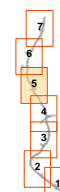
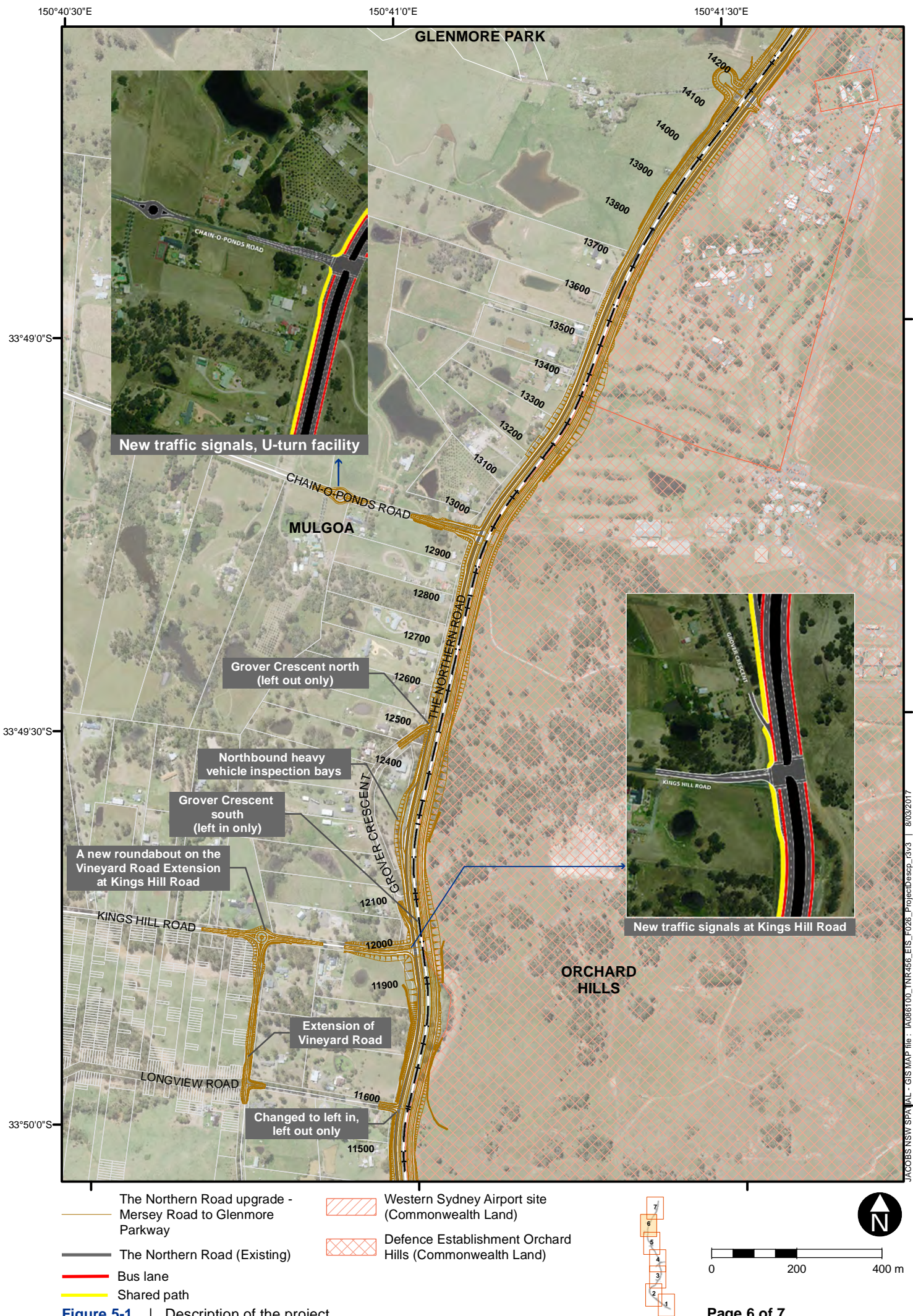
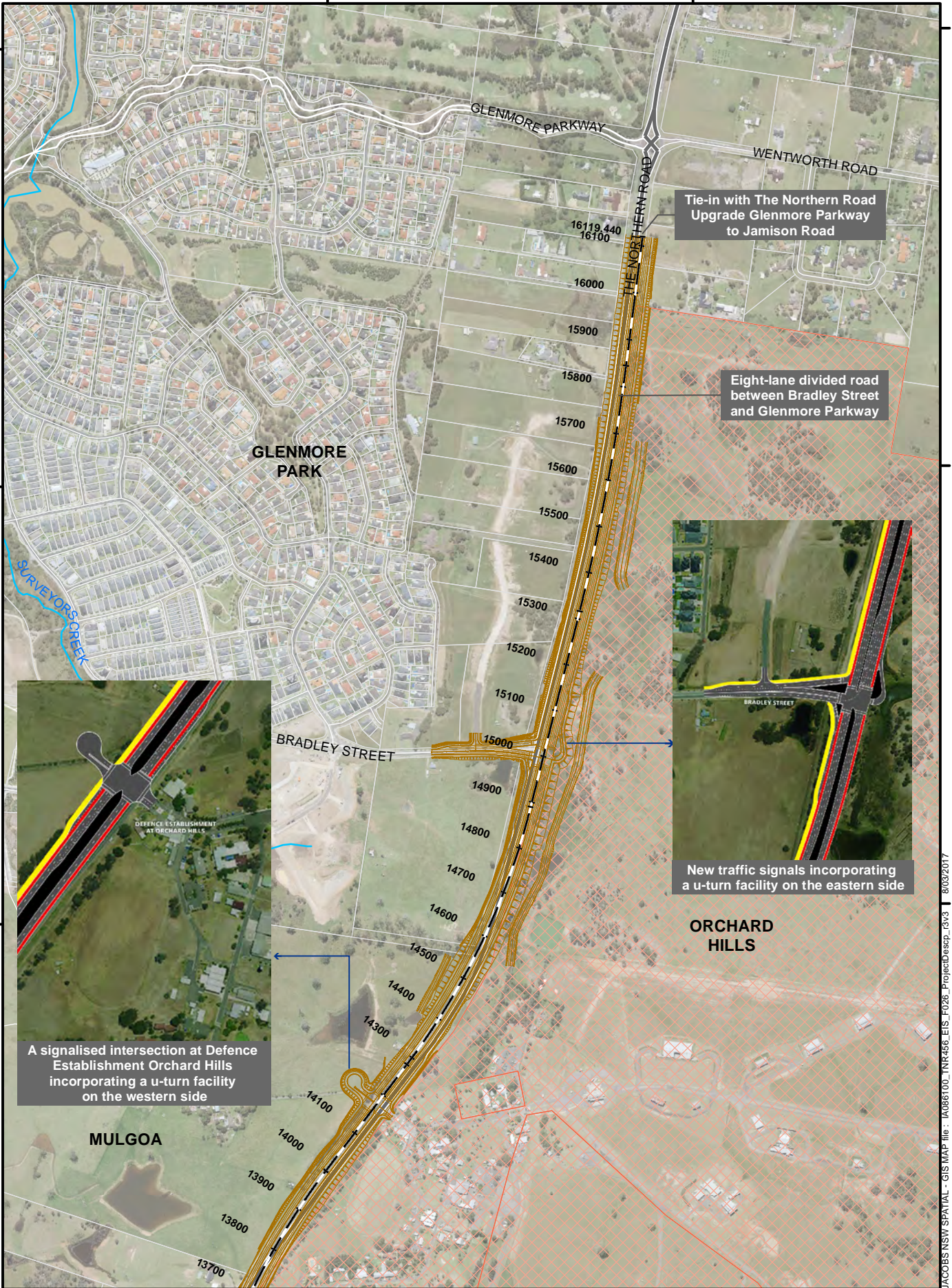


Figure 5-1 | Description of the project





- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- Bus lane
- Shared path

- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)

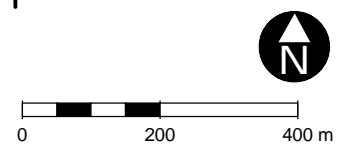
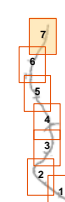


Figure 5-1 | Description of the project

5.2.2 Road grade and lane widths

The gradient of the road would generally be about three per cent, but in places it could reach a maximum of six per cent.

The dual carriageways of the upgraded road south of Bradley Street would generally have:

- Two lanes per carriageway, each lane a minimum width of 3.5 m
- One dedicated bus lane, a minimum width of four metres
- A typical median width of about 16.5 m between edge lines (this would divide the carriageways and allow for future widening of the road within the median in the future if required).

The dual carriageways of the upgraded road north of Bradley Street would generally have:

- Three lanes per carriageway, each lane a minimum width of 3.5 m
- One dedicated bus lane, a minimum width of four metres
- A typical median width of about 9.5 m between edge lines (this would divide the carriageways and allow for future widening of the road within the median in the future if required).

Typical cross sections are presented in Figure 5-2 for the section of the project south of Bradley Street and Figure 5-3 for the section of road north of Bradley Street.

5.2.3 Corridor width and project footprint

The strategic and concept design process for the project has included refinements to the proposed alignment to ensure network enhancement objectives can be achieved while minimising environmental impacts, such as land acquisition and vegetation removal.

The total construction footprint (including compound and laydown sites) is estimated at about 278 ha. The construction footprint would include the land required for the construction of the main carriageway, intersection upgrades, new intersection, integration with existing surface roads, drainage infrastructure, surface support infrastructure, construction access tracks and temporary ancillary facilities (such as construction compounds).

Once operational, the total operational footprint is estimated at 202 ha. The operational footprint would consist of the land required to accommodate the operation of The Northern Road, the upgraded local roads and any drainage and ancillary infrastructure. It would incorporate about 45 ha of land currently owned by the Commonwealth consisting of:

- About 25 ha of land within the DEOH
- About 20 ha of land purchased for the Western Sydney Airport.

Figure 5-4 shows the proposed operational and construction footprints of the project.

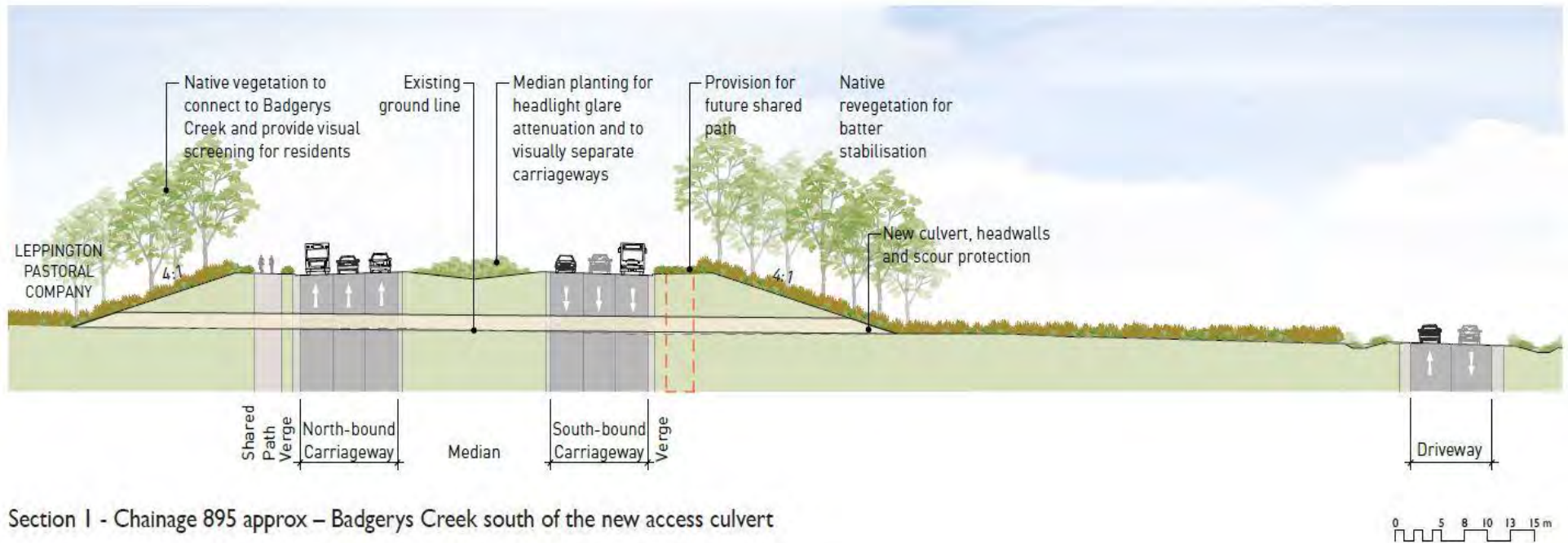
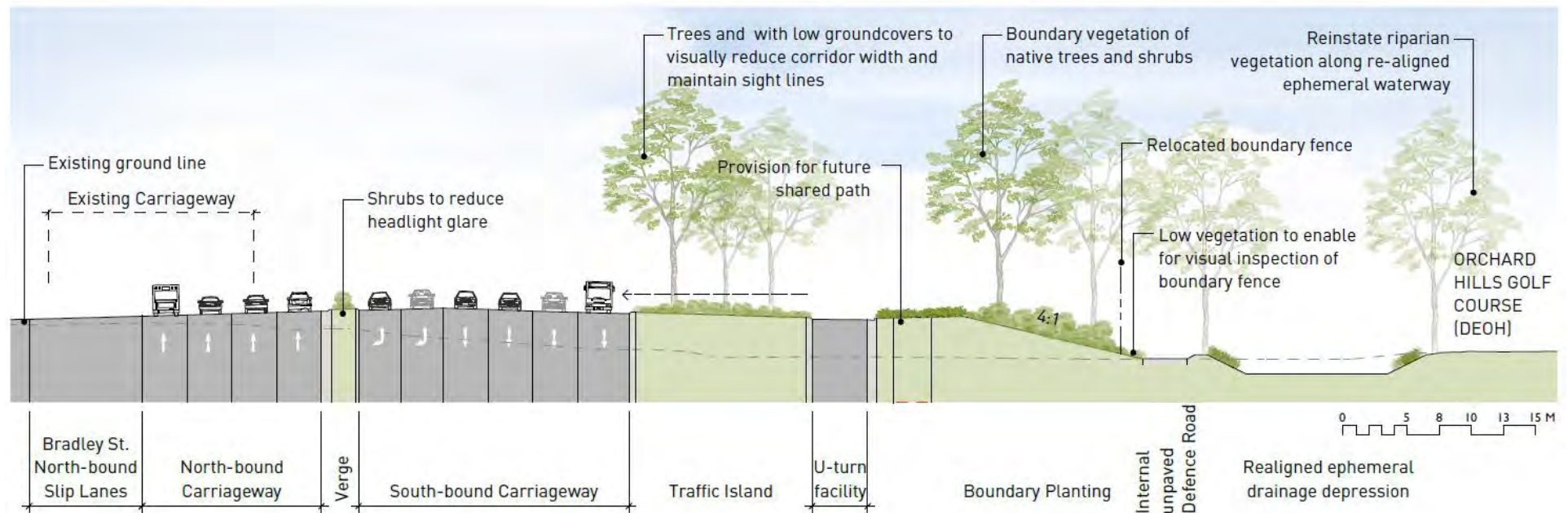


Figure 5-2 Typical cross section between Mersey Road and Bradley Street (six-lane divided road)

Chapter 5 – Project description

The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park
Environmental impact statement / draft Environmental Impact Statement

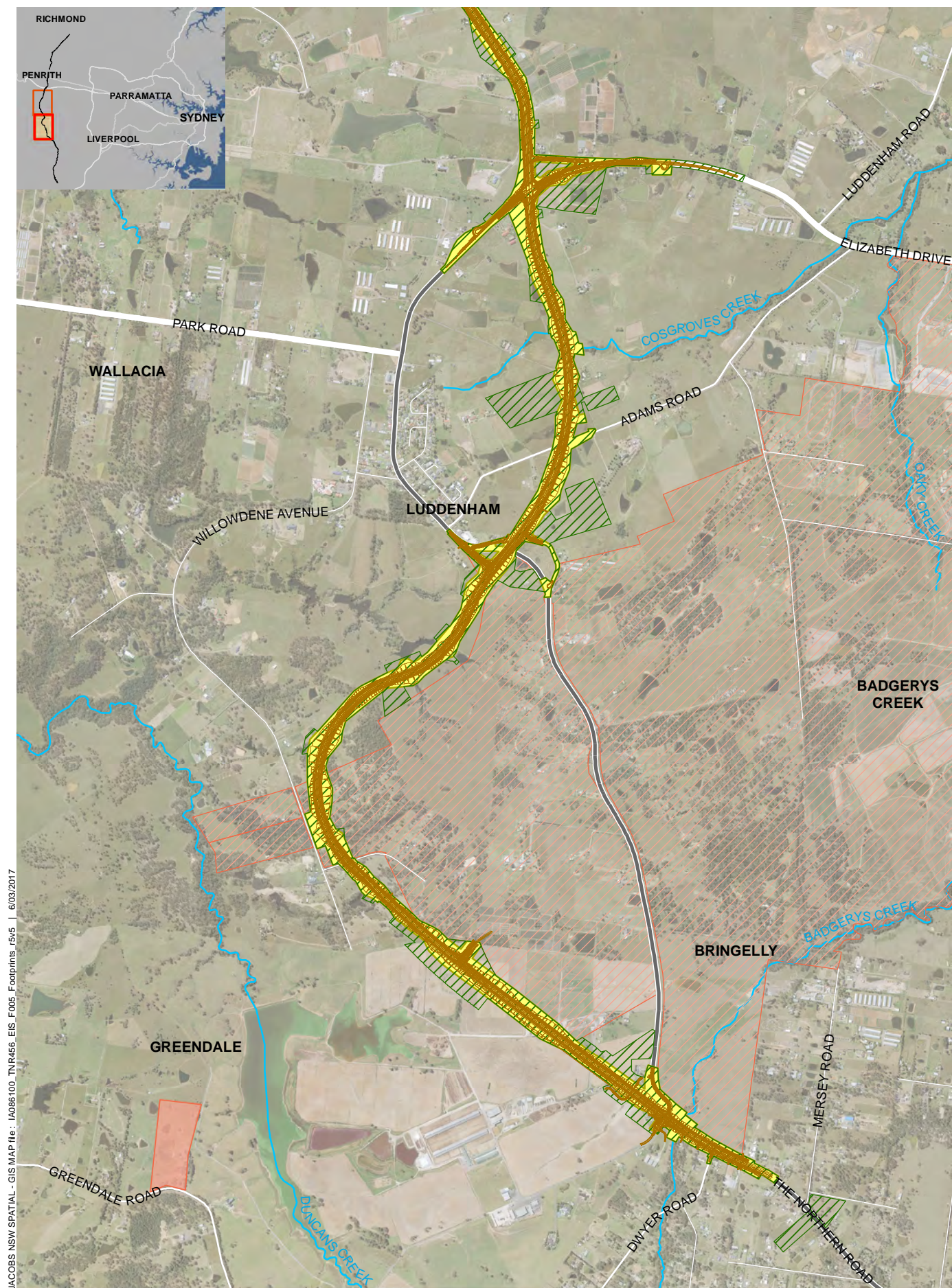


Section 11 - Chainage 15,035 approach – Bradley Street intersection

Figure 5-3 Typical cross section between Bradley Street and Glenmore Parkway (eight-lane divided road)

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JACOBS NSW SPATIAL - GIS MAP file: IA086100_TNR456_EIS_F005_Footprints_r5v5 | 8/03/2017

- | | |
|---|---|
| The Northern Road upgrade - Mersey Road to Glenmore Parkway | Western Sydney Airport site (Commonwealth Land) |
| The Northern Road (Existing) | Defence Establishment |
| Operational footprint | Orchard Hills (Commonwealth Land) |
| Construction footprint | Commonwealth Lands |

0 0.5 1 km



Figure 5-4 | Operational and construction footprints for the project

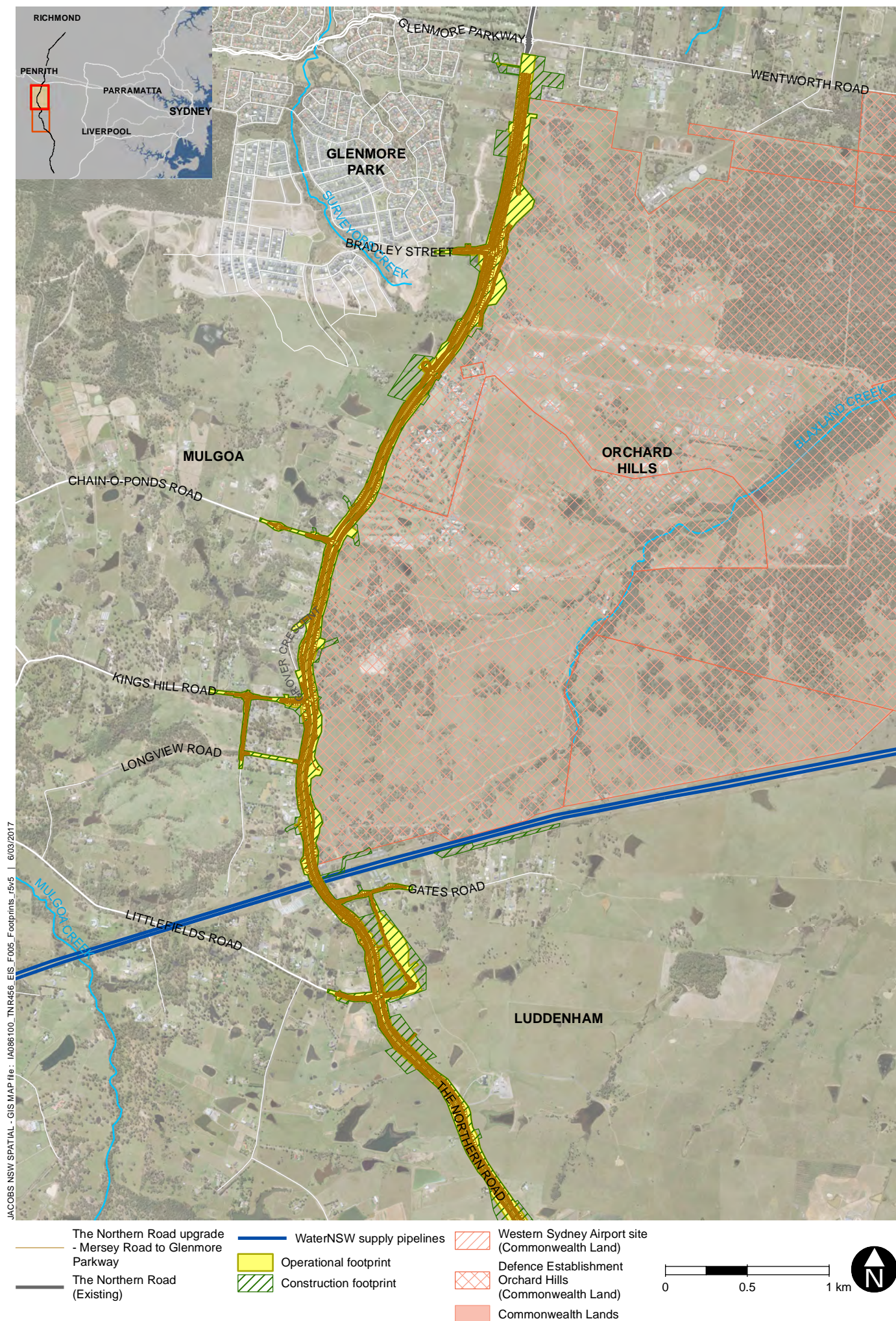


Figure 5-4 | Operational and construction footprints for the project

5.2.4 Intersections

The project would include new intersections with traffic lights, modified intersections, and new traffic lights at existing intersections as described in the following sections and shown in Figure 5-1.

New intersections

The project would include six new intersections:

- A traffic light intersection connecting the existing The Northern Road at the southern boundary of the Western Sydney Airport (Commonwealth land), incorporating a dedicated u-turn facility on the western side (chainage 700)
- A traffic light intersection for service vehicles accessing the Western Sydney Airport, incorporating 160 m of new road connecting to the planned airport boundary (chainage 2,200)
- A traffic light intersection connecting the new The Northern Road with the existing The Northern Road (west of the new alignment) south of Luddenham (chainage 5,200)
- An 'give way' controlled intersection (no traffic lights) connecting the new The Northern Road with Eaton Road (east of the new alignment, left in, left out only) (chainage 5,500)
- A four-way traffic light intersection formed by realigning Elizabeth Drive and the existing The Northern Road, north of Luddenham (chainage 7,600)
- A traffic light intersection at DEOH (Commonwealth land), incorporating a u-turn facility on the western side (chainage 14,200).



The project would include new traffic lights at four existing intersections:

- Littlefields Road, Luddenham (chainage 10,000)
- Kings Hill Road, Mulgoa (chainage 12,000)
- Chain-O-Ponds Road, Orchard Hills (chainage 12,900)
- Bradley Street, Orchard Hills incorporating a u-turn facility on the eastern side (chainage 15,000).

Plans and descriptions of the proposed intersection configurations are presented in Table 5-2.

Work at all intersections would generally include kerb realignments, drainage adjustments, installation of traffic lights, relocation of road furniture and other similar work to accommodate the project. Refer to Section 5.4 for further information on the construction of the project.

Table 5-2 Proposed layout of new intersections, and proposed traffic lights at existing intersections

New intersection location and configuration	
	<p>A signalised intersection connecting the existing The Northern Road at the southern boundary of the planned Western Sydney Airport, incorporating a dedicated u-turn facility on the western side.</p> <div><p>LEGEND</p><ul style="list-style-type: none">bus laneshared pathCommonwealth Land</div>
	<p>A signalised intersection for service vehicle access to the planned Western Sydney Airport, incorporating 160 m of new road connection to planned western Sydney airport boundary. The intersection would allow all turning movements into and out of the airport site.</p> <div><p>LEGEND</p><ul style="list-style-type: none">bus laneshared pathCommonwealth Land</div>

New intersection location and configuration



A signalised intersection connecting the realigned The Northern Road with the existing The Northern Road (west of the new alignment) south of Luddenham. This would provide an upgraded entry to Luddenham from the south as well as a right turn entry for vehicles coming from the north.

LEGEND

- bus lane
- shared path
- Commonwealth Land

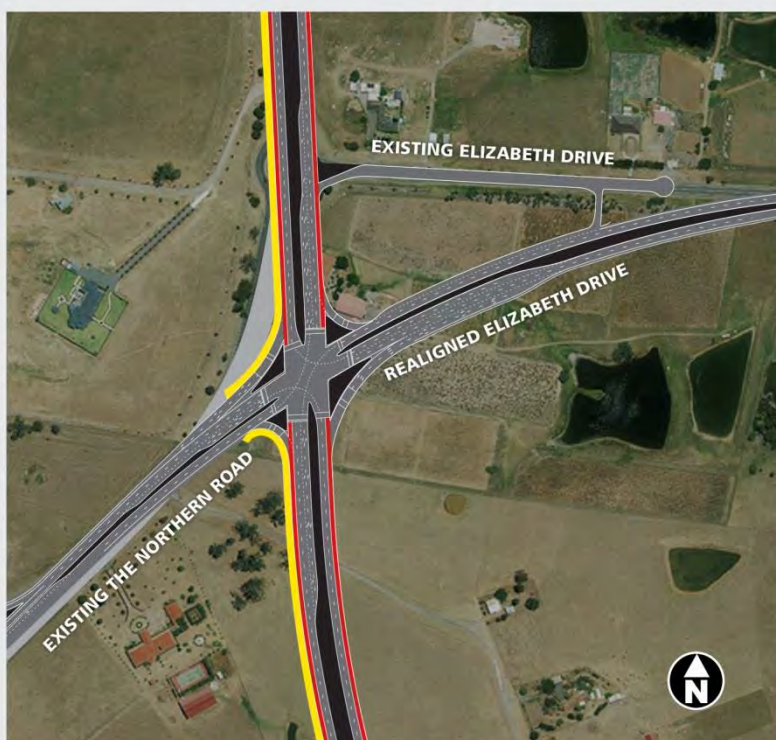


An un-signalised (give way controlled) intersection connecting the new. The Northern Road with Eaton Road south of Luddenham (east of the new alignment) This intersection would be left in, left out only for vehicles travelling south.

LEGEND

- bus lane
- shared path
- Commonwealth Land

New intersection location and configuration



A four-way signalised intersection formed from a realigned Elizabeth Drive and the existing The Northern Road, north of Luddenham.

This would provide an upgraded entry to Luddenham from the north and allow all turning movements onto the old The Northern road and the upgraded section of Elizabeth Drive.

LEGEND

- bus lane
- shared path

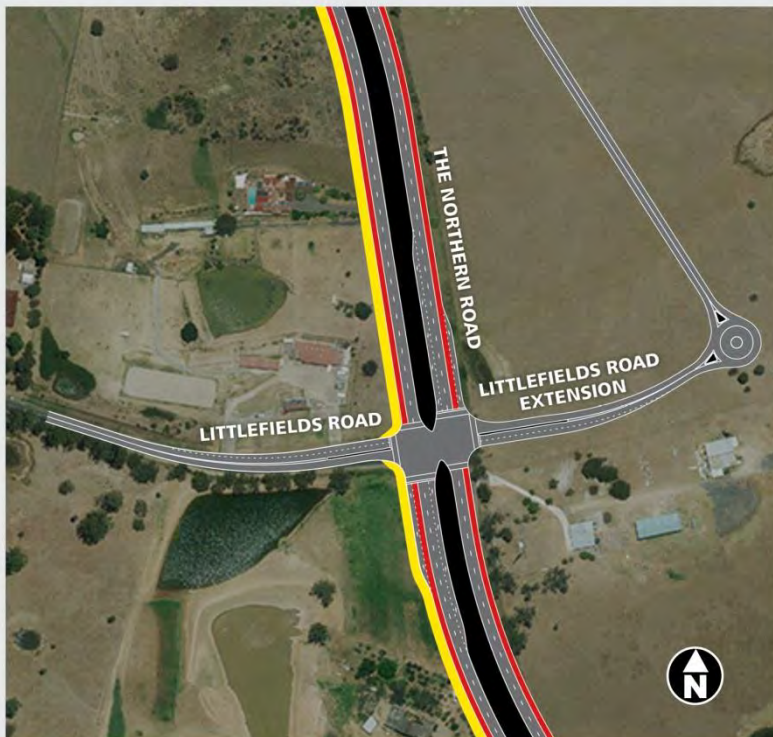


A signalised intersection at Defence Establishment Orchard Hills, incorporating a u-turn facility.

LEGEND

- bus lane
- shared path

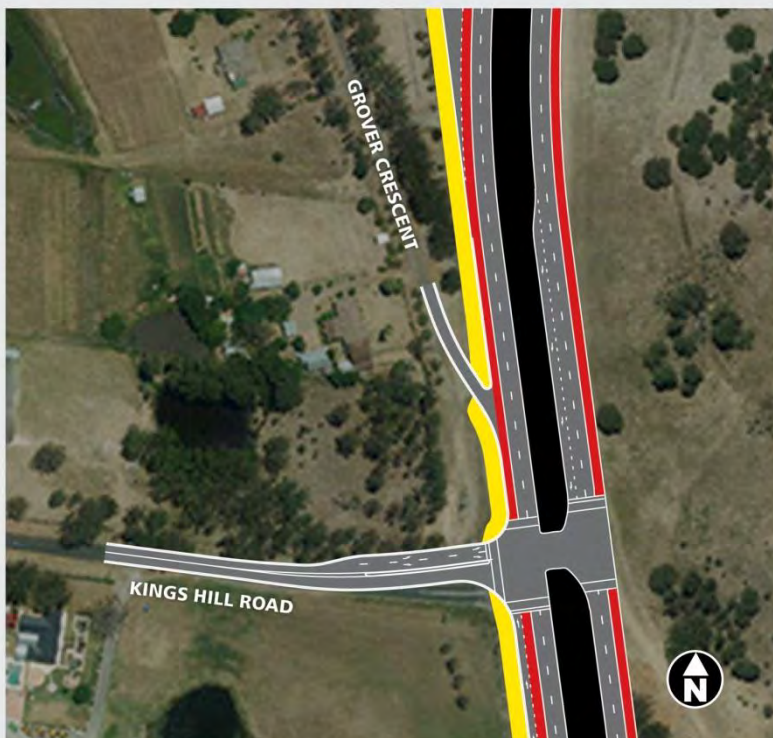
New intersection location and configuration



New traffic signals at Littlefields Road, allowing all turning movements to and from Littlefields Road.

LEGEND

- bus lane
- shared path



New traffic signals at Kings Hill Road allowing all turning movements to and from Chain-O-Ponds Road.

LEGEND

- bus lane
- shared path

New intersection location and configuration



New traffic signals Chain-O-Ponds Road, allowing all turning movements to and from Chain-O-Ponds Road.

LEGEND

- bus lane
- shared path



New traffic signals at Bradley Street, Orchard Hills incorporating a u-turn facility allowing all turning movements to and from Bradley Street.

LEGEND

- bus lane
- shared path

Modified intersection arrangements

The project would include changes to the following existing intersections:

- Dwyer Road – left in, left out only (chainage 300)
- Existing Elizabeth Drive – left out only (chainage 7,800)
- Gates Road – left in only (chainage 10,700)
- Longview Road, Mulgoa – left in, left out only (chainage 11,600)
- Grover Crescent south – left in only (chainage 12,000)
- Grover Crescent north – left out only (chainage 12,500).

Plans showing proposed changes to existing intersection configurations and a description of the change are presented in Table 5-3.



5.2.5 Dedicated u-turn facilities

Dedicated u-turn facilities would be provided at the following locations, and would be generally designed to accommodate up to 26 m B-double vehicles:

- Existing The Northern Road at Luddenham, south-west of Elizabeth Drive - designed for up to 26 m B-double vehicles
- Chain-O-Ponds Road
- Existing Elizabeth Drive around 800 m east of The Northern Road.

The proposed locations of dedicated u-turn facilities are shown in Figure 1-2 and Figure 5-1.

Table 5-3 Proposed modifications to intersection arrangements

Modified intersection arrangement location and configuration	
	<p>An unsignalised T-junction intersection, allowing left in, left out access, at the intersection between Dwyer Road and The Northern Road.</p> <div>LEGEND<ul style="list-style-type: none">bus laneshared pathCommonwealth Land</div>
	<p>New left in, left out access to the realigned Elizabeth Drive and left out access to The Northern Road for private properties located on the existing Elizabeth Drive.</p> <div>LEGEND<ul style="list-style-type: none">bus laneshared path</div>

Modified intersection arrangement location and configuration



An unsignalled T-junction intersection, allowing left in only access at the intersection between Gates Road and the proposed alignment.

LEGEND

- bus lane
- shared path



Modified intersection at Longview Road allowing left in, left out only.

LEGEND

- bus lane
- shared path



A modified intersections at Grover Crescent south (left in only) and Grover Crescent north (left out only).

LEGEND

- bus lane
- shared path

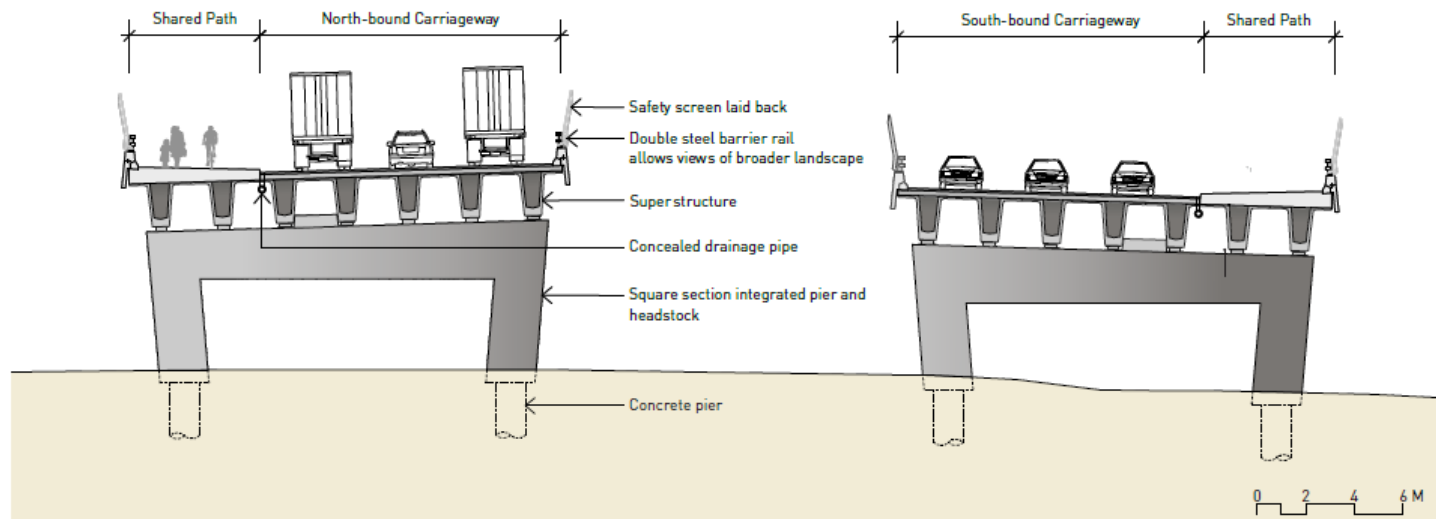
5.2.6 Bridges

The project would include one new bridge crossing over Adams Road, Luddenham (refer to Table 5-4). The final bridge type would be confirmed during detailed design. The urban design of the proposed bridges is detailed further in Section 8.5 with the indicative cross section provided in Figure 5-5 and a photomontage of the bridge provided in Figure 5-6.

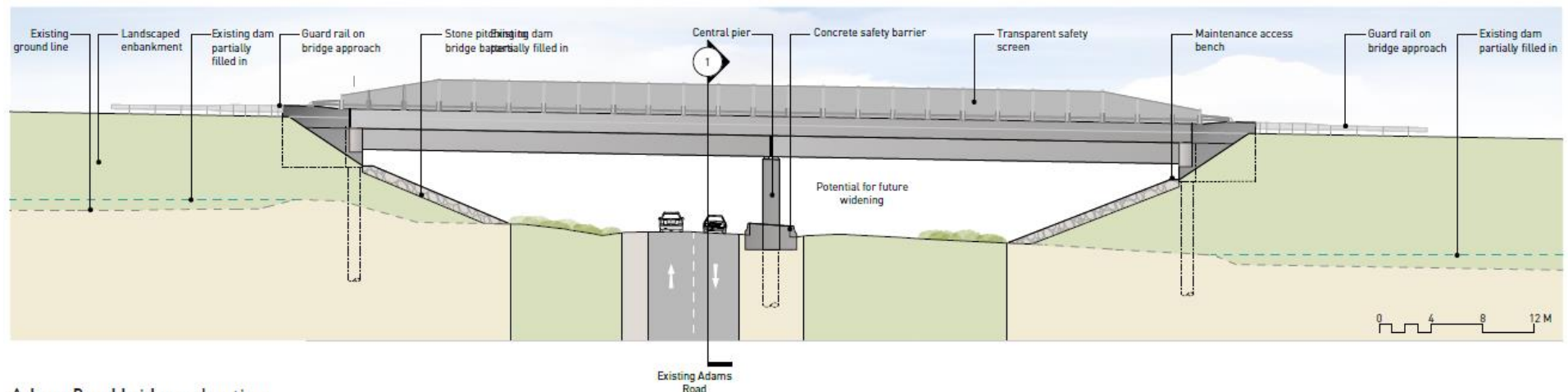
Table 5-4 Adams Road bridge details

Bridge location / description	Structure type	Length and width
Northbound and southbound bridges are proposed over Adams Road, Luddenham (chainage 6100) The bridge structure would be of sufficient length to accommodate future widening of Adams Road (by others). The bridge would maintain a clearance of at least 5.4 m over Adams Road. The bridge would incorporate a safety screen and steel barrier rails, and a shared path on the western side. A footpath may be provided on the eastern side (to be confirmed during detailed design).	Super 'T' or Plank bridge (to be confirmed during detailed design)	Span: about 65 m Width of each bridge to accommodate the ultimate design of: 3 x 3.5 m lanes 1 x 4 m bus lane 1 x 3 m shared path (minimum width)

The potential impacts of the proposed bridge are assessed in Chapter 7 and Chapter 8. The potential visual impacts of the bridge are addressed in Section 8-5 Urban Design and Visual Impact.



Adams Road bridge - cross section



Adams Road bridge - elevation

Figure 5-5 Indicative cross section and elevation of the proposed Adams Road bridge

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Figure 5-6 Photomontage of the proposed Adams Road bridge

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5.2.7 Flooding and hydrology infrastructure

A drainage strategy has been developed to mitigate the impact of the project on flooding behaviour and scour potential, and provide a minimum 100 year average recurrent interval (ARI) level of flood immunity to The Northern Road. The final design and configuration of drainage infrastructure would be confirmed during detailed design. An assessment of the drainage design is presented in Section 8.1 and in Appendix K – Flood risk assessment. Key features of the drainage design for the project are outlined in Table 5-5.

Table 5-5 Summary of proposed drainage strategy

Catchment	Proposed drainage strategy
Badgerys Creek	<ul style="list-style-type: none"> Upgrade existing transverse drainage where the existing road would be widened Provide new transverse drainage where the new section of road would be constructed Provide four box culvert arrangements sized between 1,200 mm x 600 mm and 3,600 mm x 1,200 mm. The culverts would be reinforced concrete box culverts (RCBC) Provide a flood relief channel, about 80 m long, on the eastern overbank of Badgerys Creek immediately upstream of the road embankment. The channel appears as an open trench and would be lined with concrete. Flood waters would spill into the channel during events up to the 100 ARI before discharging into Badgerys Creek. The channel in combination with upgraded culvert structures would prevent the project from increasing peak flood levels in existing development for events up to the 100 year ARI Fill or partially infill several dams located beneath the road footprint.
Duncans Creek	<ul style="list-style-type: none"> Upgrade existing transverse drainage where the existing road would be widened Provide a box culvert arrangement sized at 1,800 mm x 1,200 mm Provide new transverse drainage where the new section of road would be constructed Fill or partially infill several dams located beneath the road footprint.
Cosgrove Creek	<ul style="list-style-type: none"> Upgrade existing transverse drainage where the existing road would be widened Provide two box culvert arrangements sized at 3,000 mm x 900 mm and 2,400 mm x 1,200 mm Provide new transverse drainage where the new section of road would be constructed Remove the earth embankments of the two large dams, located on either side of Adams Road, and reinstate drainage lines Fill or partially infill several dams located beneath the road footprint.

Catchment	Proposed drainage strategy
Unnamed tributary of South Creek	<ul style="list-style-type: none"> • Upgrade existing transverse drainage where the existing road would be widened • Provide new transverse drainage where the new section of road would be constructed.
Mulgoa Creek	<ul style="list-style-type: none"> • Upgrade existing transverse drainage where the existing road would be widened • Provide new transverse drainage where the new section of road would be constructed • Divert runoff from the project in a westerly direction along Littlefields Road, where it would discharge to a drainage line near the limit of the proposed road work.
Blaxland Creek	<ul style="list-style-type: none"> • Upgrade existing transverse drainage where the existing road would be widened • Provide new transverse drainage where the new section of road would be constructed • Convert two existing dams on Commonwealth land into two permanent detention ponds and provide a third detention pond on Commonwealth land. All three ponds would be on the eastern side of The Northern Road where runoff from the project would discharge directly to the DEOH site. The detention ponds would reduce the volume of runoff discharging to the DEOH site • Provide energy dissipation measures and level spreaders on the spillway to reduce the potential for scour in the receiving drainage lines • Provide a new piped trunk drainage line to convey runoff from the project in an easterly direction within the WaterNSW Supply Pipelines corridor, where it would discharge to the DEOH site. Provide energy dissipation measures and a flow spreader at the outlet of the new drainage line, where flow would be discharged • Provide a concrete causeway and low-flow pipe arrangement in the design of the three metre wide access track to be constructed along the eastern side of the DEOH boundary fence.
Surveyors Creek	<ul style="list-style-type: none"> • Upgrade existing transverse drainage where the existing road would be widened within in Commonwealth land • Provide four box culvert arrangements sized between 2,100 mm x 900 mm and 3,600 mm x 1,500 mm • Convert an existing dam on the eastern side of The Northern Road (within DEOH site) to a permanent flood retardation basin to control project runoff (up to 100 year ARI events), discharging directly to the DEOH site. The flood retardation basin would attenuate flows generated by the upstream catchment (within DEOH) with the aim of offsetting the impact the increase in impervious area would have on peak flows downstream of its location. The basin would have the following key features: <ul style="list-style-type: none"> – A four metre high earth embankment constructed across the

Catchment	Proposed drainage strategy
	<p>valley between the embankment of the new road and high ground to the east</p> <ul style="list-style-type: none"> - A 1,200 mm diameter outlet pipe - A spillway constructed in natural ground at the eastern end of the basin embankment <ul style="list-style-type: none"> • Construct a flood bypass channel on the eastern side of The Northern Road (within the DEOH site) for a length of about 100 m. The channel would convey flood waters for events greater than the 10 year ARI between the inlets of two transverse (cross) drainage structures. An earthen bund would be constructed at the northern end of the bypass channel to prevent flood waters flowing towards The Northern Road • Provide drainage channels extending from the project boundary to the first farm dam on a number of drainage lines where peak flows would be increased in privately owned land. Easements for drainage are to be provided along each channel to facilitate future maintenance • Provide drainage measures in the design of the 3 m wide access track, to be constructed on the eastern side of the OHDE boundary fence • Provide energy dissipation measures and level spreaders on the spillway of the ponds to reduce the impact of scour in the receiving drainage lines.

Drainage pits, pipes and open drains have been designed to collect and convey stormwater runoff from the road pavement and to manage overland flow from surrounding catchments. The proposed drainage pit and pipe networks would either connect to the existing council drainage network or discharge into the inlet or outlet headwall of the proposed or existing cross culverts. Where table drains are proposed, the drainage network would discharge runoff into the table drain before it is discharged into a receiving waterbody.

Drainage scuppers would be provided at four-metre intervals to drain the decks of the new bridges.

Drainage culverts would be provided at low points in the road and at waterway crossings. The culverts would generally be located where there are existing culverts. The existing culverts would be upgraded where the hydraulic modelling shows they need to be enlarged to cater for an increased flow of water. Existing culverts that do not need to be enlarged would be extended to suit the proposed road widening. The sizing and design of culverts would be reviewed during detailed design.

In addition, scour protection measures would be provided at the inlet and outlet of each transverse drainage structure. These measures would typically comprise dumped rock riprap and/or reno mattress.

The potential impacts of the proposed drainage infrastructure are assessed in Chapter 7 and Chapter 8 of this EIS. Catchment hydrology and flooding behaviour after the implementation of the proposed drainage infrastructure are assessed in Section 8.1 for design storms of two, 10 and 100 year ARI, together with the probable maximum flood (PMF).

Design criteria

The major drainage and cross drainage structures proposed are presented in Table 5-6.

Table 5-6 Drainage structures

Drainage infrastructure	Design criteria ARI
Pavement drainage	10 years on grades 100 years in unrelieved sag sections
Culverts	Culverts would be designed for existing catchment conditions, assuming any future development of the external catchments would provide stormwater detention to maintain peak flows up to the 100 year ARI.
Open channels	5 years
Runoff from cut batters and grassed medians	100 years
Gutters and medians	10 years
Catch drains	100 years
Bridge drainage	20 years
Shared path and footpath	1 year

5.2.8 Waterway realignments

Sections of the un-named tributary of Surveyors Creek would be realigned (straightened) where it runs along the eastern side of The Northern Road near Bradley Street. This work would create a low-flow channel and a benched overbank area which would tie into the existing channel on the opposite side of the road. The realignment is required as the road widening would intercept the existing drainage depression.

The potential impact of the proposed creek realignment is assessed in Chapter 7 and Chapter 8 of this EIS. Specifically, the potential for scour and erosion is assessed in Section 8.1 Flooding and Hydrology, and Section 8.2 Soils, Water and contamination.

5.2.9 Provisions for pedestrians and cyclists

Pedestrian and cyclist facilities would be provided to improve connectivity and safe crossing locations along the project. A shared pedestrian and cycle path would be provided the whole length of the project. The shared path would generally be three meters wide and would be located on the western side of the project.

A footpath would be provided on the eastern side of the project where warranted. The footpath would typically be 1.5 m wide and suitable for pedestrians only.

Signalised pedestrian and/or cyclist crossings would be provided at upgraded intersections where traffic lights are provided. The crossings would be designed to meet current safety standards.

5.2.10 Local road changes and upgrades


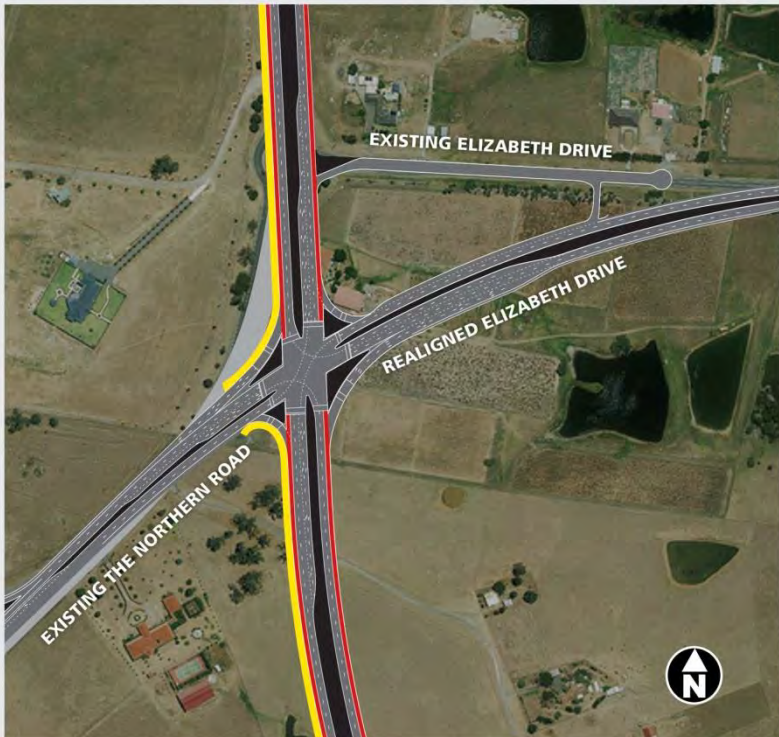
Some local roads would be upgraded as part of the project to cater for additional traffic demands, and to ensure safe and efficient connections with the realigned and upgraded The Northern Road. These upgrades would involve:

- Vicar Park Lane – closure of this road east of the realigned The Northern Road
- Eaton Road – new cul-de-sac 200 m east and west of The Northern Road
- Elizabeth Drive – new u-turn around 800 m east of The Northern Road

- Elizabeth Drive – new cul-de-sac about 300 m east of The Northern Road with a connection to the realigned Elizabeth Drive
- Littlefield Road – extension of the road east of the realigned The Northern Road, and provision of a new roundabout on the extension
- Littlefields Road – new north–south service road between the Littlefields Road roundabout and Gates Road
- Vineyard Road – extension of the road between Longview Road and Kings Hill Road, and provision of a new roundabout on the extension at Kings Hill Road
- Chain-O-Ponds Road – new u-turn bay.

The location and scope of the proposed local road upgrades are presented in Table 5-7.

Table 5-7 Proposed changes and upgrades to local roads

Location of local road upgrade
<div></div> <div><p>Eaton Road would be cut where it crosses The Northern Road with a cul-de-sac east and west of The Northern Road.</p></div> <div><p>LEGEND</p><ul style="list-style-type: none">bus laneshared pathCommonwealth Land</div>
<div></div> <div><p>A cul-de-sac about 300 m east of The Northern Road with a connection to the realigned Elizabeth Drive.</p></div> <div><p>LEGEND</p><ul style="list-style-type: none">bus laneshared path</div>

Location of local road upgrade



A new service road with one lane in each direction connecting between the Littlefields Road roundabout and Gates Road.

LEGEND

- bus lane
- shared path



Extension of Vineyard Road, Mulgoa between Longview Road and Kings Hill Road.
A new roundabout on the Vineyard Road extension at Kings Hill Road.

LEGEND

- bus lane
- shared path

5.2.11 Cuttings and embankments

Cutting and batter slopes have generally been designed to be 1 in 4 slope. During detailed design, some batters may be locally steepened to 1 in 2 at pinch points (or be replaced by retaining walls) or as steep as 1 in 1.5 at the bridge spill-through abutments.

A retaining wall may be required near the intersection of Eaton Road (west) and The Northern Road (existing) where the road formation spills over the existing boundary at Luddenham. The wall is required to retain road fill. If required, it would be about 27 m long and less than one metre high.

Table 5-8 lists the approximate extents of deep cuttings and high fills proposed (five metres or more). The cuttings are subject to change following geotechnical investigations and analysis. The location and dimension of cuttings, retaining walls, and batters would be confirmed during detailed design. Deep cuttings and high fills are not proposed along local roads.

Table 5-8 Proposed indicative cuttings and fills for the project

Cutting / fill (from south to north)	Location	Approximate length (m)	Approximate depth / height (m)
Cutting	North of the signalised intersection connecting the existing The Northern Road at the southern boundary of the Western Sydney Airport (about chainage 1600)	255 m	5–10 m
Cutting	South of the proposed service entrance for the Western Sydney Airport (about chainage 1900)	125 m	5–10 m
Cutting	North of the proposed service entrance for the Western Sydney Airport (about chainage 2400)	110 m	5–10 m
Fill	South of Vicar Park Lane (about chainage 2800)	40 m	5–7 m
Fill	North of Vicar Park Lane (about chainage 3300)	95 m	5–12 m
Cutting	About 500 m north of Vicar Park Lane (about chainage 3500) – see Figure 5-8	220 m	5–10 m
Fill	About 800 m north of Vicar Park Lane (about chainage 3800) – see Figure 5-9	240 m	5–12 m
Cutting	About 1 km south of The Northern Road access to Luddenham (about chainage 4100)	75 m	5–7 m
Fill	About 750 m south of The Northern Road access to Luddenham (about chainage 4400)	120 m	5–10 m
Fill	About 500 m south of The Northern Road access to Luddenham (about chainage 4700)	85 m	5–10 m
Fill	South of The Northern Road access to Luddenham (about chainage 5000)	220 m	5–10 m
Cutting	North of Eaton Road (about chainage 5600)	200 m	5–7 m
Fill	Either side of Adams Road (about chainage 6000)	535 m	5–12 m
Cutting	About 350 m north of Adams Road (about chainage 6400)	154 m	5–12 m
Fill	About 550 m north of Adams Road (about chainage 6700)	160 m	5–10 m
Fill	South of Elizabeth Drive (about chainage 7100)	300 m	5–7 m

Cutting / fill (from south to north)	Location	Approximate length (m)	Approximate depth / height (m)
Cut	North of Littlefields Road on the western side of the alignment (about chainage 10,200)	70 m	5–7 m
Fill	North of Littlefields Road on the eastern side of the alignment (about chainage 10,300)	150 m	5–10 m
Cut	South of Gates Road (about chainage 10,400)	75 m	5–7 m
Cut	About 250 m south of Longview Road (about chainage 12,200)	25 m	5–7 m

5.2.12 Operational water quality controls

The potential impacts of the project on water quality would be minimised by implementing adequate permanent water quality measures for the operational phase. For this project, water quality treatment would be provided through 24 vegetated swales with rock check dams, which would be designed and vegetated in accordance with water sensitive urban design principles.

The swales would convey pavement runoff to the receiving waterways and creeks. The swales would also provide some water quality treatment. The amount of treatment would depend on the length and slope of the swale; wider swales would provide additional water quality treatment. The swales would incorporate rock check dams to provide additional treatment by slowing down the runoff and allowing it to temporarily pond during storm events. The swales have been modelled to assess their respective pollutant load reductions.

A water quality monitoring program is proposed to assess the water quality in receiving creeklines during construction and operation of the project, and to monitor the effectiveness of the swales.

Further information on the swales, including an assessment of their effectiveness, location and lengths, is provided in Section 8.2. Further information on the water quality monitoring program is provided in Section 8.2 and Appendix L – Soils, Water and Contamination.

The indicative location of the vegetated swales is shown in Figure 8-7. An indicative cross section illustration of a vegetated swale is shown in Figure 5-7.

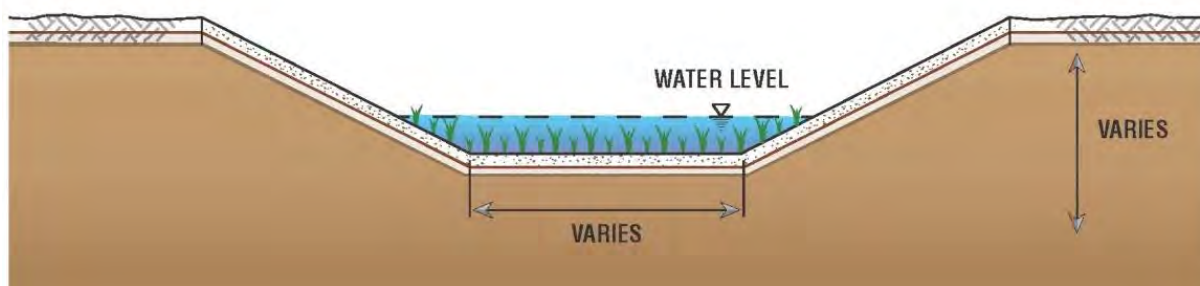


Figure 5-7 Indicative cross section of a vegetated swale

5.2.13 Roadside furniture, bus stops and lighting

Roadside furniture would be included along the length of the project for safety reasons, including delineation and directional guidance. All roadside furniture would be designed in accordance with the urban design objectives set out in Section 5.3.2. The location and design of these elements would be further refined during detailed design.

Bus shelter locations would be redesigned to suit planned bus route upgrades by Transport for NSW. Shelters would be designed to Transport for NSW and local government requirements.

The location of bus stops would be considered further during detailed design. These would then need to be modelled into the project. A number of existing bus stops would be relocated or removed (see Section 7.1), and two new bus stops may be provided for northbound and southbound routes near Bradley Street. Although the majority of relocated bus stops would only be moved from the entry side to the exit side of an intersection, bus stops between Kings Hill Road and Littlefields Road would be relocated a substantial distance from existing stops. The maximum additional distance passengers would need to travel as a result of relocated bus stops would be for the bus stop located at Gates Road, where passengers would need to travel up to an additional 650 m to reach the relocated bus stop at Littlefields Road.

New street lighting or adjustments to existing street lighting would be required at the signalised intersections. Street lighting would be provided along the full length of the project to light the carriageway and shared path. Street lighting would be designed to ensure relevant guidelines are adhered to, particularly in the vicinity of the Western Sydney Airport, to ensure lighting intensity; configuration and colour do not cause confusion, distraction or glare to pilots in the air. Lighting would meet the relevant guidelines, including requirements under the National Airports Safeguarding Framework *Guideline E: Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports* and Regulation 94 of the Civil Aviation Regulations 1988, as required, enabling lights to be designed and installed so that they.

The potential impacts of project lighting, including the effects on nocturnal fauna, are assessed in Chapter 7.3 Biodiversity.

There is provision in the design for wide footpaths and traversable batters with a 1 in 4 slope. As a result, there is no requirement for safety barriers for the length of the project with the exception of barriers provided for the Adams Road bridge and around isolated hazards such as VMS.

Indicative cross sections of typical cut and fill elevations are shown in Figure 5-8 and Figure 5-9.

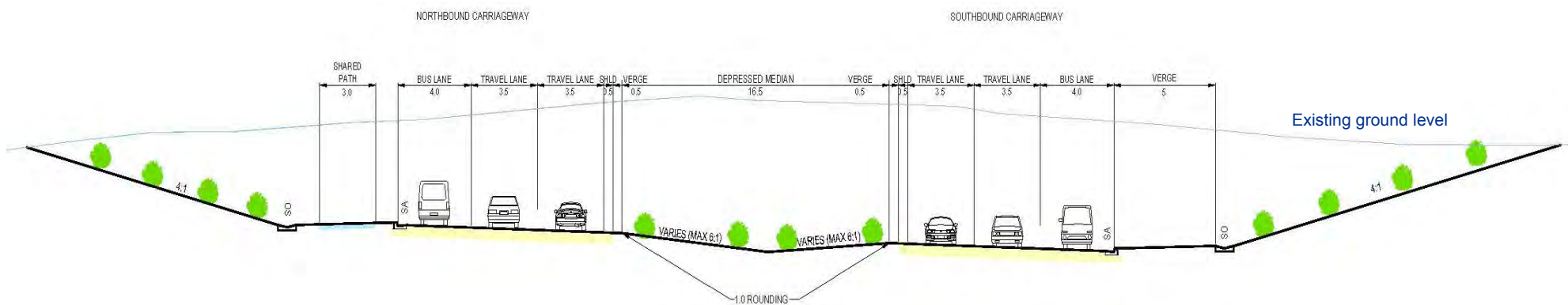


Figure 5-8: Indicative cross section and elevation of the proposed cut, about 500 m north of Vicar Park Lane (about chainage 3500)

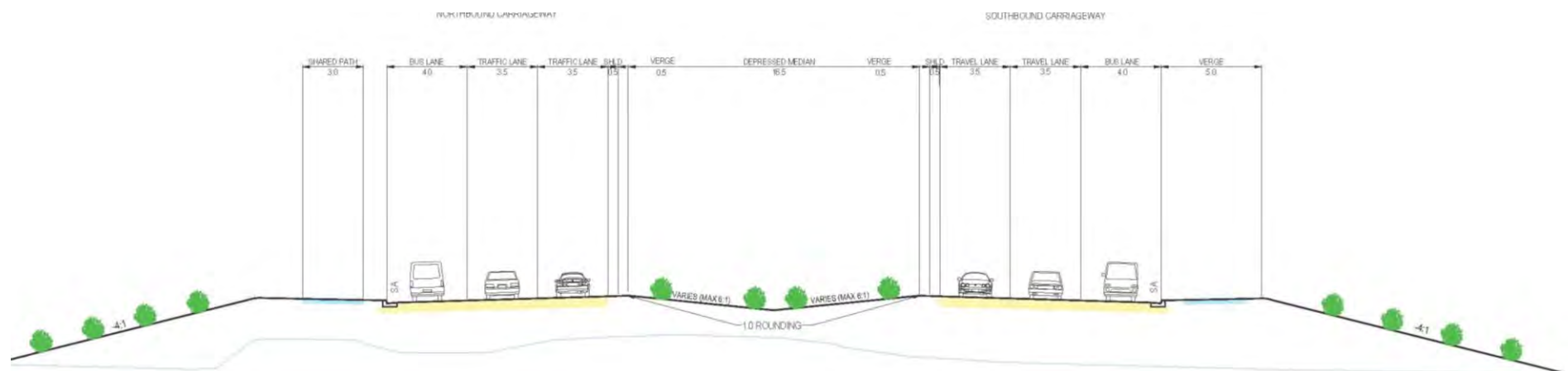


Figure 5-9: Indicative cross section and elevation of the proposed fill, about 500 m north of Vicar Park Lane (about chainage 3500)

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5.2.14 Property access changes and acquisition

Property access

The dividing median within the proposed alignment would change the allowable movements from properties onto The Northern Road.

In addition, the project alignment would deviate from the existing road through existing properties, resulting in new segments of land that require access to the proposed alignment.

Access arrangements for the majority of properties that currently have access directly onto The Northern Road, and some properties that have access along roads that connect to The Northern Road, would change as a result of the project.

Proposed alternative access routes and arrangements are outlined in detail in Appendix G – Traffic and Transport and Section 7.1.

Property acquisition

Sections of the project have been designed and aligned to minimise impacts on private property. Where reasonably practicable, houses and other property infrastructure have been avoided and consideration has been given to ensuring that land holdings are viable where partial acquisitions are required.

Nevertheless, private, Commonwealth (Department of Defence and DIRD) and Crown land would be required for the project. All private land would be acquired in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. The acquisition of Commonwealth and Crown land would be negotiated with the Commonwealth Government and the NSW Department of Finance, Services and Innovation respectively.

Properties impacted by acquisition or adjustments are listed in Table 5-9 and are shown in Appendix J – Socio-economic Assessment.

The extent of property impacts would be refined and confirmed during detailed design in consultation with the property owners. For partial acquisitions, property adjustment plans would be developed in consultation with the property owner.

Table 5-9 Properties impacted by the project

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
1	Lot 1 DP235845	Residential	Partial	-	-
2	Lot 97 DP27550	Residential	Partial	-	-
3	Lot 1 DP250684	Residential	Partial	-	-
4	Lot 96 DP27550	Residential / business	Partial	-	-
5	Lot 95 DP27550	Residential / business	Partial	-	-
6	Lot 94 DP27550	Residential	Partial	-	-
7	Lot 93 DP654182	Residential	Partial	-	-
8	Lot 92 DP27550	Business	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
9	Lot 102 DP812653	Rural / residential	Partial	-	-
10	Lot 1 DP838361	Rural / Western Sydney Airport / Commonwealth land	Partial	-	Yes (2)
11	Lot 11 DP1092165	Rural residential	Partial	-	Yes (2)
12	Lot 27 DP259698	Residential	Partial	-	-
13	Lot 28 DP259698	Residential	Partial	-	-
14	Lot 33 DP259698	Rural residential	Partial	-	-
15	Lot 22 DP258581	Rural residential	Partial	-	-
16	Lot 21 DP258581	Residential	Dual offer/ partial	Yes (1)	-
17	Lot 20 DP258581	Residential	Partial	-	-
18	Lot 2 DP851626	Business	Partial	-	-
19	Lot 1 DP851626	Rural	Partial	-	-
20	Lot 2 DP623457	Business	Partial	-	-
21	Lot 21 DP614481	Residential	Partial	-	-
22	Lot 1 DP250030	Residential	Dual offer/ partial	Yes (1)	Yes (1)
23	Lot 1 DP90157	Residential	Partial	-	-
24	Lot 2 DP250030	Residential	Partial	-	-
25	Lot 3 DP250030	Residential	Partial	-	-
26	Lot 2 DP519034	Residential	Partial	-	-
27	Lot 104 DP846962	Residential	Partial	-	-
28	Lot 3 DP827223	Residential	Partial	-	-
29	Lot 103 DP846962	Residential	Partial	-	-
30	Lot 102 DP846962	Residential	Partial	-	-
31	Lot 1 DP232996	Rural residential	Partial	-	-
32	Lot 101 DP846962	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
33	Lot 100 DP846962	Residential	Partial	-	-
34	Lot 5 DP232324	Crown land (road reserve)	Full	-	-
35	Lot 4 DP232324	Crown land (road reserve)	Full	-	-
36	Lot 3 DP911607	Crown land (road reserve)	Full	-	-
37	Lot 1 DP517853	Residential	Partial	Yes (2)	Yes (4)
38	Lot 2 DP517853	Rural residential	Partial	-	-
39	Lot 6 DP32026	Rural	Partial	-	-
40	Lot 5 DP32026	Rural	Partial	-	-
41	Lot 4 DP32026	Rural	Partial	-	-
42	Lot 1 DP1169433	Residential/ business	Partial	-	-
43	Lot 3 DP32026	Residential/ business	Partial	Yes (1)	-
44	Lot 504 DP581138	Residential	Partial	-	-
45	Lot 2 DP32026	Residential/ business	Partial	Yes (1)	Yes (1)
46	Lot DP160890	Residential/ business	Partial	Yes (1)	-
47	Lot 5 DP599382	Residential	Partial	-	-
48	Lot 1 DP200435	Residential/ business	Partial	-	-
49	Lot 501 DP580982	Residential	Partial	-	-
50	Lot 12 DP249113	Residential	Partial	-	-
51	Lot 11 DP249113	Residential	Partial	-	-
52	Lot 10 DP249113	Residential	Partial	-	-
53	Lot 9 DP249113	Residential	Partial	-	-
54	Lot 1 DP109697	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
55	Lot 8 DP249113	Residential	Partial	-	Yes (1)
56	Lot 7 DP249113	Residential	Partial	-	-
57	Lot 101 DP580082	Business	Partial	-	-
58	Lot 11 DP30775	Residential	Partial	-	-
59	Lot 12 DP30775	Sydney Water pumping station	Partial	-	-
60	Lot 9 DP232322	Rural**	Full	-	-
61	Lot 13 DP30775	Residential	Partial	-	Yes (1)
62	Lot 8 DP232322	Rural residential**	Full	-	-
63	Lot 14 DP30775	Residential	Partial	-	-
64	Lot 22 DP32053	Rural	Partial	-	-
65	Lot 15 DP30775	Residential	Partial	-	-
66	Lot 23 DP207317	Residential	Partial	-	-
67	Lot 2 DP32053	Residential/ rural	Partial	-	-
68	Lot 1 DP420840	Residential	Partial	-	-
69	Lot 16 DP30775	Residential	Partial	-	Yes (1)
70	Lot DP341893	Water NSW asset maintenance	Partial	-	-
71	Lot A DP341629	Crown land (road reserve)	Partial	-	-
72	Lot 22 DP843123	Residential	Partial	-	Yes (1)
73	Lot 68 DP651114	Residential	Partial	-	Yes (2)
74	Lot 71 DP668758	Residential	Partial	-	-
75	Lot 73 DP2120	Residential	Partial	-	-
76	Lot 1 DP1064093	Residential	Partial	-	-
77	Lot 1 DP232322	Crown land (road reserve)	Full	-	-
78	Lot 77 DP659462	Business	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
79	Lot 79 DP1085461	Residential	Partial	-	-
80	Lot 1 DP1085051	Residential	Partial	-	-
81	Lot 211 DP2255	Vacant	Partial	-	-
82	Lot 210 DP2255	Vacant	Full	-	-
83	Lot 80 DP2120	Residential	Partial	-	-
84	Lot 10 Sec H DP2234	Vacant	Full	-	-
85	Lot 3 DP202647	Residential	Partial	-	-
86	Lot 36 DP959167	Vacant	Partial	-	-
87	Lot 101 Sec H DP2234	Vacant	Partial	-	-
88	Lot 100 Sec H DP2234	Vacant	Partial	-	-
89	Lot 99 Sec H DP2234	Vacant	Partial	-	-
90	Lot 2 DP202647	Residential	Partial	-	-
91	Lot 98 Sec H DP2234	Vacant	Partial	-	-
92	Lot 97 Sec H DP2234	Vacant	Partial	-	-
93	Lot 96 Sec H DP2234	Vacant	Partial	-	-
94	Lot 37 DP959167	Vacant	Partial	-	-
95	Lot 84 Sec H DP2234	Vacant	Partial	-	-
96	Lot 83 Sec H DP2234	Vacant	Partial	-	-
97	Lot 38 DP959167	Residential	Partial	-	-
98	Lot 75 Sec H DP2234	Residential	Partial	-	-
99	Lot 74 Sec H DP2234	Residential	Partial	-	-
100	Lot 73 Sec H DP2234	Residential	Partial	-	-
101	Lot 72 Sec H DP2234	Residential	Partial	-	-
102	Lot 71 Sec H DP2234	Residential	Partial	-	-
103	Lot 70 Sec H DP2234	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
104	Lot 69 Sec H DP2234	Residential	Partial	-	-
105	Lot 1 DP202647	Business	Partial	-	-
106	Lot 68 Sec H DP2234	Residential	Partial	-	-
107	Lot 67 Sec H DP2234	Residential	Partial	-	-
108	Lot 66 Sec H DP2234	Residential	Partial	-	-
109	Lot 65 Sec H DP2234	Residential	Partial	-	-
110	Lot 64 Sec H DP2234	Residential	Partial	-	-
111	Lot 63 Sec H DP2234	Residential	Partial	-	-
112	Lot 42 DP878814	Residential	Partial	-	-
113	Lot 62 Sec H DP2234	Residential	Full	-	-
114	Lot 23 DP29081	Residential	Partial	-	-
115	Lot 61 Sec H DP2234	Residential	Full	-	-
116	Lot 60 Sec H DP2234	Residential	Partial	-	-
117	Lot 24 DP29081	Residential	Partial	-	-
118	Lot 28 DP29081	Rural residential	Partial	-	-
119	Lot 1 DP569729	Residential	Partial	-	-
120	Lot 11 DP29081	Rural residential	Partial	-	-
121	Lot 10 DP29081	Residential	Partial	-	-
122	Lot 3 DP238092	Commonwealth Department of Defence uses	Partial	-	-
123	Lot 31 DP244610	Residential	Partial	-	-
124	Lot 32 DP244610	Residential	Partial	-	-
125	Lot 30 DP244610	Rural residential	Partial	-	-
126	Lot 8 DP29081	Residential/ business	Partial	-	-
127	Lot 1 DP1088989	Rural residential	Partial	-	-
128	Lot 6 DP29081	Rural residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
129	Lot 2 DP224861	Rural residential	Partial	-	-
130	Lot 1 DP224861	Residential	Partial	Yes (1)	-
131	Lot 7 DP4832	Residential	Partial	-	-
132	Lot 500 DP1133119	Residential	Partial	-	-
133	Lot 1 DP551558	Residential	Partial	-	-
134	Lot 1 DP238092	Commonwealth Department of Defence uses	Partial	-	-
135	Lot 5 DP26658	Rural residential	Partial	-	-
136	Lot 6 DP26658	Rural residential	Partial	-	-
137	Lot 7 DP26658	Rural residential	Partial	-	-
138	Lot 1 DP711076	Residential	Partial	-	-
139	Lot 2 DP711076	Vacant	Partial	-	-
140	Lot 132 DP1002668	Residential	Partial	-	-
141	Lot 113 DP1015911	Rural	Partial	-	-
142	Lot 3 DP711076	Rural residential	Partial	-	-

Notes:

* Information on existing land use is based on a review of aerial photography and visual inspection

** strip of land located along road reserve

Temporary leases for construction access would be negotiated in accordance with the requirements of the site access schedule. Details of properties to be temporarily leased are outlined in in Table 5-10. The number and location of leases would be confirmed during detailed design and in consultation with property owners.

Table 5-10 Properties subject to temporary leases during construction

Temporary ancillary facility	Lot / plan	Existing land use
C1	Lot 3 DP234403 Lot 3 DP334403	Rural residential
C2	Lot 6 DP249262	Rural residential
C3/ C5	Lot 11 DP1092165	Rural/ commercial
C4	Lot 102 DP812653	Rural/ commercial
C6	Lot 2 DP851626	Rural/ commercial

Temporary ancillary facility	Lot / plan	Existing land use
C7	Lot 1 DP851626	Rural/ Commonwealth land (airport)
C8	Lot 1 DP250030	Rural
C9	Lot 2 DP519034	Rural
C10	Lot 105 DP846962	Rural
C11		Crown land (road reserve)
C12	Lot 1 DP517853	Residential/ commercial
C13	Lot 5 DP599382	Rural
C14	Lot 9 DP249113	Rural residential
C15/ C16	Lot 1 DP109697	Rural
C17	Lot 1 DP232322	Crown land (road reserve)
C18	Lot 1 DP202647	Residential/ commercial
C19	Lot 1 DP224861	Rural/ residential
C20	Lot 5 DP26658 Lot 6 DP26658	Rural residential
C21	Lot 1 and 2 DP711076 Lot 1 DP1033226 Lot 3 DP250030	Rural residential

5.2.15 Utility services relocations

The following utilities have been identified along or near the proposed alignment:

- Electricity – including high and low voltage transmission and distribution lines
- Water – Water NSW and Sydney Water mains including the WaterNSW Supply Pipelines
- Gas – A Jemena gas main is located near Bradley Street, Orchard Hills
- Telecommunications – including optic fibre and coaxial cables and several mobile towers
- Sewer – No sewer mains have been identified on the Sydney Water Dial Before You Dig (DBYD) data base. However, it is known that there is limited sewer in the area and some properties use septic systems.

Potential utility modifications and protection measures (including potential relocations) are discussed in Section 5.4.12.

5.2.16 Heavy vehicle inspection bays

Heavy vehicle inspection bays would be located for both northbound and southbound traffic. The northbound site would be adjacent to Grover Crescent, while the southbound site would be located between Littlefields Road and Gates Road.

The inspection bays would typically include a paved inspection area (about 2,000 square metres), fencing, lockable gates and two retaining walls. Both bays would be about 150 m long and 12 m

wide. A specific deceleration lane is not proposed as vehicles using the bay can use the bus lane to decelerate. Heavy vehicle compliance would occur at the inspection bay periodically once operational, which may vary based on road traffic flow patterns.

The locations of the heavy vehicle inspection bays are shown in Figure 1-2 and Figure 5-1.

5.2.17 Traffic management facilities

The following traffic monitoring and management systems would be provided for the project:

- VMS – these electronic signs would communicate up-to-date information about traffic and road conditions
- CCTV – would be installed at key intersections and other locations
- Traffic sensors – would be installed at key locations to provide information about traffic speeds, queue lengths and traffic numbers
- Power and communications cabling – would be installed along the length of the project to connect all the ITS infrastructure.

Four VMS are likely to be provided, but the exact number would be refined during detailed design. The proposed VMS locations of VMS are:

- Northbound on approach to the intersection with Elizabeth Drive
- Southbound on approach to the intersection with Elizabeth Drive
- Northbound on approach to the heavy vehicle inspection area adjacent to Grover Crescent
- Southbound on approach to the heavy vehicle inspection area opposite Longview Road.

A typical cantilever style VMS is proposed at these four locations. Indicative infrastructure is Figure 5-10.

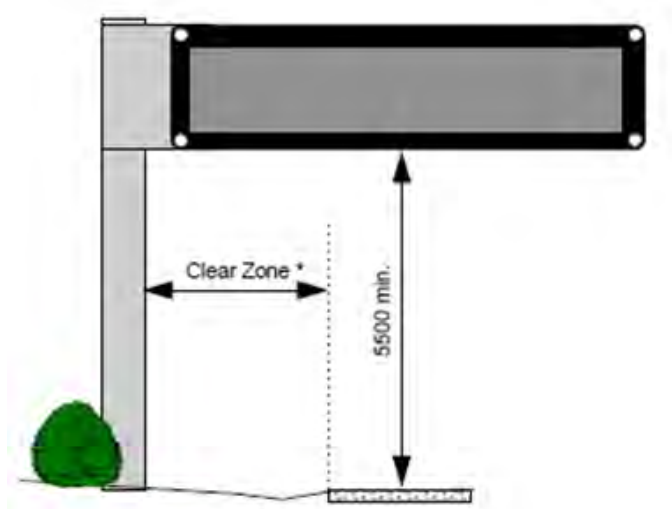


Figure 5-10 Indicative VMS infrastructure

The selection, placement and assessment of VMS are guided by the Roads and Maritime Guideline TDT 2005/ 02b – Guidelines for the Location and Placement of Variable Message Signs (Roads and Traffic Authority, 2008).

A visual assessment of the proposed VMS is presented in Appendix O – Urban Design and Visual Impact and Section 8.5 of this EIS. The final type and location of VMS would be determined during detailed design, which would aim to reduce the visual impact of VMS while maintaining their functionality.

5.2.18 Incident response facility

An incident response facility consisting of a paved area, office and garage would be constructed at the south-west corner of the realigned Elizabeth Drive and The Northern Road intersection. This facility would be staffed by Roads and Maritime, Transport for NSW or contractor personnel and would house incident response vehicles and equipment. The design of the incident response facility would be refined during detailed design but is likely to include:

- A car park for operational staff and a heavy vehicle tow truck (10 m long)
- An entry and exit roadway which would connect the front and rear of the double garage area and allow vehicles to attach trailers or drive through from either direction
- An operational building incorporating
- Kitchen, office and amenities
- A storage facility for trailers, portable VMS, portable lighting towers and other incident response equipment
- Communications and security equipment.

The location of the proposed incident response facility is shown in Figure 1-2 and Figure 5-1, and an indicative image of the proposed facility is shown in Figure 5-11.



Figure 5-11 Indicative image of the incident response facility

5.3 Design criteria

5.3.1 Design standards

Elements of the project have been designed using the following engineering standards, which are listed in order of precedence:

- Roads and Maritime QA Specification PS351 – Road Design
- Roads and Maritime QA Specification PS341 – Pavement Investigation and Design
- Roads and Maritime Specification R145 Pavement Marking
- Roads and Maritime Specification R142 and RMS Delineation Guidelines Section 15
- Published RMS supplements to Austroads Guide to Road Design
- Austroads Guide to Road Design

- RMS Guide Signposting Manual 2007
- Soils and Construction guidelines, 2004 Volume 1, and 2008 Volume 2
- Austroads Guide to Road Design (Part 5: Drainage Design)
- Soils and Construction Guidelines (2004) and (2008)
- Installation and Maintenance of Signs Manual 2010, Amended March 2014
- NSW Speed Zoning Guide 2011
- Australian Standard AS1742.

The engineering design parameters for the project are summarised in Table 5-11 and Table 5-12.

Table 5-11 The Northern Road design criteria

Design parameter	Value adopted in design
Design speed	90 km/h
Minimum general traffic lane width	3.5 m
Minimum bus lane width	4.0 m
Minimum auxiliary lane width	3.3 m
Minimum grade	0.5%
Maximum grade	6%
Cut batter slope	Generally 1 in 4, but steepening 1 in 2 where required
Fill batter slope	Generally 1 in 4, but steepening 1 in 2 where required
Bench width	4 m cut 4.5 m fill
Design vehicle	B-double

Table 5-12 Local road design criteria

Design parameter	Value adopted in the design
Posted speed limit	Adams Road – not signposted Eaton Road – 60 km/h Vicar Park Lane – not signposted Dwyer Road – not signposted Airport Access – 60 km/h The Northern Road (Existing) – 60 km/h Elizabeth Drive – 80 km/h Littlefields Road – 80 km/h Gates Road – 60 km/h Longview Road – not signposted Vineyard Road – not signposted Kings Hill Road – 70 km/h Grover Crescent – 60 km/h

Design parameter	Value adopted in the design
	Chain-O-Ponds Road – 70 km/h Bradley Street – 80 km/h
Design speed	Design speed generally the same as the posted speed
Minimum grade	1%
Maximum grade	6%
Cut batter slope	Generally 1 in 4, but steepening to 1 in 2 where required
Fill batter slope	Generally 1 in 4, but steepening to 1 in 2 where required
Bench width	4 m cut 4.5 m fill
Design vehicle	Dwyer Road – 19 m semi-trailer Airport Access – B-double Eaton Road – 19 m semi-trailer The Northern Road (existing) – B-Double Adams Road – 19 m semi-trailer The Northern Road and Littlefields Road – 19m semi-trailer The Northern Road and Littlefields Road extension – 26 m B-double Littlefields Road Extension u-turn – 26 m B-double The Northern Road and Gates Road – 8.8 m service vehicle Gates Road and Gates Link Road – 8.8 m service vehicle The Northern Road and Longview Road – 8.8 m service vehicle Longview Road and Vineyard Road – 8.8 m service vehicle The Northern Road and Kings Hill road – 26 m B-double Kings Hill Road u-turn – 19 m semi-trailer The Northern Road and Grover Crescent South – 8.8 m service vehicle The Northern Road and Grover Crescent North – 8.8 m service vehicle The Northern Road and Chain-O-Ponds Road – 19 m semi-trailer Chain-O-Ponds u-turn – 19 m semi-trailer The Northern Road, Defence entry and u-turn – 26 m B-double The Northern Road, Bradley and u-turn – 19 m semi-trailer

5.3.2 Urban design objectives and principles

The urban and landscape design objectives and principles for the project are based on:

- The South Western Sydney Urban Design Strategy (SWSUDS) (Cox, 2015), which provides guidance on the desired outcomes for the road network of the area
- The Northern Road Corridor Plan of Management (RMS, 2015) Narellan to Bringelly - Consistent with the corridor approach to the design of the road network promoted by the SWSUDS, the design objectives and principles identified by the Corridor Plan of Management for The Northern Road sections south of the project (Stage 1 and 2) are of relevance to achieve a consistent corridor outcome
- The proposed upgrade of The Northern Road between Glenmore Parkway and Jamison Road. Consistent with the corridor approach to the design of the road network promoted by the SWSUDS, the design objectives and principles identified for the Upgrade of The Northern Road north of Glenmore Parkway are of relevance to achieve a consistent corridor outcome

- Beyond the Pavement (RMS, 2008). This is the overarching Roads and Maritime policy guiding urban design on all projects. It outlines nine design principles as key to achieving an integrated engineering and urban design outcome for all Roads and Maritime projects
- The analysis of the local setting and its landscape character.

The following four overarching urban design objectives have been developed for the project:

- Protect and enhance existing views, character and cultural values of the corridor
- Provide a flowing road alignment that is responsive to, and integrated with the natural and built landscape
- Facilitate the provision of good urban design outcomes for areas adjoining the road
- Develop a simple and unified palette of elements and details that are attractive and easily maintained.

Further detail regarding the project's urban design objectives and principles is provided in Section 8.5 and Appendix O – Urban Design and Visual Impact Assessment.

5.3.3 Landscape framework

An urban design and landscape framework has been developed, based on the project objectives and principles, to achieve an integrated design for the project. It describes the relationship between the proposed road work, structures, the Adams Road bridge and the adjoining areas based on the current project design.

The urban design concept for the project includes a landscape design framework that has been guided by the following principles:

- Complement the existing landscape, visual and spatial character through appropriate vegetation types and heights
 - Use vegetation to stabilise cut batters and to minimise their visual impact
 - Use vegetation to stabilise fill embankments, carefully balancing plant selection to ensure views of the surrounding landscape as identified on the strategy plans
 - Provide vegetation to screen the upgrade from sensitive nearby land uses where applicable
 - Provide tree cover in verges and medians where it is safe to do so, based on clear zone requirements
- Design soft works to direct views and vistas to emphasise the attractive rural setting, having regard to planned future land use changes, in particular the Western Sydney Airport and employment lands in the WSPGA
- Retain existing woodland where possible. Where removal cannot be avoided, reinstate native vegetation to compensate for the loss of vegetation and habitat
- Use vegetation to maximise potential for biodiversity links in areas of identified ecological value
- Enhance intersections through feature planting to enhance them as 'gateways'. Examples include the entrances to places such as Luddenham, rural residential clusters, residential subdivisions and the service entry to the Western Sydney Airport. This would provide variety and visual interest along the route as well as visually enhance the local identity
- Select species around the end of the airport runway (at Willowdene Avenue) that are not bird-attracting to avoid safety risk for planes
- Wherever possible, use surplus local natural materials such as rock and timber in creek restoration and water quality treatments to help recover biodiversity and create habitat
- Where required, carry out landscaping work in accordance with water sensitive urban design guidelines (Roads and Maritime, 2016).

The plant species for the project would generally build on the native Cumberland Plain Woodland vegetation communities of the area. They may be supplemented by commercially available species known to perform well under motorway conditions.

During detailed design, development of the planting concept and layouts for vegetation would be developed to ensure the selection and placement of species accord with all relevant requirements including the Roads and Maritime Landscape Guideline, clear zone and sight topping distance requirements and the Obstacle Surface Limitation requirements of the Western Sydney Airport.

The urban design and landscape strategy for the project is a large-scale diagram that translates the landscape framework and principles into an overall urban design approach. It provides the basis for the urban concept design plans and sections. The strategy is presented in Appendix O – Urban Design and Visual Impact Assessment.

5.4 Construction

The construction work described in this section is based on the construction methodologies required to construct the project (described in Section 5.1.1) and may be refined during detailed design of the project and/or in response to submissions received during the exhibition of the EIS.

Detailed construction planning would occur before construction starts and would consider methods and scheduling to manage community and environmental issues including noise, access, amenity and general disruption.

Equipment and plant requirements would be refined during detailed design and during the development of the construction methodology by the construction contractor. The details of construction would be detailed in the Construction Environmental Management Plan (CEMP).

The construction strategy for the project has been designed to ensure that construction occurs in a safe and efficient manner while managing identified constraints and minimising environmental impacts. The general principles of the construction strategy are to:

- Achieve safe and convenient access for construction vehicles and the public, plant and equipment along the length of the project and to and from public roads while at the same time minimising impacts
- Consider impacts on road users, the effect on urban amenity and the suitability of local road pavements
- Manage impacts on existing infrastructure including local roads, utilities and services
- Recognise that modifications to existing infrastructure come with increased safety risks to road users and construction personnel and can result in the need to undertake work at night or to implement traffic switches
- Manage community and environmental issues including noise, access, amenity and general disruption.

5.4.1 Construction footprint

The total area required to construct the project is referred to as the 'construction footprint'. The construction footprint generally includes the area required for road works, bridge works, access for construction vehicles and plant, drainage infrastructure, temporary sediment basins, utilities and services adjustments, and temporary stockpiles and temporary ancillary facilities.

The total construction footprint (including compound and laydown sites) is estimated at 278 ha and is shown in Figure 5-4. The construction footprint would be refined during detailed design.

5.4.2 Overview of construction activities

Construction of the project would generally include the following key activities:

- Early works and property adjustments

- Construction of ancillary facilities
- Earthworks
- Traffic management and access
- Road widening and new road work
- Intersection works
- Construction of bridges and viaducts
- Construction drainage
- Construction of pavements
- Installation of noise mitigation measures
- Relocation of utilities and services
- Finishing work.

Construction activities and stages may occur concurrently. More information about the main components of these construction activities are provided in the following sections.

5.4.3 Early works (pre-construction activities)

Early works (or pre-construction activities) are works that take place prior to the main construction, in preparation for the start of construction. Some of these activities would take place prior to the formal approval of construction management plans, in accordance with the standard NSW Conditions of Approval for Critical State Significant Infrastructure projects, and would be managed by a separate Early Works Environmental Management Plan.

Pre-construction activities for the project would generally include:

- Notification of residents of construction work
- Leasing or acquisition of land
- Relocation of fencing on DEOH lands
- Clearance of unexploded ordinance (UXO) within DEOH as required
- Installation of construction signage and advisory signs
- Installation of environmental controls
- Preparation of dilapidation and building condition surveys
- Adjustment, relocation and protection of public utilities and services
- Site establishment activities, such as:
 - Establishment of temporary ancillary facilities, including minor clearing, minor earthworks, installation of office accommodation, utilities and other facilities
 - Establishment of construction site fencing, signage and lighting
 - Establishment of construction site access points, traffic management measures, alternative public access routes and diversions. This could include any minor road modifications
 - Demolition of redundant structures on acquired/leased land
 - Relocation and/or removal of farm infrastructure (including farm dams) as required and in consultation with affected land owners
- The following activities prior to vegetation clearing:
 - Pre-clearing surveys
 - Marking out 'no go' zones
 - Identifying fauna habitat trees and fauna release areas through pre-clearing surveys
- Establishment of temporary drainage.

Pre-construction activities may be carried out at various times over the duration of the project corresponding to different construction stages and project components. For each construction stage or project component, the various types of preliminary activities may also be carried out collectively or in isolation, depending on the specific requirements of the stage or component.

Section 5.4.4 covers the establishment and operation of temporary ancillary facilities. Section 5.4.6 considers traffic management and construction access arrangements in more detail.

5.4.4 Earthworks

Earthworks would be required along the entire length of the project. Earthworks would typically also be required for:

- Topsoil stripping
- Areas of new cut and fill along the alignment
- Construction of retaining walls
- Cut and fill or preparation of site for the new bridge over Adams Road
- Installation of road drainage infrastructure.

Vegetation would be cleared before the start of earthworks.

Material excavated from the corridor would be re-used in road widening or placed on site to stabilise batters. Potential for spoil re-use would be confirmed during detailed design. It is estimated that there is likely to be a net deficit of fill material.

Table 5-13 outlines the indicative types and volumes of materials that would be managed during construction and provides the recommended management approach for each material.

Table 5-13 Indicative material types and quantities required during construction

Type of material	Approximate quantity	Management approach
Clearing and grubbing	65,000 square meters	Determine the amount of material to be used on site or removed from site, including consideration of the <i>Raw Mulch Exemption 2008</i> (PoEO Act).
Excavated material (cut)	240,000 m ³	Re-use or disposed of surplus material that cannot be used on site in the following order of priority: <ul style="list-style-type: none"> • Transfer to other Roads and Maritime projects for reuse in accordance with the EPA's excavated public road resource recovery exemption • Transfer to an approved Roads and Maritime stockpile site for reuse on a future project only if a specific project has been identified prior to stockpiling and POEO Act waste regulatory requirements are met. If a project cannot be identified the material would not be stockpiled • Transport off site for reuse by a third party in accordance with relevant EPA resource recovery exemption or to an EPA licensed waste recovery facility • Dispose at an accredited materials recycling or waste disposal facility.
Imported material (fill)	400,000 m ³	Where practical, locally sourced.

5.4.5 New road work (including intersections)

The project would include the construction of about eight kilometres of new road between Mersey Road and just south of Elizabeth Drive.

The typical stages for constructing the new road pavement would include:

- Clearing of any vegetation
- Removal and stockpiling of topsoil
- Cut to fill operations including the removal of spoil to achieve the required levels at the underside of the new road surface
- Placement and compaction of selected material (usually crushed rock or natural gravels)
- Placing, compacting and finishing of either concrete or gravel road surface sub-base layers (to match existing adjacent road surface profile)
- Placing, compacting and finishing of asphalt road surface base layers
- Installation of new drainage infrastructure and any other services
- Installation of traffic lights
- Installation of kerbing and barriers
- Finishing work, such as line marking; kerb and gutter construction; installation of safety barriers, street lighting and sign posting; and landscaping
- Decommissioning and rehabilitation of temporary ancillary facilities and all temporary works.

5.4.6 Road widening

The project would involve widening the existing The Northern Road to provide additional lanes between Elizabeth Drive and 100 m south of Glenmore Parkway. Road widening would also include the provision of a central median. The stages for road widening typically include:

- Minor demolition of kerbs, other road elements and other structures
- Clearing of any vegetation
- Removal and stockpiling of topsoil
- Construction of temporary haul roads
- Excavation of any excess or geotechnically unsuitable subsoils
- Installation of new drainage infrastructure and any other services
- Modification of existing stormwater systems including water management ponds and culverts
- Importation, placement and compaction of engineered fill material
- Construction of the road sub-base and base (the road base would consist of deep lift asphalt)
- Asphaltting, which would involve either full pavement reconstruction or the milling and re-sheeting of asphalt overlay and full depth asphalt paving of the additional lanes
- Finishing work, such as line marking; kerb and gutter construction; installation of safety barriers, street lighting and sign posting; and landscaping
- Decommissioning and rehabilitation of temporary ancillary facilities and all temporary works.

5.4.7 Bridges

A new bridge would be constructed across Adams Road. It would have a clearance of at least 5.4 m over Adams Road.

The bridge would comprise piled foundations (bored piles) with wrap-around reinforced earth wall abutments and conventional pre-cast planks if there is sufficient width over Adams Road.

Construction of the bridge would generally involve:

- Piling
- Construction of bridge abutments
- Installation of pre-cast concrete planks/girders and barriers
- Excavation of existing embankment material to create a new bridge opening
- Installation of throw screens.

The work may require partial closure of Adams Road with one lane only open during this period. Traffic control would be implemented on Adams Road throughout the bridge construction period.

Piled foundations for bridge abutments and piers may require traffic lane closures, including some local road closures or traffic contra-flow arrangements to allow sufficient space for the piling rig to operate safely.

5.4.8 Drainage

The project would require the construction of new drainage infrastructure and alterations to existing drainage infrastructure. Drainage would comprise:

- Pavement drainage, which includes:
 - Pipes and pits used to drain runoff from the road pavement
 - Bridge deck drainage consisting of scuppers and carrier pipes for proposed bridges
 - Open channels to protect the road embankments and direct collected roadway runoff to a water quality device or receiving waterway
- Transverse drainage, which includes:
 - The provision of new culverts, or the extension and/or upgrade of existing culverts, to convey existing waterways across the road alignment.

Constructing drainage would involve localised excavation, compaction and installation of drainage pipes and pits, and construction of table drains and temporary construction sediment basins.

As the road formation is being constructed, drainage structures, such as culverts, would be installed to enable flows to be maintained. Where required, a temporary diversion channel would be constructed to enable the installation of culverts. The diversion channel would be lined with scour protection measures such as geofabric or clean fill to minimise the potential for scour. After the culvert is installed, the drainage line would be reinstated and the temporary channel removed.

In addition, a tributary of Surveyors Creek on the eastern side of The Northern Road (within Commonwealth land) would need to be permanently realigned to accommodate the widened road formation. This work would typically involve:

- Removing vegetation (mostly shrubs and grasses) and topsoil
- Constructing the new channel alignment, including establishing natural bed and bank profiles
- Installing scour protection measures
- Establishing vegetation early in the process
- Diverting the creek to the new channel.

Temporary watercourse crossings may also be required for some or all watercourses traversed by the project to facilitate construction activities. If required, these watercourse crossings would likely comprise a temporary causeway with culverts to maintain the low flows, and they would likely be maintained for the duration of construction.

A number of farm dams may also require dewatering to facilitate construction. Dewatering would be undertaken in accordance with the relevant procedures outlined in the CEMP.

Generally, the construction of new surface drainage on the outside of the carriageways would be undertaken in parallel with the earthworks for road widening or new road construction.

5.4.9 Pavements (road surfaces)

New pavements would be required for road widening and new road sections as well as for upgrades to local roads and intersections. New pavement construction would typically involve:

- Placing select material (usually crushed rock, natural gravels or suitable soils)
- Placing, compacting and finishing concrete to form sub-base pavements
- Placing, compacting and finishing the open grade or dense grade asphalt wearing course.

In areas where the project would tie in or modify existing roads, pavements would potentially be subject to widening, changes in configuration, removal, milling and pavement build-up and resurfacing.

New pavement would be marked in accordance with the RMS Delineation Guidelines to delineate travel lanes, traffic merges and vehicle movements permitted at intersections. Pavement on new sections of shared path would be marked in accordance with the RMS Delineation and NSW Bicycle Guidelines (RTA, 2005).

5.4.10 Utilities and services

A number of utilities and services may be impacted by the project; some many need to be realigned. The extent of impact cannot be confirmed until the detailed design is finalised. A list of utilities that may require relocation is provided in Table 5-14.

Table 5-14 Potential impacts on existing utilities and services

Asset owner	Asset type	Location	Potential impact
Transgrid	330 kv transmission lines	Single circuit line crossing The Northern Road about 70 m directly south of Vicar Park Lane. Double circuit lines crossing The Northern Road about 350 m south of Glenmore Parkway.	No impact identified.
Endeavour Energy	33 kV transmission lines	Generally along the western side of The Northern Road starting from the intersection with Park Road, travelling north past Littlefields Road to Luddenham substation. At the northern boundary of the project, near Glenmore Parkway.	The lines would be relocated within the road corridor where impacted.

Asset owner	Asset type	Location	Potential impact
	Low voltage cables and street lighting	Numerous locations along The Northern Road and local roads.	Street lighting would be adjusted to comply with the requirements of the upgraded road. Low voltage electrical cables would be relocated where impacted to maintain service to properties. Relocations would be within the proposed footpath where appropriate.
	Substation	Near the WaterNSW Supply Pipelines.	A new driveway access would be required.
WaterNSW	DN3000 and DN2200 mains (WaterNSW Supply Pipelines)	The Northern Road crosses over the WaterNSW Supply Pipelines near Gates Road.	No impact identified on the pipelines which are located beneath the road and concrete encased at the location where the project crosses them. However, some drainage within the construction boundary extend into the pipeline easement to the east of The Northern Road where the pipelines emerge above ground. Consultation and approval from WaterNSW would be sought prior to construction over this asset and prior to any works within the asset easement.
Sydney Water	DN1050, DN900, DN750, DN 450 and <DN375 mains	Numerous locations along The Northern Road, crossing The Northern Road and along local roads. Smaller mains also provide reticulation to properties.	The water main crossing would need to have sufficient protection, otherwise there would be a need to relocate or replace the crossing so that connection to water mains are maintained.
Jemena	Gas	Bradley Street, in the northern footpath.	The gas main would be relocated into the gas allocation within the proposed northern footpath.
Telstra, Optus	Telecommunications	Optic fibre and coaxial cables are present throughout the project area.	The cables would be relocated into the telecommunications allocation within the proposed northern footpath.

Asset owner	Asset type	Location	Potential impact
			The crossing would be relocated or replaced so that connection to cables is maintained.
	Mobile towers	About 380 m north of The Northern Road near Mersey Road. About 230 m south of DEOH entrance on the western side of the alignment. Just south of Littlefields Road on the eastern side. About 80 m west of the proposed alignment halfway between Adams Road and Elizabeth Drive.	No impact identified.

Strategies to address impacts may include protection or relocation of the utility, or adjustments to the project design to avoid any impacts.

Where relocation is required, this would preferably be undertaken within the footpath or shared user path to enable greater access for maintenance activities wherever possible. However, some may need to be relocated into the road corridor, including on local side streets, in order to minimise disruption. The required works would be confirmed during detailed design in consultation with utility providers, taking into consideration tie-ins with local streets.

Either the construction contractor or the relevant utility provider would undertake utility adjustments. This work would result in short-term impacts such as noise, amenity impacts, and soil and water impacts as detailed in Chapters 7.2, 7.4 and 8.2 respectively. Appropriate management measures would be implemented during utility adjustments in order to mitigate and manage these impacts.

5.4.11 Finishing work

Finishing work would be completed towards the end of each stage of the construction program. The main finishing work for the project would typically include:

- Line marking
- Installation of directional signage and roadside furniture, such as street lighting
- Landscaping
- Site demobilisation and rehabilitation of temporary construction compound sites and other areas of construction disturbance.

5.4.12 Temporary ancillary facilities

Temporary ancillary facilities would provide support to the construction of the project and would include compounds and laydowns areas.

The final type, location and number of ancillary facilities would be determined by the construction contractor and identified in an Ancillary Facilities Management Plan, prepared as part of the CEMP. Potential locations are described below and assessed in this EIS. Any additional or alternative sites identified by the construction contractor would be considered against the site selection criteria identified below. Where any alternative sites are located outside the construction footprint, further environmental assessment would be required.

The temporary compounds would generally comprise:

- Temporary buildings (generally prefabricated) including offices and meeting rooms, amenity, first aid and toilet facilities (the size and number of office facilities at the main compounds would be greater than at the secondary compounds)
- Hardstand parking areas with capacity for all construction workers expected at any site
- Materials laydown and storage areas, including purpose-built temporary structures as required
- Perimeter fencing, including visual screening of construction compounds where necessary
- A pug mill (for mixing and working clay) at either compound location C5 or C8.

Some sites would only be used to stockpile and store materials and would therefore contain minimal facilities.

Potential locations for temporary ancillary facilities are presented in Figure 5-12 and indicative details of the size and purpose of each compound are provided in Table 5-15.

Indicative site layouts for three example ancillary facilities are provided in Figure 5-13, Figure 5-14 and Figure 5-15 below.

Table 5-15 Proposed temporary ancillary facility locations

Ancillary facility location	Approximate size (ha)	Proposed ancillary facility Use	Site access points
C1	2	Storage of pits, pipes and culvert material. No stockpiling of earthworks.	From The Northern Road.
C2	2.25	Storage of pits, pipes and culvert material. No stockpiling of earthworks.	From The Northern Road.
C3	1	Outpost site office (secondary compound). The site would consist of a shed, lunch room, portable toilets and parking.	External access to the compound via the entry road to the Leppington Pastoral Company. This access would initially be available for construction vehicles during construction of the culvert near this location. Upon completion of the culvert, access would revert to the internal access road provided along the construction mainline. Unsignalised entry to all movements.
C4	3.5	Outpost site office (secondary compound). The site would consist of a shed, lunch room, portable toilets and parking. Storage of items such as concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	External access to the compound via the entry road to the Leppington Pastoral Company. This access would initially be available for construction vehicles during construction of the culvert near this location. Upon completion of the culvert, access would revert to the internal access road provided along the construction mainline. Unsignalised entry to all movements.

Ancillary facility location	Approximate size (ha)	Proposed ancillary facility Use	Site access points
C5	12	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials. Possible pug mill site.	Access to construction of the mainline would be direct from the compound. Access to the existing arterial road network would be via the nearest access point to The Northern Road. This compound site would be partially located on Commonwealth land associated with the Western Sydney Airport.
C6	2	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	Access to construction of the mainline would be direct from the compound. Access to the existing arterial road network would be via the nearest access point to The Northern Road.
C7	3.5	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road. This compound site would be partially located on Commonwealth land associated with the Western Sydney Airport.
C8	8.5	Main compound. The site would consist of office facilities for the contractor and RMS. It would include toilets, amenities, car parking, a shed and lunch room. Storage of concrete pits, pipes and culverts. Stockpile of topsoil and mulch and drainage backfill materials. Possible pug mill site.	Temporary traffic lights at the intersection of the existing The Northern Road and the proposed new alignment to give access to and from the existing road and access to the main compound.
C9	10	Secondary compound. The site would consist of a shed, lunch room, portable toilets and parking facilities.	Access to construction of the mainline would be direct from the compound.

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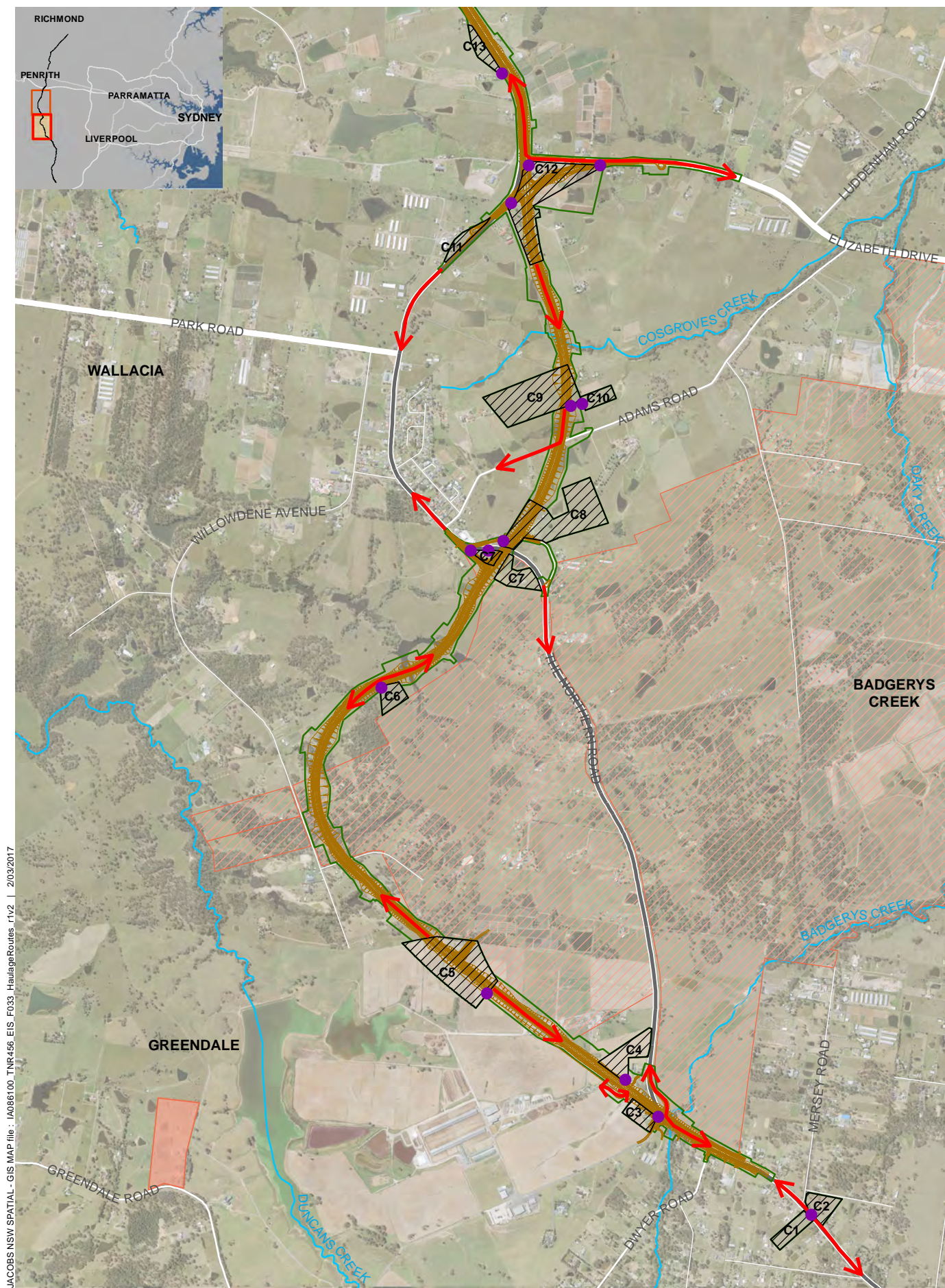
The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park
Environmental impact statement / draft Environmental Impact Statement

Ancillary facility location	Approximate size (ha)	Proposed ancillary facility Use	Site access points
C10	1.5	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	Access to construction of the mainline would be direct from the compound.
C11	1.5	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road.
C12	7	Main compound. The site would consist of office facilities for the contractor and RMS, toilets, amenities, tool sheds and car parking.	From The Northern Road and Elizabeth Drive.
C13	1.5	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road.
C14	1	Alternative site compound or small site office shed with amenities and car parking, and storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road.
C15	3.4	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road.
C16	11	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road.

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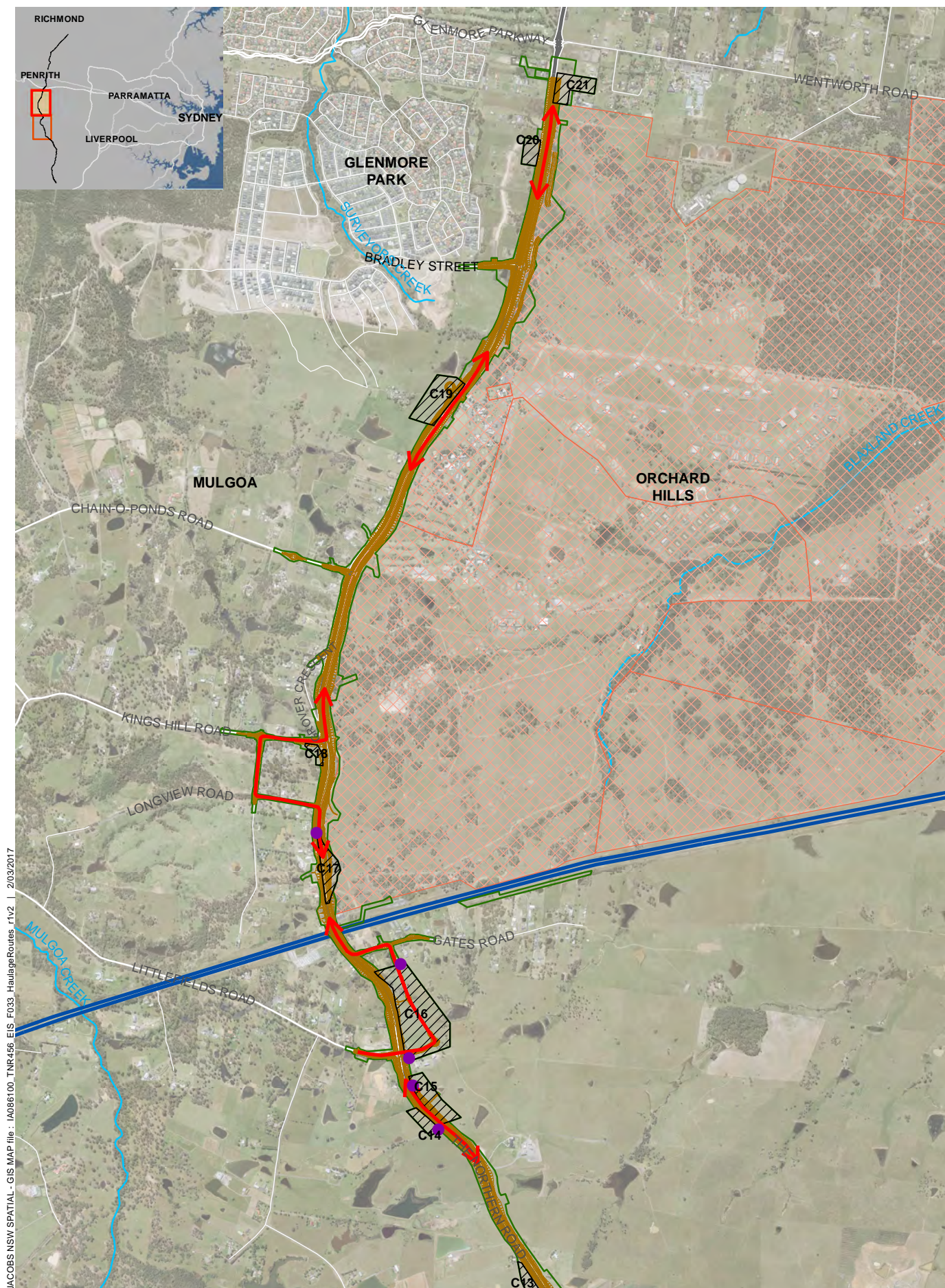
The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park
Environmental impact statement / draft Environmental Impact Statement

Ancillary facility location	Approximate size (ha)	Proposed ancillary facility Use	Site access points
C17	2.5	Stockpile site early in construction. However, once the new southbound carriageway is completed, it is unlikely to be used further as a stockpile site.	From The Northern Road.
C18	1	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road and Kings Hill Road.
C19	4.5	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road.
C20	1.5	Main compound. The site would consist of office facilities for the contractor and RMS, toilets, amenities, tool sheds and car parking.	From The Northern Road.
C21	2.5	Storage of concrete pits, pipes and culverts. Could be used to stockpile topsoil, mulch and drainage backfill materials.	From The Northern Road.



JACOBS NSW SPATIAL - GIS MAP file : IA086100_TNR456 EIS_F033_HaulageRoutes_r1v2 | 2/03/2017

Figure 5-12 | Potential locations of construction ancillary facilities (sheet 1)



JACOBS NSW SPATIAL - GIS MAP file : IA086100_TNR456 EIS_F033_HaulageRoutes_r1v2 | 2/03/2017

0 0.5 1 km



— The Northern Road upgrade - Mersey Road to Glenmore Parkway

— The Northern Road (Existing)

— WaterNSW supply pipelines

Construction footprint

Construction compound sites

Haulage routes

Compound site access points

Western Sydney Airport site (Commonwealth Land)

Defence Establishment Orchard Hills (Commonwealth Land)

Commonwealth Lands

Figure 5-12 | Potential locations of construction ancillary facilities (sheet 2)

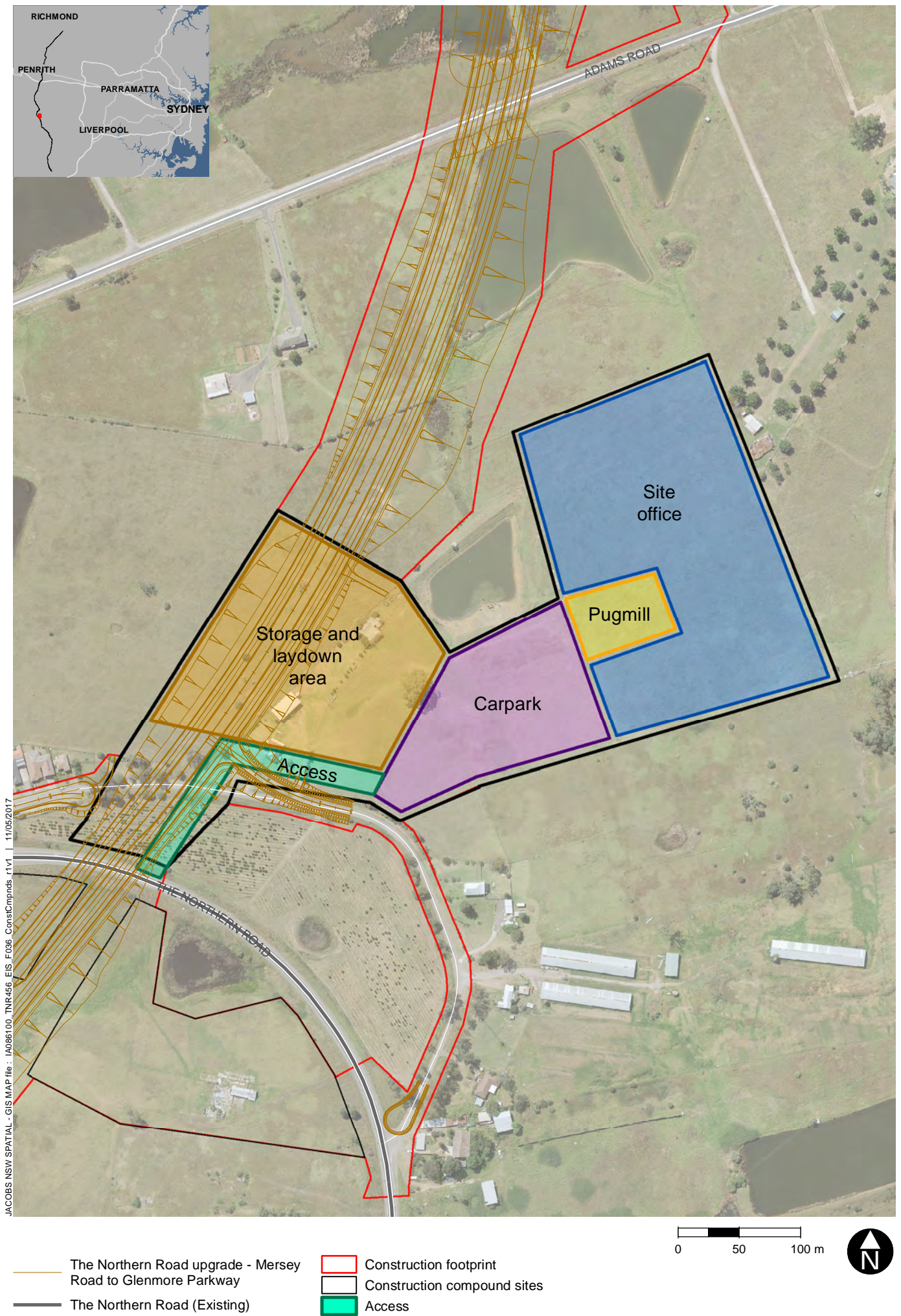
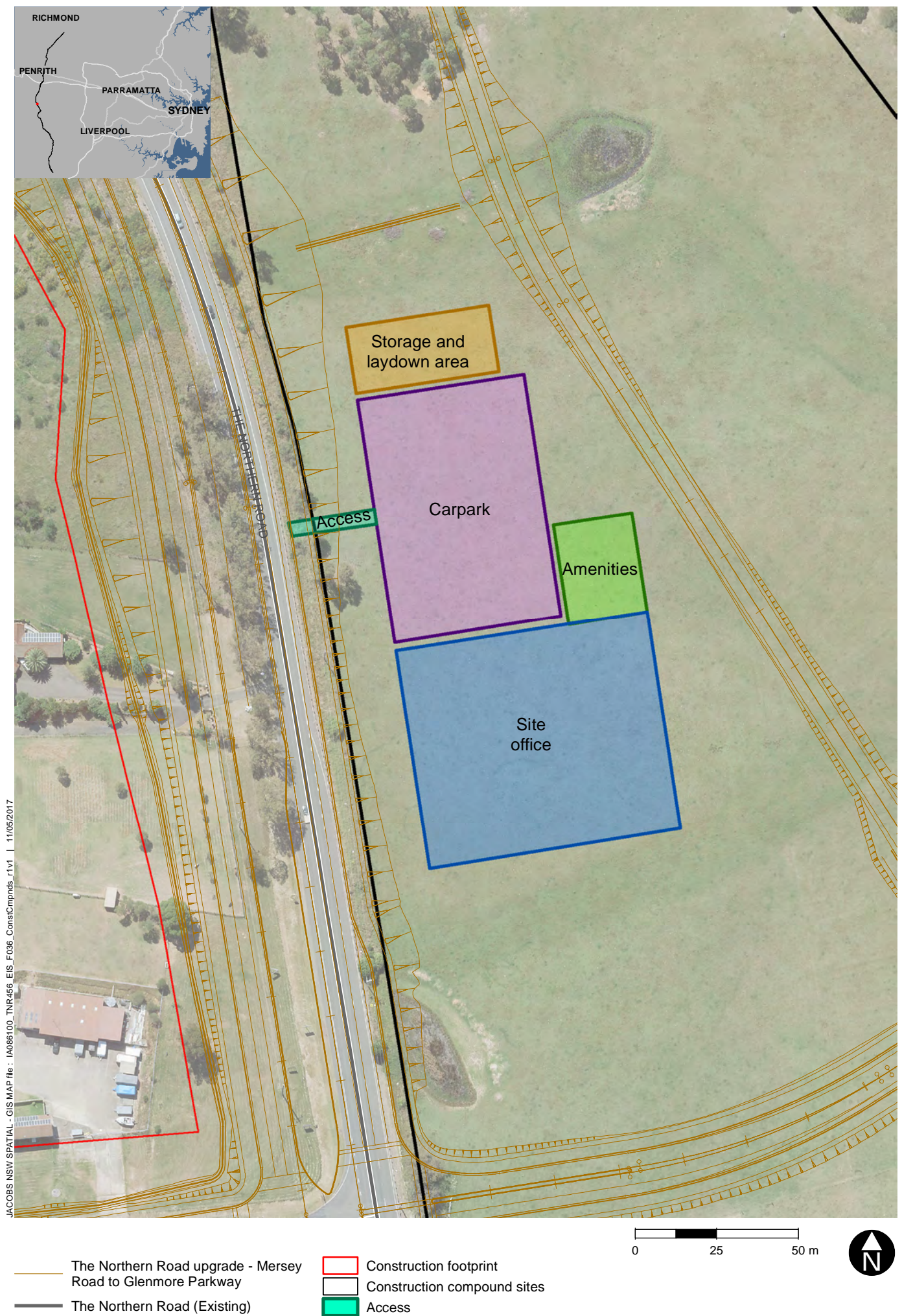
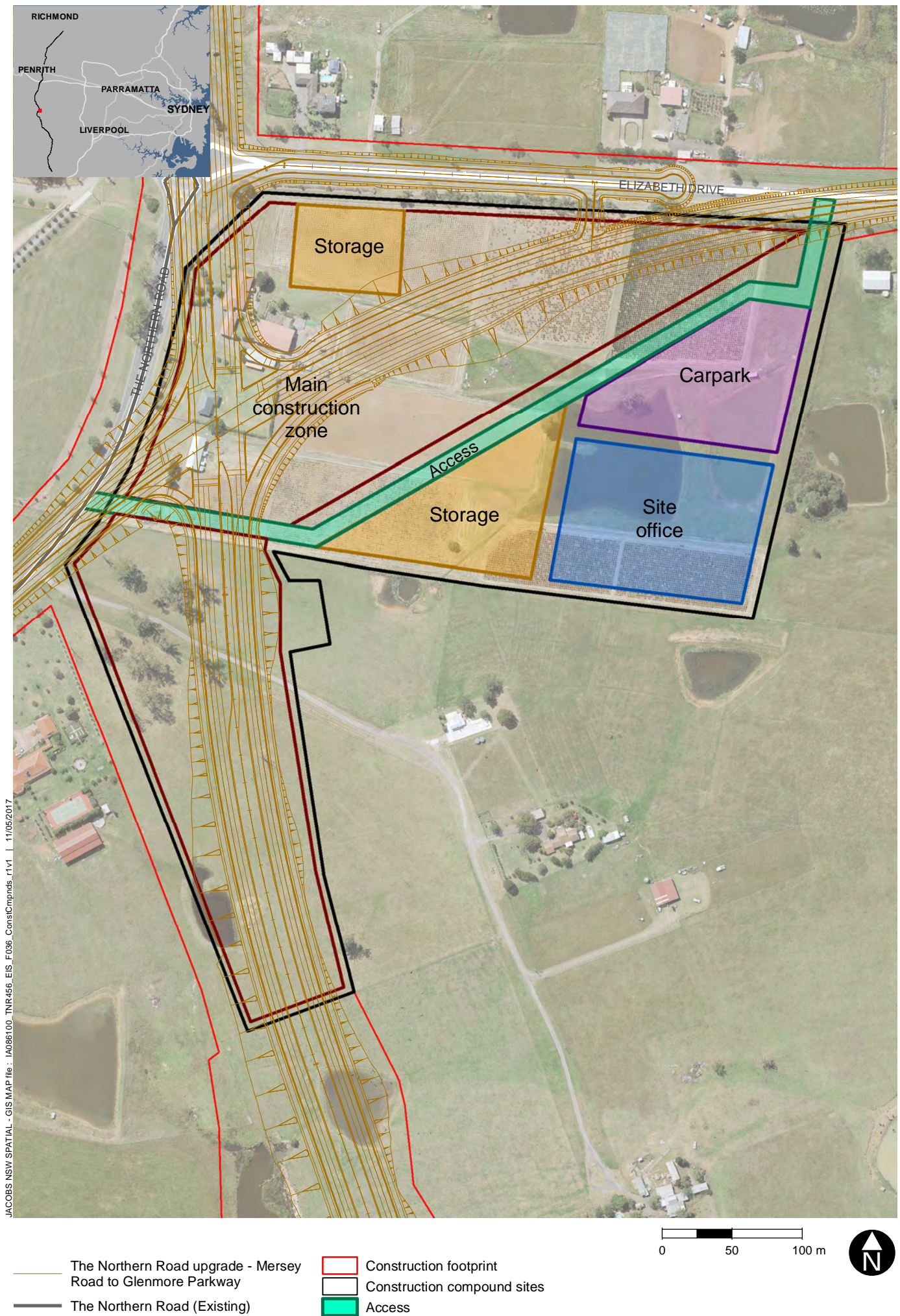


Figure 5-13 | TNR4 Main site compound 8



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Figure 5-14 | TNR5 Main site compound 16



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Figure 5-15 | TNR6 Main site compound 12

The proposed ancillary facility sites were assessed in accordance with the Critical SSI Standard Conditions of Approval for linear infrastructure projects which can be accessed on the DPE website:

<http://www.planning.nsw.gov.au/Assess-and-Regulate/Development-Assessment/Systems/~link.aspx?id=F4FB682E8DA144D08F6E554C06ACDB1E&z=z>

These standard conditions have been developed to help infrastructure providers understand the types of conditions likely to be applied to State significant projects if they are approved, including conditions related to ancillary facilities. Condition B4 of the standard conditions outlines expected criteria for locating ancillary facilities. The criteria are generally as follows:

- a) Located more than 50 m from a waterway unless an erosion and sediment control plan is prepared and implemented so as not to affect water quality in the waterway in accordance with *Managing Urban Stormwater* series
- b) Within or adjacent to land where the critical state significant infrastructure is being carried out
- c) With ready access to a road network
- d) So as to avoid the need for heavy vehicles to travel on local streets or through residential areas in order to access the facility
- e) On level land
- f) So as to be in accordance with the Interim Construction Noise Guidelines (DECC, 2009) or as otherwise agreed in writing with affected landowners and occupiers
- g) So as not to require vegetation clearing beyond the extent of clearing approved under other terms of this approval except as approved by the ER as minor clearing
- h) So as not to have any impact on heritage items (including areas of archaeological sensitivity) beyond the impacts identified, assessed and approved under other terms of this approval
- i) So as not to affect lawful uses of adjacent properties that are being carried out at the date upon which construction or establishment of the facility is to commence
- j) To enable operation of the ancillary facility during flood events referred to in Section 8.1 and to avoid or minimise, to the greatest extent practicable, adverse flood impacts on the surrounding environment and other properties and infrastructure
- k) So as to have sufficient area for the storage of raw materials to minimise, to the greatest extent practicable, the number of deliveries required outside standard construction hours.

Each proposed ancillary facility has been assessed to ascertain whether it would comply with these criteria – refer Table 5-16. Where a site would not meet the criteria, further discussion and management measures are provided in Table 5-17.

Table 5-16 Summary of proposed ancillary site locations against criteria

Compound location	Ancillary facility site location criteria										
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
C1	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C2	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C3	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C4	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C5	Y	Y	NO	Y	Y	Y*	Y	Y	Y	Y	Y

Compound location	Ancillary facility site location criteria										
C6	Y	Y	NO	Y	Y	Y	Y	Y	Y	Y	Y
C7	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C8	Y	Y	Y	Y	Y	No*	Y	Y	Y	Y	Y
C9	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C10	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C11	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C12	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C13	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C14	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C15	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C16	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C17	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C18	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C19	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C20	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y
C21	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y

*Preferred locations for pug mill

As identified in Table 5-16, some of the proposed ancillary facilities would not meet some of the criteria specified in standard condition B4, specifically criteria (c) and (f). Further assessment of these sites against these specific criteria is provided in Table 5-17, including proposed management measures and justification for proposing these sites.

Operation of the compound sites and laydown facilities would result in construction noise, air (dust), traffic and visual impacts. Refer to Chapters 7.2, 8.6, 7.1 and 8.5 respectively.

Table 5-17 Further assessment of ancillary facilities that would not meet condition B4 criteria

Criteria	Proposed management measure
c) With ready access to a road network	<p>Applicable compound or laydown site(s) C5, C6.</p> <p>Additional assessment Compound sites C5 and C6 are required for construction of the realigned section of The Northern Road bypassing the Western Sydney Airport site. There is no current road access to these sites. There would not be a dedicated haul/access road constructed for these sites. Access to C5 and C6 would be via the mainline construction access to a suitable access point on The Northern Road.</p>

Criteria	Proposed management measure
	By not constructing a dedicated haul/access road, potential impacts associated with clearing vegetation would be minimised. There would also be fewer indirect impacts associated with dust and noise emissions outside of the proposed construction footprint.
f) So as to be in accordance with the Interim Construction Noise Guidelines (DECC, 2009) or as otherwise agreed in writing with affected landowners and occupiers	<p>Applicable compound or laydown site(s) All sites with the exception of C5 and C6.</p> <p>Additional assessment There would be residential receivers located within 200 m of the proposed construction compound and laydown sites. However, due to the predominantly rural-residential nature of the project area, the number of affected receivers would be relatively low. The potential construction noise impact is assessed in Section 7.2.</p> <p>Typically, in most times, noise emissions from standard-sized compounds would be relatively low. However, any use of heavy vehicles and reversing beepers at stockpile, laydown or maintenance facilities may impact nearby receivers, particularly during night-time operations. Noise impacts may be expected during loading operations at larger compounds during night-time work.</p> <p>Predictions of construction noise impact (refer to Appendix H) consider, variously, each construction stage running concurrent with all 21 ancillary facilities operating simultaneously. Predicted worst case construction noise levels from daytime activities would comply with Noise Management Levels (NMLs) for most receivers within the study area. However, predicted worst case construction noise levels from out-of-hours work would exceed night time NMLs at most receivers within the study area at some time, including noise as a result of construction activity within ancillary facilities.</p> <p>There may be a need for a pug mill within compound C5 or C8. The need for a batching plant or pug mill would be considered and assessed further once a construction contractor commences. An Ancillary Facilities Management Plan outlining management practices and procedures for the establishment and operation of all ancillary facilities would be prepared to the satisfaction of the Secretary of the DPE and Minister for the Department of Environment and Energy.</p>

Stockpile sites would be used to temporarily store excess spoil and inert wastes such as concrete from demolition before being either reused on site or disposed off site. Stockpile sites would also include environmental protection measures such as sediment barriers and hoardings to minimise impacts on sensitive receivers from dust, and receiving waters from erosion and sedimentation. Stockpile sites would be established and managed in accordance with Roads and Maritime Stockpile Site Management Guideline (2011).

Temporary sediment basins

Because of the site topography and the number of cross drainage culverts, about 50 temporary sediment basins would be required to treat every section of the construction area throughout all stages of construction. In order to minimise the number of sediment basins, and the impact of construction of these basins on the local natural environment, the Blue Book (Soils and Construction, 2008 Volume 2D Main Road) criterion of 'Minimum 150 m³ of annual sediment loss has been adopted. This criterion indicates that if the estimated annual soil losses from a disturbed catchment are less than 150 m³, then a sediment basin may not be required subject to other erosion and sediment controls being implemented.

Where sediment basins are not required (catchment areas less than one hectare), an Erosion and Sediment Control Plan would include additional controls and small sediment traps (typically less than 5 m³ each).

The proposed locations and sizes of the temporary sediment basins are presented in Section 8.2. The design and the location of the road would have a substantial effect on the size and location of the basins. Changes to the road design in the future may result in changes to basin locations or the addition of new basins, resulting in an adjustment of the construction boundary identified for the proposed basins.

These temporary sediment basins would be removed at the end of construction and the disturbed land rehabilitated and landscaped, unless otherwise agreed in consultation with the landowner.

At the completion of construction, all ancillary facilities would be decommissioned and any disturbed land rehabilitated and landscaped to a minimum standard of its pre-construction condition. Excess spoil in stockpiles would be used for landscaping where reasonably practicable and warranted.

5.4.13 Traffic management and access

Construction traffic

The majority of traffic generated during construction would be from the delivery of plant, equipment and materials. There would also be movements by light vehicles associated with staff accessing the construction areas.

It is anticipated that the peak construction workforce for each of the three stages would be similar and not more than about 40 people per day. As the three stages would overlap, the peak workforce for the project (all three stages) would therefore be about 120 people per day when all three stages are under full construction – generally between mid-2018 and late 2019.

Construction traffic would have the greatest impact on the surrounding road network during the morning and evening peak periods.

During the peak traffic periods, about 230 additional light vehicles are expected to be generated per day as a result of construction traffic. Assuming that 80 per cent of these light vehicles would arrive in the same hour, the likely peak hour volume on the busiest days would be in the order of 184 vehicles per hour with almost all of these vehicles arriving at the work site in the morning and leaving in the afternoon. The majority of this traffic would likely travel along The Northern Road from the north, with a small proportion travelling along Elizabeth Drive from the east. Furthermore, the average traffic generation for any one work site would be around one-third of the peak volume at 62 two-way vehicle trips per day. This number of trucks is unlikely to have a significant traffic impact on the road network. A detailed assessment of potential impacts on traffic during construction is provided in Section 7.1.

Traffic management

Construction activities would be subject to careful traffic management. A traffic management and access plan would be prepared for the project during detailed design and construction planning. It is expected that there would need to be a series of traffic changes and management measures to allow the widening and intersection work to be carried out with minimum disruption to traffic flows on The Northern Road and adjoining local roads, while still preserving worker and road user safety.

Traffic management measures would be based on the predicted impacts during construction staging and are likely to include:

- Reduced speed limits at traffic switches, particularly between Mersey Road and Eaton Road, where traffic would be diverted from the existing The Northern Road alignment to a single carriageway to allow for the closure of the existing The Northern Road alignment through the Western Sydney Airport site

- Reduced speed limits and active traffic controls wherever construction activities take place over live traffic, such as tie-ins and bridge construction at Adams Road
- Temporary traffic lights to safely maintain construction vehicle access to construction facilities adjacent to public roads
- Temporary traffic calming. A temporary roundabout is likely to be in operation during the construction of traffic lights at the intersection of The Northern Road and Luddenham south access. Reduced speed limits would be required near this temporary roundabout
- Staging plans, to be prepared in consultation with adjoining contractors.

Access and haulage routes

Designated access and haulage routes for construction vehicles entering and exiting construction areas and temporary ancillary facilities would be along The Northern Road and surrounding arterial network where practicable. Construction access may be required on Adams Road while the bridge is being constructed. Light vehicles may also access local roads including residential areas of Luddenham for services, and parts of Willowdene Avenue and Vicar Park Lane for access to the mainline construction areas.

The use of local roads by heavy vehicles to access temporary ancillary facilities would be limited as far as is reasonably practicable.

Where the construction contractor identifies possible alternative haulage routes or construction access tracks in order to accommodate construction staging, the following general requirements would need to be met:

- Be located on relatively flat ground to minimise soil and water quality impacts
- Have consideration to dwellings that may be affected by noise or dust, and avoiding routes that are adjacent to dwellings where possible
- Be located where there is easy and safe access to the construction site
- Would not impact upon matters listed under the EPBC Act or TSC Act
- Would result in minimal vegetation clearing.

For haulage routes or access tracks located outside the construction footprint, further environmental assessment and approval may be required.

Roads and Maritime would work with its construction partner (once selected) to ensure that access to properties can be maintained throughout construction, or alternative arrangements would be negotiated with relevant property owners.

5.4.14 Construction workforce

Table 5-18 outlines the indicative construction timeframe for the various construction stages of the project. The construction workforce is expected to fluctuate, depending on the construction activity and number of activities occurring concurrently. Construction of the project would be delivered through three separate construction contracts (see Section 5.5).

It is anticipated that the peak construction workforce for each of the three stages would be similar and not more than about 40 people per day. The peak workforce for the project (all three stages) would therefore be about 120 people per day when all three stages are under full construction – generally between mid-2018 and late 2019.

The construction workforce for the project would generally comprise labourers, plant operators, tradesmen, technicians and supervisors and sub-contractors.

Table 5-18 Indicative construction timeframe for project stages

Project construction stage	Project construction timing															
	2017				2018				2019				2020			
Mersey Road Bringelly to Eaton Road Luddenham																
Littlefields Road Luddenham to Glenmore Parkway Glenmore Park																
Littlefields Road to Eaton Road Luddenham																

The timing of these stages would be confirmed once a construction contractor is appointed to the project. However, it is expected that the indicative duration of construction activities outlined in Table 5-19 would apply to the project.

Table 5-19 Indicative construction activity timing

Construction activity	Duration of activity	Work outside standard hours Yes/No	Haulage % at night
Early works	6 months	Y	<1%
Earthworks	18 months	N	N/A
Road work (widening, new roads, and intersections)	4 months	Y	~ 5%
Construction of bridge over Adam Road	6 months	Y	~ 5%
Drainage	15 months	Y	~ 1%
Pavements	18 months	Y	~ 10%
Utility relocation	15 months	Y	<1%
Finishing work	9 months	Y	<1%

5.4.15 Construction work hours

Where reasonable and feasible, construction would be carried out during standard working hours as defined by the *Interim Construction Noise Guideline* (OEH, 2009) and presented in Table 5-20. Most of the noisiest activities would be able to be carried out during standard construction hours.

Table 5-20 Standard working hours

Day	Start time	Finish time
Monday to Friday	7am	6pm
Saturday	8am	1pm
Sunday and public holidays	No work	

While the majority of the project could be constructed during standard hours, a number of construction activities would need to be undertaken outside standard working hours. Typical activities that would likely be undertaken outside standard working hours could include, but are not limited to:

- Installation of traffic controls, such as concrete barriers
- Some bridge construction, including installing structures such as girders, concrete decking and drainage
- Resurfacing of the existing asphalt pavement
- Removal of existing static signage and installation of new signs
- Removal of existing traffic barriers and installation of temporary and permanent traffic barriers
- Removal of existing lane marking and application of new lane marking
- Delivery of plant and materials that is required outside these hours as requested by police or other authorities for safety reasons
- Installation of lighting and CCTV
- Any work that does not cause noise emissions to be audible at any sensitive receptor
- Emergency work to avoid the loss of lives, property and/or to prevent environmental harm.

Night-time construction activities would be supported by out-of-hours operation of temporary ancillary facilities. The exact timing of out-of-hours work would depend on construction techniques and would be subject to the requirements of the construction contractor.

There are three key reasons to undertake work outside standard hours:

- To minimise traffic delays on The Northern Road and the surrounding road network
- To protect public safety
- To protect construction worker safety.

The Northern Road is a heavily utilised arterial road. Constructing the project under traffic is a complex task that would inevitably involve lane closures. Closing lanes during peak periods in particular would result in substantial traffic disruption at the work site and along The Northern Road. In addition, congestion can increase the potential for traffic incidents and often has a flow-on effect of causing congestion on the surrounding road network, increasing the potential for secondary incidents. It is therefore considered inappropriate to undertake some work in circumstances where a large number of people would be affected by daytime traffic disruption.

In addition, working on busy roads such as The Northern Road can also pose safety risks to both construction personnel and road users if appropriate measures are not put in place. Construction work associated with roads often require temporary changes to lanes and other traffic control measures which are different to the usual conditions experienced by road users at these locations. These changes increase the potential for traffic incidents that can affect the safety of construction personnel and other road users. Work outside standard hours, when there is less traffic, reduces the safety risk to workers.

An assessment of the potential noise impacts associated with construction of the project (including potential impacts from out-of-hours work) is included in Section 7.2. This assessment has been undertaken in accordance with the *Interim Construction Noise Guidelines* (DECC, 2009) and feasible and reasonable noise management measures are identified as part of this assessment.

Work outside of standard hours is expected to be subject to relevant conditions of an environment protection licence issued under the Protection of the *Environment Operations Act 1997* (POEO Act). Environment protection licence conditions would potentially include measures relating to noise emissions, community notifications and procedures for recording and addressing complaints. Additional information regarding licences and approvals that may be required to construct the project is provided in Chapter 2.

Where work is required outside standard working hours, measures would be implemented to minimise noise and other types of disturbance to residents, which would include but not limited to:

- Notifying residents of any out-of-hours work
- Minimising the out-of-hours work in residential areas where reasonable
- Including respite periods in accordance with the Interim Construction Noise Guideline (Department of Environment and Climate Change NSW, 2009)
- Using noise shielding for noisy equipment where feasible
- Undertaking noisy activities during daytime hours where reasonable and feasible.

5.4.16 Plant and equipment

The plant and equipment required for each of the key construction activities are outlined in Table 5-21. Plant and equipment requirements would be refined during detailed design and construction planning.

Table 5-21 Plant and equipment requirements

Construction phase/activity	Indicative plant and equipment	
Early works	Trucks Light vehicles Generators	Crane Bobcat
Earthworks	Light vehicles Excavator Dump trucks Compactors	Bulldozers Graders Water carts Bobcat
Road work (widening and new roads) and intersections	Excavators Bulldozers Water carts Graders Dump trucks Vibrating rollers Spray sealing equipment	Asphalt paving machines Concrete saws Compactors Cranes Slip-forming machines Concrete pumps Concrete trucks
Construction of bridge over Adam Road	Light vehicles Excavators Generators Rock breaker Concrete pumps Welding equipment	Cranes Piling machines Concrete trucks Generators Oxy-cutting equipment Cherry pickers
Drainage work	Light vehicles Excavators Generators Jackhammers Concrete pumps	Concrete trucks Cranes Compactors Boring machines Bobcats

Construction phase/activity	Indicative plant and equipment	
Pavements	Light vehicles Excavators Generators Asphalt paving machines Concrete trucks Cranes	Concrete saws Compactors Slip-forming machines Concrete pumps Generators
Utility relocation	Light vehicles Excavators Generators Excavators Boring machines Piling machines	Cranes Generators Dump trucks Plate compactors Concrete pumps Concrete truck
Finishing work	Light vehicles Excavators Generators Dump trucks Concrete trucks Hydromulching equipment	Cranes Water cart Compactor Bobcats Road marking machine Welding equipment

5.4.17 Construction materials

Construction of the project would require various materials and pre-cast elements. The major construction materials required would include:

- General fill and select fill for earthworks
- Sand and soils for landscaping
- Geotextile materials
- Pavement materials including road base and sub-base
- Materials for lining drainage channels
- Aggregate for concrete, asphalt and bitumen
- Cement and concrete
- Steel for reinforcement
- Wood for use in formwork and other temporary structures
- Water
- Pre-cast concrete including pipes, culvert segments and roadside barriers
- Mechanical and electrical equipment for VMS.

Materials would be sourced from licensed facilities and commercial suppliers in nearby areas. None of the materials proposed to be used are considered to be in short supply. Material quantities would be determined throughout detailed design prior to the start of construction and would be reduced where possible through efficient design, construction and procurement processes.

5.4.18 Natural resource consumption

All construction activities associated with the project would consume energy. Activities with high energy demands include:

- Excavation of earth and rock cuttings
- Removal, relocation and compaction of excavated material in fill embankments
- Transport of raw materials and structural elements (such as pre-cast bridge beams)
- Construction of pavement and bridges
- Operation of electronic signage and lighting
- Consumption of fuel by equipment and construction vehicles.

Equipment and vehicles would consume a large quantity of fuel. It is estimated that up to 3.5 million litres of fuel (diesel and petrol) would be used to construct the project.

Electricity needs on the site would be minor, and connecting the offices to the local power grid would be sufficient. Some generators may be necessary for emergency power supply.

Construction of the project would take about three years and require up to about 50 to 60 megalitres of water (non-potable and potable). Water would be available along the project alignment from existing filling points (potable water requiring metered standpipes) and potentially from the existing water sources along the proposed new alignment. Where existing water sources are not available, water would be transported to site as required.

Water would also be required during establishment of landscaped areas. The landscape establishment period is typically 12 weeks, with weekly watering required during this period to assist the growth and establishment of plants. Once landscaped areas are successfully established, it is not anticipated that there would be a requirement for water during operation of the road.

The principles of Ecologically Sustainable Development (ESD) have been recognised and applied during the development and assessment of the project. Chapter 10 identifies the principles of ESD, including the project's consistency with the Transport Environment and Sustainability Policy Framework (TfNSW, 2013).

5.5 Staging

5.5.1 Potential delivery scenarios

The project would be delivered through three separate construction contracts. The proposed order of construction, start and duration of construction would depend on the procurement strategy adopted following project approval. The indicative order and timing of construction is presented in Table 5-22.

Table 5-22 Plant and equipment requirements

Likely delivery staging	Possible construction start	Possible opening date
The Northern Road Upgrade – from Mersey Road, Bringelly to Eaton Road, Luddenham	Early 2018	Late 2019/early 2020
The Northern Road Upgrade – from Littlefields Road, Luddenham to Glenmore Parkway, Glenmore Park	Early 2018	Mid-2020

Likely delivery staging	Possible construction start	Possible opening date
The Northern Road Upgrade – Eaton Road, Luddenham to Littlefields Road, Luddenham	Early 2018	Mid-2020

Construction is expected to start in early 2018 and continue for about three years. The design of the project has considered the requirements to minimise impact on existing traffic, enabling safe construction access and egress and minimising the impact of disruption. Staging of the construction would consider:

- The need to minimise user disruption
- The need for local road and property access
- The need for land acquisition
- The earthworks balance, within each stage and across all stages of the project
- The sequence of utility adjustment and traffic staging considerations
- The sequence in which completed stages could be open to traffic.

Each stage of the project is expected to be delivered in a separate construction package and would include all activities needed to complete the stage, including utilities adjustments, road construction, bridge construction, traffic management, lighting and finishing work.

5.5.2 Mersey Road to Eaton Road

This stage is the diversion around the Western Sydney Airport site and would generally involve construction through greenfield areas (that is, where there is no existing development), which would have little impact on traffic flows.

Construction would be staged so that one carriageway is completed early to allow traffic to be switched from the existing The Northern Road through this area, allowing the existing The Northern Road to be closed to general traffic. Indicative staging would involve:

- Construction of the section of project from Leppington Pastoral Company driveway to Luddenham offline, where there would be little disruption to traffic flow
- The tie-in works at Luddenham, which would be constructed under traffic, mostly at night
- The tie-in at the southern end, which would be undertaken in two main stages
- Construction of the new carriageway, with traffic on the existing carriageway
- Switching traffic to the newly constructed carriageway to allow upgrading of the existing carriageway
- Construction of a temporary roundabout at the Luddenham southern connection until the section from Littlefields Road to Eaton Road Luddenham is completed
- Replacement of the temporary roundabout with traffic lights.

5.5.3 Littlefields Road to Glenmore Parkway

This stage would involve road widening, generally within and to the east of the existing road corridor. As such, staging is an important consideration so that construction minimises disturbance to road users. Indicative staging would involve:

- Construction of the northbound carriageway between Littlefields Road and the WaterNSW Supply Pipelines (this would occur in conjunction with construction of the Littlefields extension to the east, Gates Link Road and upgrade to Gates Road and construction of the northbound carriageway and U turn facility)

- Switching traffic in the areas where construction is complete to allow construction of the southbound carriageway in conjunction with the Vineyard Road extension to Kings Hill Road and a u-turn facility in Chain-O-Ponds Road
- Switching traffic again to the southbound carriageway to allow construction of the remainder of the northbound carriageway
- Tie-ins with the other construction stages.

5.5.4 Eaton Road to Littlefields Road

The stage between Eaton Road and Elizabeth Drive Luddenham would generally involve construction in greenfield areas (that is, where there is no existing development), which would have little impact on traffic flows. Indicative staging would involve:

- Construction of the bridge over Adams Road
- Realignment of Elizabeth Drive (constructed off line)
- Tie-in of Elizabeth Drive (constructed under traffic)
- Construction of the section north of the existing Elizabeth Drive intersection and The Northern Road in two main stages:
 - construction of the new carriageway (constructed under traffic on the existing carriageway)
 - upgrading of the existing carriageway (constructed under traffic on the new carriageway).

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6 Consultation

This chapter describes the consultation process and activities that were, and would continue to be, undertaken for the project. It also presents a summary of issues raised by the community and stakeholders and where they are addressed in this EIS.

Table 6-1 outlines the environmental assessment requirements (SEARs) of the Secretary of the NSW Department of Planning and Environment and Commonwealth EIS Guidelines as they relate to consultation with government, stakeholders and community groups, and identifies where these are addressed in this EIS.

Table 6-1 EIS assessment requirements – Consultation

Requirements	Where addressed in EIS
Secretary's Environmental Assessment Requirements (NSW EP&A Act)	
<p>The EIS must also address the following specific matters: Social and Economic — including:</p> <ul style="list-style-type: none"> a draft Community Involvement Plan for the works, identifying relevant stakeholders, procedures for distributing information and receiving/responding to feedback and procedures for resolving community complaints during construction. Key issues that should be addressed in the draft Plan should include (but not necessarily be limited to): <ul style="list-style-type: none"> traffic management (including property access and pedestrian access), and noise and vibration mitigation and management, including work outside standard construction hours. 	<p>A Draft Community Involvement Plan for the project is provided in Appendix R.</p>
<p>During the preparation of the EIS, you must consult with the relevant local, State and Commonwealth Government authorities, service providers, community groups and affected landowners.</p>	<p>Chapter 6</p>
<p>In particular you must consult with Local, State and Commonwealth government authorities, including the:</p> <ul style="list-style-type: none"> Environment Protection Authority Office of Environment and Heritage (including Heritage Division) Department of Primary Industries NSW Office of Water Sydney Catchment Authority Civil Aviation Safety Authority AirServices Australia Where known, the operator of the proposed Western Sydney Airport Department of Defence 	<p>Consultation with government agencies is described in Section 6.2.</p> <p>Issues raised by government agencies are presented in Table 6-7.</p>

Requirements	Where addressed in EIS
<ul style="list-style-type: none"> Ministry of Health, including the South Western Sydney and Nepean Blue Mountains Local Health Districts Liverpool City Council Penrith City Council Emergency Services. 	
Specialist interest groups, including local sporting groups, Aboriginal stakeholders, and pedestrian and bicycle user groups.	Consultation with special interest groups and Aboriginal stakeholders is described in Section 6.2.3 and the outcomes of consultation are presented in Section 6.3.3. Further details are provided in Section 8.3 and Appendix M – Aboriginal Cultural Heritage Assessment Report).
Utilities and service providers.	Consultation with utilities and service providers and issues raised are described in Table 6-8.
The public, including community groups, businesses, and adjoining and affected landowners.	Consultation with the public, including community groups and adjoining and affected landowners, is described in Section 6.2. Community feedback is presented in Table 6-8.
The EIS must describe the consultation process and the issues raised, and identify where the design of the infrastructure has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.	The consultation process is outlined in Section 6.2. The feedback and issues raised by government agencies, local councils and the community (with reference to where they are addressed in the EIS), are presented in Section 6.3.
Commonwealth EIS Guidelines (Commonwealth EPBC Act)	
Any consultation about the action, including: <ul style="list-style-type: none"> Any consultation that has already taken place Proposed consultation about relevant impacts of the action If there has been consultation about the proposed action, any documented response to, or result of, the consultation Identification of affected parties, including a statement mentioning any communities that may be affected and 	Chapter 6, specifically: <ul style="list-style-type: none"> Section 6.2 Consultation process and activities to date Section 6.4 Future consultation Section 6.3 Summary of issues raised Section 6.3.2 Issues raised by the community, and Section 6.3.3 Issues raised by the

Requirements	Where addressed in EIS
describing their views.	Aboriginal community.
Details of any public consultation activities undertaken, and their outcomes.	Consultation with the public, including community groups and adjoining and affected landowners, is described in Section 6.2. Community feedback is presented in Table 6-8. Public consultation outcomes are also discussed in Section 7.4 Socio-economic and land use.
Details of any consultation with indigenous stakeholders.	Consultation with special interest groups and Aboriginal stakeholders is described in Section 6.2.3 and the outcomes of consultation are presented in Section 6.3.3. Further details are provided in Section 8.3 and Appendix M – Aboriginal Cultural Heritage Assessment Report).

6.1 Consultation objectives and strategy

Roads and Maritime developed a Draft Community Involvement Plan (Appendix R) to identify key objectives and a program for consultation with community, stakeholders and government agencies. These objectives have guided all communication and consultation with stakeholders in preparing this EIS and would continue to apply to all stages of the project to ensure consistent implementation and appropriate consultation with all stakeholders.

The project objectives are aligned with other projects on The Northern Road as well as the WSIP objectives and include:

- Providing regular and targeted information to build awareness about The Northern Road Upgrade and the likely impacts and benefits of the project
- Providing clear direction to the community and stakeholders about whether we are providing information or seeking feedback so that expectations are clear at all stages of engagement
- Ensuring community and stakeholder views are continuously fed into the project's development and used to understand and effectively assess impacts
- Collaborating with government agencies and local councils to ensure a whole-of-government approach and consistent key messages.

In addition to the community and stakeholder consultation objectives, the following values underpin Roads and Maritime's consultation activities carried out for the project:

- Customer focus – We place the customer at the centre of everything we do
- Collaboration – We value each other and create better outcomes by working together
- Solutions – We deliver sustainable and innovative solutions to NSW's transport needs
- Integrity – We take responsibility and communicate openly
- Safety – We prioritise safety for our people and our customers.

The Draft Community Involvement Plan has been developed in accordance with the SEARs and includes:

- Identification of relevant stakeholders
- Procedures for distributing information and receiving and responding to feedback
- Procedures for resolving community complaints during construction
- Traffic management (including property access and pedestrian access)
- Noise and vibration mitigation and management, including work outside standard construction hours.

6.2 Consultation process and activities to date

6.2.1 Overview

Roads and Maritime has carried out an extensive community consultation program for the project and other Western Sydney Infrastructure Plan (WSIP) projects.

In April 2014, the project was first announced as part of the WSIP program by The Hon Jamie Briggs, Assistant Minister for Infrastructure and Regional Development.

In July and August 2015, Roads and Maritime released – for community and stakeholder comment – a preliminary design and access strategy for The Northern Road Upgrade between Littlefields Road, Luddenham and Jamison Road, South Penrith and route options for the proposed new alignment of The Northern Road to bypass the Western Sydney Airport.

In October 2015, Roads and Maritime released a Consultation Report covering several WSIP projects including The Northern Road Upgrade between Mersey Road, Bringelly to Littlefields Road, Luddenham and Littlefields Road, Luddenham to Jamison Road, South Penrith.

In November 2015, Roads and Maritime announced the preferred route for The Northern Road Upgrade between Mersey Road, Bringelly and Littlefields Road, Luddenham. After considering early studies and community feedback, the eastern option that provides a bypass to access the Luddenham town centre and homes along the existing The Northern Road was selected as the preferred route.

In February and March 2016, Roads and Maritime displayed the preliminary design and access strategy between Mersey Road, Bringelly and Adams Road, Luddenham. At that time, the community was informed that more information on The Northern Road Upgrade, between Adams Road and Littlefields Road would be presented to the community in mid-2016, following further investigations of other transport projects in the area.

In May 2016, Roads and Maritime released a Consultation Report detailing stakeholder and community feedback following consultation of the preliminary design and access strategy between Mersey Road, Bringelly and Adams Road, Luddenham.

In July and August 2016, Roads and Maritime released a preliminary design and access strategy between Eaton Road, Luddenham and Littlefields Road, Luddenham as well as an updated access strategy for property access from Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park. These were developed in response to community feedback requesting fewer sets of traffic lights along The Northern Road Upgrade.

6.2.2 Communication and consultation tools

A number of channels and communication tools have been and continue to be used to inform and engage stakeholders. These include:

- Community information contact line: 1800 703 457
- Project email: wsip@rms.nsw.gov.au

- Project website: www.rms.nsw.gov.au/thenorthernroad
- Project video and animations via the WSIP interactive portal <https://v2.communityanalytics.com.au/rms/wsip>
- Project database to record all correspondence relevant to the project, including stakeholder contact details and issues raised during the life of the project
- Community information sessions
- Meetings with key stakeholders
- Face-to-face meetings with individual property owners, businesses and residents that may be directly affected by the project
- Community update newsletters
- Letterbox drops
- Mail-outs (addressed and unaddressed)
- Door knocking within the immediate project areas
- Feedback form
- Media releases
- Advertisements in local newspapers
- Variable message signs along roadsides in the area during consultation display periods.

6.2.3 Aboriginal cultural heritage consultation

The aim of consultation is to integrate cultural and archaeological knowledge and ensure registered stakeholders have information to make decisions on Aboriginal cultural heritage.

Roads and Maritime is committed to effective consultation with Aboriginal communities regarding its activities and the potential for impact on Aboriginal cultural heritage. The Roads and Maritime developed the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) to provide a consistent means of effective consultation with Aboriginal communities regarding activities that may impact on Aboriginal cultural heritage, and a consistent assessment process for Roads and Maritime activities across NSW.

Consultation with Aboriginal people has also been carried out in accordance with the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (OEH, 2010a) and the requirements of Clause 80C of the National Parks and Wildlife Regulation 2009.

Roads and Maritime invited Aboriginal people who hold knowledge relevant to determining the cultural heritage significance of Aboriginal objects and Aboriginal places in the project area to register an interest in a process of community consultation. Investigations for the project have included consultation with 61 Aboriginal community groups and individuals, as listed in Appendix M – Aboriginal Cultural Heritage Assessment Report.

The formal consultation process has included:

- Advertising for registered stakeholders (refer Appendix M)
- Notification letters to government agencies
- Notification of the closing date for registration
- Provision of proposed archaeological assessment methodology (20 January 2016) (allowing a 28 day review) outlining the methodology to prepare the Cultural Heritage Assessment Report (CHAR)
- Ongoing compilation of a register of individuals and groups for consultation

- Provision of the draft CHAR to Aboriginal stakeholders for a 28 day review and comment period (comments were received from Tocomwall and Darug Land Observations and are incorporated in the CHAR and included in Appendix M)
- The holding of an Aboriginal focus group meeting to discuss assessment methodology, investigation results, the CHAR and detailed mitigation strategies (27 April 2016)
- Ongoing consultation with the local Aboriginal community.

6.2.4 Consultation undertaken before preparation of the EIS

Stakeholders were identified in consideration of the project's potential direct and indirect impacts and from records of past and current contact with relevant government bodies, stakeholders and interest groups. Stakeholders were also identified in accordance with the requirements of the SEARs and Commonwealth EIS Guidelines.

Stakeholders were grouped into the following categories:

- Potentially directly affected property owners, including adjoining land owners
- Interest groups, such as community, business owners and business groups
- Local Aboriginal Land Councils
- Government and non-government agencies
- The broader community.

It is noted that in reference to the SEARs, no local sporting groups were consulted as the project would not impact any sporting facilities or groups. Additionally, no local sporting groups came forward during consultation with the general public.

A list of stakeholder groups that have been consulted is provided in Table 6-2.

Table 6-2 Stakeholder groups identified for the project

Community / stakeholder group	Stakeholder
Federal Government	Department of the Prime Minister and Cabinet Minister for Urban Infrastructure Minister for Infrastructure and Transport Minister for Regional Development Federal Member for Hume Federal Member for Lindsay Federal Member for Werriwa
State Government	Department of Premier and Cabinet Minister for Roads, Maritime and Freight Minister for Transport and Infrastructure Minister for Western Sydney State Member for Mulgoa State Member for Camden
Government partners	Federal Department of Infrastructure and Regional Development (Infrastructure Investment and Western Sydney units) Transport for NSW
Government agencies	Australian Government Department of the Environment and Energy (DoEE) NSW Environment Protection Authority (EPA)

Community / stakeholder group	Stakeholder
	NSW Office of Environment and Heritage (OEH) NSW Department of Primary Industries NSW Department of Planning and Environment WaterNSW Civil Aviation Safety Authority AirServices Australia Commonwealth Department of Defence Ministry of Health, including the South Western Sydney and Nepean Blue Mountains Local Health Districts UrbanGrowth NSW Infrastructure NSW Infrastructure Australia Greater Sydney Commission
Councils	Penrith City Council Liverpool City Council Western Sydney Regional Organisation of Councils (WSROC)
Specialist interest groups, including Local Aboriginal Land Councils and Aboriginal stakeholders	Deerubbin Land Council Gandangara Land Council Tharawal Land Council Aboriginal Heritage Office
Emergency services	NSW Fire and Rescue NSW Rural Fire Service Penrith Local Area Command NSW Police Force State Emergency Service NSW Ambulance Service
Utilities and service providers	Sydney Water Telstra Optus Jemena Gas TransGrid Energy Endeavour Energy NBN Co (National Broadband Network)
The public, including educational facilities, community groups, businesses, and adjoining and affected landowners	Educational facilities: Luddenham Public School Holy Family Primary School Luddenham Long Day Child Care Centre Community groups: Bicycle NSW Luddenham Progress Association Numerous individual businesses and adjoining and affected landowners

6.2.5 Consultation carried out before preparation of this EIS

In July and August 2015, Roads and Maritime released a preliminary design and access strategy for The Northern Road Upgrade between Littlefields Road, Luddenham and Jamison Road, South Penrith and route options for the proposed new alignment of The Northern Road to bypass Luddenham and the Western Sydney Airport for community and stakeholder comment. The following consultation activities were associated with this announcement.

Community update newsletter – In July 2015, a community update newsletter was distributed for The Northern Road Upgrade between Mersey Road, Bringelly and Littlefields Road, Luddenham. The newsletter included a general overview of the WSIP, key features of the project and further information to provide feedback (including details of the information sessions).

The newsletters, published on the Roads and Maritime website, were available at all community information sessions, and were also letterbox dropped to 20,700 local residences across the different project areas. The community update newsletter is available to view at <http://www.rms.nsw.gov.au/documents/projects/sydney-west/the-northern-road/the-northern-road-stage-4-community-update-1507.pdf>

Postcard – A postcard was mailed to 47,000 local residences outlining WSIP, the projects on public display and further information to provide feedback (including details of the information sessions).

Door knock – 590 homes were door knocked at the beginning of consultation. The purpose was to notify local residents along the proposed corridor of the four shortlisted route options and provide dates for the upcoming community information sessions. The July 2015 community update newsletter was provided. Where the door knock was unsuccessful a 'Sorry We Missed You' flyer was left at the premises.

Media releases – A joint media release from the Australian and NSW governments was distributed to all major metropolitan and western Sydney publications on Thursday 17 April 2014. The media release, titled 'Local Stakeholders Welcome \$3.5 Billion Infrastructure Plan', marked the first announcement to the public on the proposed major upgrades to The Northern Road and Bringelly Road and the construction of other WSIP projects including the proposed M12 Motorway.

A joint media release from the Australian and NSW governments was distributed to all major Sydney metropolitan and western Sydney publications on Tuesday 14 July 2015. The media release, titled 'Next Major Road Upgrade Stages Announced for Western Sydney' encouraged local community members and stakeholders to get involved in the consultation process. A summary of key media releases prior to preparation of the EIS is provided in Table 6-3.

Table 6-3 Key media releases for the project prior to EIS preparation

Announcement	Date	Link
Local Stakeholders Welcome \$3.5 Billion Infrastructure Plan	17 April 2014	http://minister.infrastructure.gov.au/jb/releases/2014/April/jb029_2014.aspx
Getting on with Delivering Western Sydney's \$3.5Billion Roads Package	01 May 2014	http://minister.infrastructure.gov.au/jb/releases/2014/May/jb032_2014.aspx
Western Sydney Infrastructure Plan	13 May 2014	http://minister.infrastructure.gov.au/wt/releases/2014/May/budget-infra_15-2014.aspx
Western Sydney Infrastructure Plan: Delivering First Stage of \$500 Million Bringelly Road Upgrade	01 July 2014	http://minister.infrastructure.gov.au/jb/releases/2014/July/jb058_2014.aspx

Announcement	Date	Link
Next Major Road Upgrade Stages Announced for Western Sydney	14 July 2015	http://www.rms.nsw.gov.au/about/news-events/news/members-of-parliament/2015/150714-next-major-road-upgrade-stages-announced-for-western-sydney.html

Newspaper advertisements – A total of 11 newspaper advertisements appeared between Tuesday 14 and Tuesday 21 July 2015 to raise awareness of the consultation and information sessions.

Publications included the Penrith Press, Penrith Gazette, Penrith Western Weekender, South West Advertiser, Macarthur Chronicle, Liverpool Leader, Liverpool Champion, The Sydney Morning Herald and The Daily Telegraph.

Additionally, in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act), newspaper advertisements were placed in July 2015 to notify the public that the State Significant Infrastructure application for the project was lodged with the Department of Planning and Environment.

Email – Emails were sent from Roads and Maritime to stakeholders (community members and groups on the Roads and Maritime WSIP project database), local Members of Parliament (MPs) and other government stakeholders to raise awareness of the consultation and information sessions. A reminder email noting that consultation was closing on Friday 14 August 2015 was also sent to stakeholders before this date.

SMS – Reminder text messages were sent to stakeholders on the stakeholder and community database at the start of consultation and on the day before each information session.

Webpage – The project webpage (www.rms.nsw.gov.au/wsip) is regularly updated with the latest project information including all relevant community update newsletters and how to submit feedback. A total of 3856 unique page visitors were recorded during July and August 2015, when Roads and Maritime carried out consultation for the WSIP projects.

WSIP web portal – An interactive web portal covering all aspects of the WSIP was launched on 13 July 2015. The web portal includes nine videos about the projects and provides a space for viewers to leave feedback. A total of 2836 unique visitors to the web portal were recorded during the consultation period. A banner directing people to the portal was placed on the Roads and Maritime home page <http://www.rms.nsw.gov.au/> and on the www.nsw.gov.au website.

Information sessions – Six community information sessions were held between 22 July and 8 August 2015. The purpose was to provide the community with the opportunity to view all display materials, talk with members of the project team and submit feedback in person. Project teams from Transport for NSW, Sydney Water, Department of Planning and Environment, and the DIRD were also present at some of the sessions to provide information on other projects in the area. Table 6-4 outlines the details of these community information sessions.

Table 6-4 Details of community information sessions July–August 2015

Date	Location
Wednesday 22 July 2015 4–8pm	Penrith Anglican College Gymnasium 338–356 Wentworth Road, Orchard Hills
Saturday 25 July 2015 12–3pm	Bringelly Community Centre 5 Greendale Road, Bringelly

Date	Location
Wednesday 29 July 2015 3–7pm	Holy Family Primary School Hall Lot 32 Willowdene Avenue, Luddenham
Saturday 1 August 2015 11am–2pm	Glenmore Park Youth and Community Centre Luttrell Street (off Town Terrace), Glenmore Park
Thursday 6 August 2015 3–7pm	Kemps Creek Public School Hall 100 Cross Street, Kemps Creek
Saturday 8 August 2015 12–3pm	Holy Family Primary School Hall Lot 32 Willowdene Avenue, Luddenham

Key agency and Ministerial briefings – Roads and Maritime holds monthly meetings with the DIRD and Transport for NSW to facilitate information exchange across government agencies on projects in the area.

There have been a number of Ministerial briefings on the progress of the planning for the upgrade, including a briefing in July 2015 with Federal Member for Lindsay, Ms Fiona Scott MP, State Minister the Hon Duncan Gay MLC, and local State Members Mr Stuart Ayres MP and Mrs Tanya Davies MP.

Liverpool and Penrith City Councils were also briefed on the project prior to community consultation in early July 2015.

Electronic variable message signs (VMS) – Eight VMS were displayed along The Northern Road, Elizabeth Drive and Bringelly Road during the consultation period to notify the community of the information sessions.

Static poster displays – Project posters were displayed during the consultation period at Penrith Library, Penrith Civic Centre, Narellan Library, Camden Council, Camden Library, Liverpool Library, Liverpool City Council and Fairfield City Council.

Meetings and briefings – Individual, face-to-face meetings were held with residential and commercial property owners and business operators to discuss property impacts including property acquisition. Meetings with property owners have been ongoing regarding property acquisition.

6.2.6 Consultation carried out during preparation of this EIS

Community update newsletters – Newsletters were sent to the community and stakeholders in November 2015, February 2016 and July 2016.

The newsletter distributed in November 2015 outlined the preferred eastern option for The Northern Road Upgrade between Mersey Road, Bringelly and Littlefields Road, Luddenham. The newsletter included a map and details of the project, why the alternative options were not chosen, questions and answers, and information on how to provide feedback. The newsletter was sent to more than 2200 stakeholders. It is available to view at

<http://www.rms.nsw.gov.au/documents/projects/sydney-west/the-northern-road/the-northern-road-stage-4-community-update-1511.pdf>

The newsletter distributed in February 2016 outlined the preliminary design and access strategy for part of the alignment (between Mersey Road, Bringelly and just north of Adams Road, Luddenham). The newsletter included an overview of the WSIP, key features of the project and further details on the information sessions and how to provide feedback. The newsletter was available online and was also letter box dropped to 2300 local residents and businesses. It is available to view at

<http://www.rms.nsw.gov.au/documents/projects/sydney-west/the-northern-road/bringelly-northern-road-upgrade-stage-4-2016-02.pdf>

The newsletter distributed in July 2016 outlined the preliminary design and access strategy between Eaton Road, Luddenham and Littlefields Road, Luddenham as well as the alternative

access arrangements for Littlefields Road and Gates Road. The newsletter included details of The Northern Road Upgrade from Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park, key features of the project, a map and information on how to provide feedback on the project. The newsletter was distributed to 10,000 residents and businesses. It is available to view at <http://www.rms.nsw.gov.au/documents/projects/sydney-west/the-northern-road/the-northern-rd-upgrade-project-update-2016-07.pdf>

Door knock – The project team door knocked 65 affected property owners in August 2016. The purpose was to notify local residents along the proposed corridor of the preliminary design and to seek feedback. The July 2016 community update newsletter was provided. Where the door knock was unsuccessful, a business card was left at the property.

Media releases – Roads and Maritime announced the preferred route for the Luddenham and Western Sydney Airport bypass on 12 November 2015. A further media release announcing shortlisted options for the proposed M12 Motorway (which would tie into The Northern Road) was released on 15 February 2016. A media release announcing the release of the Consultation Report was issued on 19 May 2016 and on 22 July 2016, Roads and Maritime issued a media release encouraging the community to have a say on the final stage of The Northern Road upgrade. A summary of key media releases during preparation of the EIS is provided in Table 6-5.

Table 6-5 Key media releases for the project during preparation of the EIS

Announcement	Date	Link
Preferred Route for The Northern Road Upgrade Luddenham and Western Sydney Airport Bypass (Stage 4)	12 November 2015	http://minister.infrastructure.gov.au/pf/releases/2015/November/pf024_2015.aspx
Shortlisted Route Options for Proposed M12 Motorway Announced (includes an announcement regarding The Northern Road)	15 February 2016	http://www.rms.nsw.gov.au/about/news-events/news/roads-and-maritime/2016/160215-m12-motorway-route-options.html
Consultation Report for M12 Motorway Route Options and The Northern Road Upgrade Stage 4	19 May 2016	http://www.rms.nsw.gov.au/about/news-events/news/roads-and-maritime/2016/160519-consultation-report-m12-motorway-northern-rd-stage-4.html
Community Invited to have a Final Say on the Final Stage of the Northern Road Upgrade	22 July 2016	http://www.rms.nsw.gov.au/about/news-events/news/roads-and-maritime/2016/160722-have-a-say-on-the-final-stage-of-the-northern-road-upgrade.html

Newspaper advertisements – Roads and Maritime placed advertisements in the *Koori Mail*, *Penrith Press*, *Penrith Gazette* and *Western Weekender* between Tuesday 17 November and Friday 20 November 2015. The purpose of these advertisements was to invite Aboriginal people and Aboriginal groups that hold cultural knowledge relevant to determining the significance of Aboriginal objects and places in The Northern Road Upgrade to provide feedback. Six advertisements were also placed in the *South West Advertiser*, *Penrith Press* and *Macarthur Chronicle* announcing the eastern option as the preferred route and inviting community and stakeholder feedback.

A total of 11 newspaper advertisements were placed between 17 and 26 February 2016 to raise awareness and promote the consultation period for The Northern Road Upgrade between Mersey Road, Bringelly and the preliminary design and access strategy for just north of Adams Road, Luddenham. Publications included the *Penrith Press*, *Penrith Gazette*, *Macarthur Chronicle*, *Liverpool Leader*, *Liverpool Champion* and *Penrith Western Weekender*.

Roads and Maritime placed eight advertisements between 22 July and 12 August 2016 in the *Liverpool Champion*, *Penrith Press*, *Penrith Western Weekender* and *The Advertiser* to announce the preliminary design and access strategy for The Northern Road Upgrade between Eaton Road and Littlefields Road and to encourage community and stakeholder feedback.

Stakeholder emails – On 12 November 2015, Roads and Maritime sent emails to 883 stakeholders (community members and groups), local MPs and other government stakeholders to announce the preferred route option for the diversion of The Northern Road Upgrade around the Western Sydney Airport site.

On 15 February 2016, Roads and Maritime sent emails to 954 stakeholders (community members and groups), local MPs and other government stakeholders to raise awareness of the consultation and information sessions in February and March 2016. A reminder email noting the consultation would close on 11 March was sent to stakeholders before the closing date.

On 22 July 2016, Roads and Maritime sent emails to 950 stakeholders to announce the preliminary design and access strategy for The Northern Road Upgrade from Mersey Road to Glenmore Parkway and to encourage stakeholders to provide feedback.

SMS – Reminder text messages were sent to stakeholders at the start of the February and March 2016 consultation period and on the day before each information session.

Webpage – The project webpage is regularly updated with the latest project information including all relevant community update newsletters and how to submit feedback. A total of 1906 unique page visitors were recorded in February and March 2016, when Roads and Maritime carried out consultation for the preliminary design and access strategy for The Northern Road between Mersey Road and Littlefields Road.

During the July 2016 consultation period, there were 1197 unique visitors to The Northern Road webpage.

From July 2015 and mid-August 2016, there were 9062 unique web visitors The Northern Road webpage. This figure does not include repeat visits during the same session.

WSIP portal – For the February and March 2016 consultation period, a new video was developed for The Northern Road Upgrade between Mersey Road and Littlefields Road. There were 548 unique visitors to The Northern Road webpage during this consultation period. A banner directing people to the portal was placed on the Roads and Maritime home page www.communityanalytics.com.au/wsip.

For the July 2016 consultation period, a new video was developed showing the preliminary design and access strategy between Eaton Road and Littlefields Road, and the alternative access arrangement for Gates Roads and Littlefields Road. There were 484 unique visitors to the video page during this consultation period.

Information sessions – Four community information sessions were held between 24 February and 5 March 2016. The purpose was to provide the community with an opportunity to view display materials, talk with members of the project and property teams and submit feedback in person. Project teams from DIRD, Department of Planning and Environment and Sydney Water were also present at some of the sessions to provide information on other projects in the area.

Table 6-6 outlines the details of the four community information sessions.

Table 6-6 Details of community information sessions February–March 2016

Date	Location
Wednesday 24 February 2016 5–8pm	Holy Family Primary School Hall Lot 32 Willowdene Avenue, Luddenham
Saturday 27 February 2016 10am–1pm	Kemps Creek Public School Hall 100 Cross Street, Kemps Creek
Wednesday 2 March 2016 3–6pm	Kemps Creek Public School Hall 100 Cross Street, Kemps Creek
Saturday 5 March 2016 10am–1pm	Holy Family Primary School Hall Lot 32 Willowdene Avenue, Luddenham

Electronic variable message signs (VMS) – Seven VMS were displayed along The Northern Road, Elizabeth Drive and Bringelly Road during the February and March 2016 consultation period to notify the community about upcoming information sessions.

Key agency and Ministerial briefings – On 12 February 2016, Roads and Maritime held a briefing with the Federal Member for Lindsay, Ms Fiona Scott MP, Federal Member for Macarthur Mr Russell Matheson MP and local State Members Mr Stuart Ayres MP, Mrs Tanya Davies MP and Mr Chris Patterson MP.

Briefings were also held with Fairfield City Council (16 February), Liverpool City Council (18 February), Penrith City Council (22 February) and Western Sydney Parklands Trust (10 February).

Roads and Maritime also holds monthly meetings with the DIRD and Transport for NSW to facilitate information exchange across government agencies on projects in the area.

Meetings and briefings (October 2015 – August 2016) – Meetings and briefings have been held with key government agencies, local councils and industry stakeholders to explain specific details of the project and gather feedback. Opportunities for meetings and briefings with stakeholders would continue throughout the life of the project.

Roads and Maritime invited stakeholders to meet to discuss the project and/or provide feedback on the project as part of the EIS process. The following stakeholders were invited to face-to-face meetings:

- NSW Environment Protection Authority
- NSW Office of Environment and Heritage (OEH)
- NSW Department of Primary Industries (NSW Agriculture, NSW Fisheries, DPI – Water)
- WaterNSW
- Civil Aviation Safety Authority (Commonwealth)
- AirServices Australia (Commonwealth)
- Department of Defence (Commonwealth)
- NSW Ministry of Health, including the South Western Sydney and Nepean Blue Mountains Local Health Districts
- Penrith City Council
- Liverpool City Council
- NSW Police

- NSW Ambulance
- NSW Fire and Rescue
- NSW Rural Fire Service
- NSW State Emergency Service
- Bicycle NSW
- NSW Taxi Industry Association and NSW Taxi Council.

The following stakeholders accepted the invitation to meet with Roads and Maritime:

- Nepean Area Health Services – Department of Health (March 2016)
- Penrith City Council (April 2016)
- Liverpool City Council (May 2016).

The following utilities and government agencies have also been engaged during the project on a Utility Coordination Team for the WSIP:

- Telstra
- Optus
- Transgrid
- Endeavour Energy
- Jemena
- Sydney Water
- WaterNSW
- National Broadband Network (NBN)
- Department of Planning and Environment
- DIRD.

Property owners who were not able to meet with Roads and Maritime at the community information sessions were given the opportunity to meet at a more convenient time. Individual, face-to-face meetings were held with residential and commercial property owners and business operators to discuss property impacts including property acquisition. Meetings with property owners have been ongoing regarding property acquisition.

Liverpool and Penrith City Councils were further briefed on the project in mid-February 2016, April 2016, May 2016 and July 2016 as part of the EIS consultation process.

Roads and Maritime also met with the Luddenham Progress Association to discuss the shortlisted route options at the southern end of the proposed upgrade in early December 2015.

6.3 Summary of issues raised

6.3.1 Issues raised by government agencies

Roads and Maritime has consulted on an ongoing basis with key State and local government agencies identified in Table 6-7 (and including those outlined in the SEARs). This consultation was designed to ensure agency issues and concerns were understood, documented and addressed, and that attendees had an opportunity to discuss any aspect of the project. Consultation has included phone calls, emails and face-to-face meetings.

Table 6-7 provides a summary of the consultation carried out, and issues raised by government agencies and local councils and where these issues are addressed in this EIS.

Table 6-7 Summary of issues raised by Commonwealth, State and local government

Stakeholder	Issues raised	Where addressed in EIS
Department of Primary Industries – Agriculture NSW	<ul style="list-style-type: none"> • Management of weeds • Minimisation of impact on good quality cropping land • Impact on access for farm gate sales 	Weed management is assessed in Section 7.3 Impact on cropping land and farm gate sales is assessed in Section 7.4 and the Socio-economic Working Paper (Appendix J of the EIS)
Department of Primary – Fisheries NSW	<ul style="list-style-type: none"> • Protection of aquatic habitats and threatened species • The project should be designed to: maintain fish passage, minimise potential water quality and erosion impacts on waterways, and avoid moving or harming riparian and aquatic vegetation • Design and construction of bridges and culverts should be in accordance with Policy and Guidelines for Fish Friendly Waterway Crossings 	Aquatic impacts and management measures are assessed in Section 7.3 and water quality impacts and management measures are addressed in Section 8.2
Department of Primary Industries – DPI Water	<ul style="list-style-type: none"> • Consistency with water sharing plans and site water usage/management • Licensing considerations, including identification of water requirements, water supply sources and any groundwater extraction requirements • Impacts on surface water resources • Impacts on groundwater resources • Impacts on groundwater dependent ecosystems, wetlands and riparian land 	Surface and groundwater impacts and management measures, including licensing requirements, are addressed in Section 8.2 Potential impacts on Groundwater Dependent Ecosystems, wetlands and riparian land are also addressed in Section 7.3
NSW Environment Protection Authority (NSW EPA)	<ul style="list-style-type: none"> • Requirements for an environment protection licence (EPL) 	Licensing requirements for the project, including EPL requirements, are addressed in Section 2.2.1
NSW Health – Nepean Blue Mountains Local Health District	<ul style="list-style-type: none"> • Impacts of traffic congestion on health facilities • Design of proposed pedestrian and cycle routes – bike tracks should be separated from roadways and safe crossings and be well lit, and footpaths should be regularly inspected and maintained, and effectively lit • Noise and air quality impacts on local communities in the vicinity of Luddenham and Mulgoa 	Provision and design of pedestrian and cycle routes are addressed in Chapter 5 Traffic impacts on local communities are addressed in Section 7.1 Noise impacts on local communities are addressed in Section 7.2 Air quality impacts on local communities are addressed in Section 8.6
NSW Health –	<ul style="list-style-type: none"> • Cyclist and pedestrian access and 	Cyclist and pedestrian access

Stakeholder	Issues raised	Where addressed in EIS
South Western Sydney Local Health District	<ul style="list-style-type: none"> safety Noise and air quality impacts on local communities in the vicinity of Luddenham and Mulgoa 	<p>and safety are addressed in Section 7.1</p> <p>Noise impacts on local communities are addressed in Section 7.2</p> <p>Air quality impacts on local communities are addressed in Section 8.6</p>
Office of Environment and Heritage (OEH)	<ul style="list-style-type: none"> Impacts on Aboriginal heritage (including cultural and archaeological significance) 	Impacts on Aboriginal heritage are addressed in Section 8.3
Liverpool City Council	<ul style="list-style-type: none"> Consideration of land use changes along the corridor Traffic interface with expected additional developments in the region such as the Western Sydney Airport Property access arrangements along the corridor Impacts on hydrology, soils and water Urban design interfaces with other developments 	<p>Traffic interface and property access arrangement are addressed in Section 7.1</p> <p>Consideration of land use changes and property access arrangements are also addressed in Section 7.4</p> <p>Impacts on hydrology are addressed in Section 8.1</p> <p>Impacts on soils and water are addressed in Section 8.2</p> <p>Urban design interfaces are addressed in Section 8.6</p>
Penrith City Council	<ul style="list-style-type: none"> General additions and amendments to the SEARs Changes to flow rate and duration of receiving watercourses as a result of the project A Water Sensitive Urban Design (WSUD) Strategy which details how stormwater quality and quantity control measures would be implemented during both construction and operational phases Stormwater quality and quantity Identification of any contaminated land remediation Assessment of the impacts on local fauna of severed connectivity, vehicle strike, road lighting, noise and vibration during construction and operation of the road The use of native species for landscaping Impacts on aquatic habitat of fish and other fauna that utilise the creeks, including macroinvertebrates Preparation of a Waste Management 	<p>SEARs as presented in Appendix B are addressed throughout the relevant chapters of the EIS:</p> <p>Section 7.3 – Biodiversity</p> <p>Section 8.1 – Flooding and hydrology</p> <p>Section 8.2 – Soils, water and contamination</p> <p>Section 8.7 – Resources and waste management</p>

Stakeholder	Issues raised	Where addressed in EIS
	Plan (WMP)	
NSW Police	<ul style="list-style-type: none"> Construction work zones are to be safe for motorists and workers Congestion on other arterial roads in the area during construction 	Construction traffic impacts and management measures are addressed in Section 7.1

6.3.2 Issues raised by the community

Consultation was generally carried out during July to August 2015, February to March 2016 and July to August 2016, as outlined in Section 6.2.1. Many submissions raised general issues for the entire WSIP while others raised issues concerning individual aspects of the project, as follows:

- July to August 2015 – 296 submissions were received
- February to March 2016 – 36 submissions were received specific to the Luddenham and the Western Sydney Airport bypass section (between Mersey Road and Adams Road) of The Northern Road Upgrade
- July to August 2016 – 22 submissions were received on the section from Eaton Road to Littlefields Road.

Table 6-8 provides a summary of the issues raised by the community, community groups (including pedestrian and bicycle user groups), businesses and adjoining and affected landowners. It consolidates the issues raised for the purpose of the EIS and indicates where the issue is addressed in the EIS. Key issues raised included:

- Consultation
- Property acquisition and property value
- Property access
- Noise and air quality impact
- Flora and fauna
- Construction impacts
- Traffic impact and management (congestion)
- Cycle access and facilities
- Design recommendations, particularly about intersection locations and the need to increase capacity
- Route options.

The outcomes of this consultation process have informed the design and development of the project to date.

Table 6-8 mentions where each issue is addressed and assessed in the EIS.

Table 6-8 Summary of issues raised by the community – individuals, special interest groups, utilities and service providers.

Key issue	Issues raised	Where addressed in EIS or response
Consultation	Need for ongoing consultation	Chapter 6

Key issue	Issues raised	Where addressed in EIS or response
	<p>Consultation with bicycle clubs on the design, facility and treatment of cycleways</p> <p>Quality of consultation including the need for appropriate documentation in languages other than English</p>	
Property acquisition and value	<p>Impact on property values along The Northern Road</p> <p>Further explanation of the property acquisition process</p> <p>Property compensation (fair compensation)</p> <p>Land value in the overall area</p> <p>The impact of partial acquisition on existing businesses</p> <p>Changes to property access</p>	Section 7.4
Noise and air quality	<p>Impact on local amenity</p> <p>Concern about the potential noise impacts</p> <p>Impacts on Luddenham town centre</p> <p>Concern about the potential increase in pollution</p>	Section 7.2
Flora and fauna	<p>Consideration of Cumberland Plain woodlands</p> <p>Consideration to Cumberland Plain Recovery Plan</p> <p>Impacts on flora and fauna near Willowdene Avenue</p>	Section 7.3
Aboriginal and European Heritage	<p>Concern about the impact on European and Aboriginal heritage sites</p>	<p>Section 8.3</p> <p>Section 8.4</p>
Construction impacts	<p>Concern about impact on the local community and businesses during construction</p> <p>Mitigation measures for issues such as dust and noise during construction</p> <p>Compensation to businesses to cover loss of trade during construction</p>	<p>Section 7.2</p> <p>Section 7.4</p> <p>Section 8.6</p>
Traffic impacts	<p>Changes to traffic conditions</p> <p>Changes to travel times</p> <p>Traffic demand from the Western Sydney Airport</p>	Section 7.1
Cycle access and facilities	<p>Design requirements of the shared path</p> <p>Use of the Upgrade by cyclists</p> <p>The cycleway infrastructure should consider not only existing users, but also the likely future users who may choose to commute in and around the airport precinct</p>	Section 7.1
Design recommendations	<p>Comments on changes to local roads such as Vicar Lane and Adams Road</p> <p>Request for Elizabeth Drive to be upgraded to a 4-way intersection</p> <p>Ensure sufficient time is allowed for those with a disability when crossing roads</p> <p>Number and width of lanes</p> <p>Bus lane restrictions</p>	<p>Chapter 5</p> <p>Section 7.1</p> <p>Section 8.1</p>

Key issue	Issues raised	Where addressed in EIS or response
	Further information on planned road closures Make u-turn bays roundabouts Any upgrades to drainage systems	
Route options	General comment/preference for the shortlisted Luddenham and Western Sydney Airport bypass options	Chapter 4

Throughout consultation, community feedback was considered where either appropriate or possible. The design has been refined in some areas to minimise the severance of properties, particularly in the planned airport bypass section. This has generally been achieved by aligning the project along property boundaries. In some areas this was not possible due to the requirement to provide a safe road design, with safe sight lines and road curvature. As such, some issues that were raised by the community did not result in design changes.

The inclusion of right turn lanes or bays and additional connections to the local road network also have safety and operational implications, where cars attempt to cross four lanes of oncoming traffic at unsignalised intersections. Alternative options have been provided to allow for safe access to properties and the local road network. Additional infrastructure requests such as retaining walls and wider shared paths have implications for property acquisition, maintenance and cost. A key consideration is the provision of a safe and cost effective road alignment for all users. This has been a key consideration throughout the concept design process and would continue to be through detailed design.

6.3.3 Issues raised by the Aboriginal community

Roads and Maritime has engaged Kelleher Nightingale Consulting to undertake an Aboriginal community consultation and cultural heritage investigations. This process is consistent with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (OEH, 2010). The outcomes of consultation with the Aboriginal community are outlined in Section 8-3 and Appendix M – Aboriginal Cultural Heritage Assessment Report and summarised below.

Comments received from Tocomwall and Darug Land Observations are summarised in Table 6-9.

Table 6-9 Summary of issues raised by the Aboriginal community

Issues raised	Where addressed in EIS or response
Support for the draft methodology proposed for the Aboriginal cultural heritage assessment	Noted. See Methodology section of the CHAR (Appendix M) and Section 8.3.1.
Advice as to how the CHAR methodology would inform understanding of the individual cultures that exist in the region	See Methodology section of the CHAR (Appendix M) and Section 7.4.1.
Comment that any recovered artefacts should be reburied 'on Country'	Recovered artefacts would be managed in accordance with the methodology outlined in the CHAR (Appendix M) of the EIS.
Darug Land Observations would like to receive a copy of any section 90 Aboriginal Heritage Impact Permits (AHIP)	As identified in Section 2.2.1 of the EIS, no AHIP is required for any project approved under Part 5.1 of the EP&A Act, which applies to this project.

Issues raised	Where addressed in EIS or response
Darug Land Observations would like to be involved in the monitoring of topsoil removal and all other works carried out on site	Aboriginal consultation and involvement during construction would be undertaken in accordance with the Roads and Maritime PACHCI and the CHAR (Appendix M) of the EIS.

6.4 Future consultation

Following the exhibition period, Roads and Maritime would continue to identify and manage issues of interest or concern to the community during the assessment and approval process and, if the project is approved, during its construction. The aim of ongoing communication and consultation is to provide the community with:

- Accurate and accessible information regarding the processes and activities associated with the project
- Information in a timely manner
- Appropriate avenues for providing comment or raising concerns, and to ensure the community is aware of how to provide feedback
- A high level of responsiveness to issues and concerns throughout the development and delivery of the project.

6.4.1 Consultation during the exhibition of the EIS

The EIS is being advertised and placed on public exhibition for a minimum of 30 days in accordance with the NSW EP&A Regulation, the Federal Minister's approval to publish and the Commonwealth EPBC Regulation. The EIS is available for viewing at the following locations:

Penrith City Library

601 High Street, Penrith
Monday to Friday 9am to 8pm
Saturday 9am to 5pm
Sunday 10am to 5pm

Liverpool Library

170 George Street, Liverpool
Monday to Friday 9.30am to 8pm
Saturday 9.30am to 4pm
Sunday 12pm to 4pm

Camden Council

70 Central Avenue, Oran Park
Monday to Friday 8.30am to 5pm

Narellan Library

Cnr Queen and Elyard St, Narellan
Monday, Wednesday 9:30am - 8:00pm
Tuesday, Thursday, Friday 9:30am - 5:00pm
Saturday 9:00am - 3:00pm

Nature Conservation Council

14/338 Pitt Street, Sydney
Monday to Friday 8.30am to 5pm

Roads and Maritime will also be hosting community information sessions. A project information line will be available throughout the exhibition period to answer questions from the community relating to the project 1800 703 457 (toll free). Staffed displays and stakeholder/community meetings are being held during the exhibition of the EIS to enable community representatives to ask questions and to provide further information for consideration in the assessment process. Staffed displays will be at the following locations:

Holy Family Primary School

Willowdene Avenue, Luddenham

Saturday 1 July 2017, 10am to 1pm

Wednesday 19 July 2017, 3pm to 7pm

Orchard Hills Masonic Centre

290 Homestead Road, Orchard Hills

Saturday 22 July 2017, 10am to 1pm

During the EIS exhibition, the community, government agencies and other interested parties are invited to make written submissions on the project to the NSW Department of Planning and Environment and to the Federal Minister for the Environment and Energy.

In terms of the NSW approvals process, following the exhibition of the EIS, the Secretary of the Department of Planning and Environment will provide copies of submissions to Roads and Maritime or a report containing a summary of the issues raised. The Secretary may then require Roads and Maritime to prepare a submissions report to respond to the issues raised in the submissions, and may require a preferred infrastructure report to outline any proposed changes to the project. If significant changes to the project are proposed, the Secretary may make the preferred infrastructure report publicly available.

The Secretary will prepare a Secretary's environmental assessment report and provide it to the Minister for Planning. The Minister for Planning will then decide whether or not to approve the project and the conditions to be attached. In terms of the Commonwealth approvals process, Roads and Maritime will be required to finalise the EIS based on the submissions received. A copy of all submissions is to be included in the final EIS and be submitted to the Federal Minister for the Environment and Energy for consideration and published for information. The Department of Environment and Energy will prepare a Recommendations Report and provide it to the Minister for the Environment and Energy. The Minister will then decide whether or not to approve the action and the conditions to be attached.

6.4.2 Consultation during construction

Should the project proceed to construction, the project team would continue to work with the community to ensure they are informed about the project and have opportunities to provide feedback to the project team. Key involvement activities and tools would include:

- Development and implementation of a detailed construction communications plan
- Notification of upcoming construction work (including targeted letterbox drops)
- 24 hour toll-free project information phone line
- Transport Management Centre (TMC) communication channels; radio crosses and interviews, variable message signs throughout the metropolitan network
- Live Traffic and Transport Info websites and TMC 24 hour Traffic Information Line (132 701)
- Public displays
- Complaints management process
- Regular updates to the project website/website

- Newsletters, information brochures and fact sheets
- Clear signage at construction sites
- Media releases and project advertisements in local and metropolitan papers
- Construction updates (including for councils, emergency services and bus operators).

A more detailed description of the consultation activities that would be undertaken during construction can be found in Appendix R – Draft Community Involvement Plan.

7 Assessment of key Issues

This chapter provides an assessment of the key environmental issues for the project as identified in the SEARs and as per the relevant requirements of Schedule 2, Part 3 of the (NSW) Environmental Planning and Assessment Regulation 2000, Section 97 of the EPBC Act and Schedule 4 of the Commonwealth EPBC Act Regulation 2000.

Chapter 11 – Environmental risk analysis, provides an overview of how environmental issues for the project were identified and evaluated through an environmental risk analysis process. This process was followed to assign an environmental risk category to each potential impact, including identification of any additional key issues (in addition to those identified in the SEARs), or other issues to be addressed. It is noted that no additional key issues were identified.

The key environmental issues addressed in this chapter are as follows:

- Traffic and transport (Section 7.1)
- Noise and vibration (Section 7.2)
- Biodiversity (Section 7.3)
- Socio-economic and land use (Section 7.4).

For each key issue the following information is provided:

- A description of the existing environment, which includes (where relevant) all components of the environment as defined in Section 528 of the EPBC Act
- An assessment of the potential direct and indirect impacts of the project during construction and operation, with consideration of the scale, intensity, duration, timing and frequency of the potential impacts. This assessment has been prepared in accordance with:
 - Secretary's Environmental Assessment Requirements (SEARs) issued by the Secretary of the NSW Department of Planning and Environment on 9 March 2016.
 - Commonwealth EIS Assessment Requirements issued by the Commonwealth Department of Environment and Energy on 24 August 2016
 - *Significant impact guidelines 1.1 – Matters of national environmental significance* (Department of Sustainability, Environment, Water, Populations and Communities, 2013)
 - *Significant impact guidelines 1.2 – Actions on, or impacting upon, Commonwealth Land, and actions by Commonwealth agencies* (Department of Sustainability, Environment, Water, Populations and Communities, 2013)
 - All relevant NSW and Commonwealth assessment guidelines, plans and policies.
- Consideration of the influence of relevant planning matters
- A description of proposed measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the potential impacts of the project
- Identification of potential residual impacts remaining after the implementation of mitigation measures. Where potential residual impacts have been identified as being significant, these impacts have been quantified.

A summary of the environmental risk analysis results for these key issues is provided in Table 11-3, including a summary of potential impacts, environmental management measures, and residual impacts.

The proposed environmental management measures in this chapter are collated in Chapter 12.

The assessment of key issues is supported by detailed investigations, which have been documented in the working papers. To the extent of any inconsistency between this main volume of the EIS and the working papers, the former prevails.

SEARs / Commonwealth assessment requirements specific to each key issue are documented in the relevant sections in Chapter 7. General assessment requirements relevant to all key issues – and where these have been addressed – are documented in Table 7-1.

Table 7-1 EIS assessment requirements – Environmental impacts and mitigation

Requirement	Where addressed in EIS
Secretary's Environmental Assessment Requirements (NSW EP&A Act)	
<p>The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 the Environmental Planning and Assessment Regulation 2000.</p> <p>Where relevant, the assessment of the key issues below, and any other significant issues identified in the risk assessment, must include:</p> <ul style="list-style-type: none"> adequate baseline data; consideration of potential cumulative impacts due to other development in the vicinity; and measures to avoid, minimise and if necessary, offset the predicted impacts, including detailed contingency plans for managing any significant risks to the environment. 	Chapter 7, Chapter 8 and Chapter 9
Commonwealth EIS Guidelines (Commonwealth EPBC Act)	
<p>The EIS must include a description of the environment of the proposal site and the surrounding areas that may be affected by the action. It is recommended that this include the following information:</p> <p>A description of the environment in all areas of potential impact, including all components of the environment as defined in Section 528 of the EPBC Act:</p> <ul style="list-style-type: none"> Ecosystems and their constituent parts, including plants and animals, people and communities, landscapes and soils Natural and physical resources, including water resources and air The qualities and characteristics of locations, places and areas Heritage values of places The social, economic and cultural aspects of a thing mentioned in preceding dot-points. 	Chapter 7 and Chapter 8
<p>The EIS must include a description of all of the relevant impacts of the action. Relevant impacts are impacts that the action will have or is likely to have on a matter protected by a controlling provision. Impacts during both the construction, operational and (if relevant) the decommissioning phases of the project should be addressed, and the following information provided:</p> <ul style="list-style-type: none"> A detailed assessment of the nature and extent of the likely short-term and long-term relevant impacts A statement of whether any relevant impacts are likely to be unknown, unpredictable or irreversible 	Chapter 7 and Chapter 8

Requirement	Where addressed in EIS
<ul style="list-style-type: none"> Analysis of the significance of the relevant impacts Any technical data and other information used or needed to make a detailed assessment of the relevant impacts. 	
<p>The EIS should also provide a detailed assessment of any likely impact that this proposed action may facilitate MNES at the local, regional, state, national and international scale.</p>	Chapter 7 and Chapter 8
<p>If the conclusion is made that any relevant controlling provision or element of a relevant controlling provision will not be impacted by the proposed action, then justification must be provided for how this conclusion has been reached. This includes any threatened species or ecological communities that are likely to be present on site, heritage items/places likely to be on site and other relevant elements of the environment that may be impacted by the proposed action.</p>	Chapter 7 and Chapter 8
<p>Quantification and assessment of impacts should:</p> <ul style="list-style-type: none"> Be against appropriate background/baseline levels Be prepared according to best practice guidelines and compared to best practice standards Consider seasonal and temporal variations where appropriate (including temporal changes in the sensitivity of the receptor) Be supported by maps, graphs and diagrams as appropriate to ensure information is readily understandable; and Guidelines and standards used to quantify baselines and impacts should be explained and justified. 	Chapter 7 and Chapter 8
<p>For information given in a draft Environmental Impact Statement, the draft must state:</p> <ul style="list-style-type: none"> The source of the information How recent the information is How the reliability of the information was tested What uncertainties (if any) are in the information What guidelines, plans and/or policies have been considered during preparation of the EIS. 	Chapter 7 and Chapter 8 Guidelines, plans and policies are also discussed in Chapter 3
<p>The EIS must provide information on proposed safeguards and mitigation measures to manage the relevant impacts of the action. Specific and detailed descriptions of proposed measures must be provided and substantiated, based on best available practices and must include the following elements. A consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including:</p> <ul style="list-style-type: none"> A detailed description of the environmental outcomes the measures are expected to achieve including details of any baseline data or proposed 	Chapter 7, Chapter 8 and Chapter 12

Requirement	Where addressed in EIS
<p>monitoring to demonstrate progress towards achieving these outcomes</p> <ul style="list-style-type: none"> • A description of proposed safeguards and mitigation measures to deal with relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the Proponent • Assessment of the expected or predicted effectiveness of the mitigation measures • Any statutory or policy basis for the mitigation measures • The cost of the mitigation measures • The likely cost of the mitigation measures. 	
<p>The EIS must provide details of the likely residual impacts upon a matter protected by a controlling provision after the proposed avoidance and mitigation measures have been taken into account. This includes:</p> <ol style="list-style-type: none"> a) The reasons why avoidance or mitigation of impacts may not be reasonably achieved b) Quantification of the extent and scope of significant residual impacts. 	Chapter 7 and Chapter 8
<p>Offsets should compensate for an impact for the full duration of the impact.</p>	Section 7.3
<p>Offsets must directly contribute to the ongoing viability of the protected matter impacted by the project and deliver an overall conservation outcome that maintains or improves the viability of the protected matter, compared to what is likely to have occurred under the 'status quo' (i.e. if the action and associated offset had not taken place).</p>	Section 7.3
<p>Note: Offsets do not make an unacceptable impact acceptable and do not reduce the likely impacts of a proposed action. Instead, offsets compensate for any residual significant impact.</p>	Section 7.3
<p>The EIS must provide:</p> <ol style="list-style-type: none"> a) Details of the offset package to compensate for significant residual impacts on a protected matter b) An analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy. 	Section 7.3
<p>The EIS must include information on any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action. This must include:</p> <ul style="list-style-type: none"> • A description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action. 	Chapters 7, 8 and 12

7.1 Traffic and transport

This chapter describes the existing traffic conditions influencing The Northern Road, identifies the potential impacts to those conditions as a result of the construction and operation of the project, and assesses those impacts in light of the project. This chapter also recommends environmental management measures to reduce the impacts of the project.

The working paper, Traffic and Transport Assessment (Appendix G) has been used to inform this chapter.

Table 7-2 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to traffic and transport impact and states where in this EIS these have been addressed.

It is noted that there are no specific Commonwealth EIS guidelines in relation to traffic and transport. General Commonwealth EIS guidelines in relation to the assessment are described above including the assessment of residual impacts, which have been addressed in Section 7.1.6.

Table 7-2 EIS Secretary's Environmental Assessment Requirement for traffic and transport

Requirement	Where addressed in EIS
<p>Traffic and Transport — including: details of how:</p> <ul style="list-style-type: none"> the preferred alignment, design and staging, the proposed intersections, interchanges and connections to the surrounding road network, and associated road infrastructure facilities. 	Section 7.1
<p>meet the traffic and transport objectives of the proposal, taking into account the following local and regional issues:</p> <ul style="list-style-type: none"> adjacent sensitive land uses, the Western Sydney Airport, transport connectivity to and from existing communities and centres (such as South West Growth Centre), future growth areas, the Broader Western Sydney Employment Area, approved and proposed infrastructure projects (including other proposed upgrades of The Northern Road, Bringelly Road Upgrade Stages 1 and 2, and the proposed M12 Motorway between M7 and The Northern Road), traffic (vehicular, cyclist and pedestrian) needs; 	Section 7.1.2 Section 7.1.3 and Section 7.1.4
<ul style="list-style-type: none"> an assessment and modelling of operational traffic and transport impacts on the local and regional road network, and M4 Western Motorway, including an assessment of road user safety, and discussion of the currency of baseline traffic and transport data; 	Section 7.1.4
<ul style="list-style-type: none"> a detailed assessment of public transport impacts and opportunities, including a summary of bus routes that would utilise the proposed bus 	Section 7.1.4

Requirement	Where addressed in EIS
lanes;	
<ul style="list-style-type: none"> an assessment of potential impacts the proposal may have on aviation associated with the Western Sydney Airport 	Section 7.1.5
<ul style="list-style-type: none"> an assessment of impacts on cyclist and pedestrian access and safety, and description of proposed cyclist and pedestrian routes, having consideration of opportunities to integrate cycleway and pedestrian elements with surrounding networks and facilitate connectivity between existing communities and with proposed future land uses; and 	Section 7.1.3 and Section 7.1.4
<p>construction traffic and transport impacts of the proposal (including ancillary facilities) and associated management measures, in particular:</p> <ul style="list-style-type: none"> impacts to the road network (including safety and level of service, pedestrian and cyclist access, and disruption to public transport services and access to properties), access and route identification and scheduling of transport movements, the number, frequency and size of construction related vehicles (passenger, commercial, heavy and oversized vehicles), effects on commercial and industrial access, including staff and customer parking, the nature of existing traffic on construction access routes (including consideration of peak traffic times), and the need to close, divert or otherwise reconfigure elements of the road network associated with construction of the proposal, having reference to the cumulative construction impacts of other major projects preparing for or commencing construction. 	Section 7.1.3, Section 7.1.4 and Section 7.1.5

7.1.1 Assessment methodology

The information sources used in carrying out the assessment are identified throughout this chapter. A complete list of information sources used in the assessment is also provided in the working paper. The assessment methodology identifies where those sources of information have been verified through either validation of traffic survey data, traffic signal data and calibration and validation of the traffic model itself. Traffic forecasts have been based on:

- Operation of the Western Sydney Airport by the mid 2020's
- Standard Land Use 2014 assumptions from Bureau of Statistics and Analytics (BSA) including South West Priority Growth Area, Western Sydney Priority Growth Area and Western Sydney Airport
- Completion of The Northern Road upgrade between Glenmore Parkway and Jamison Road by 2021
- Completion of Bringelly Road upgrade between Camden Valley Way and The Northern Road before 2021.

The Northern Road Upgrade traffic model has been developed using the Aimsun modelling platform (version 8.1.0) and has been calibrated and validated according to the principles outlined in the Roads and Maritime Services *Traffic Modelling Guidelines, 2013*.

High-level land use forecasting and mode split has been undertaken using the Transport for NSW Sydney Strategic Transport Model (STM) which has been used to provide initial network structure and to generate future growth scenarios.

Future demand was generated based on forecast traffic volumes from Roads and Maritime Sydney Traffic Assignment Model (STAM).

A detailed description of the traffic and transport assessment methodology is provided in Appendix G - Traffic and Transport and summarised below.

Construction traffic

The assessment of construction traffic and transport impacts involves a review of the types of construction activities proposed, staging of works, working hours and the need for temporary periods of road occupancy to allow for construction. Potential impacts on general traffic, local traffic, access, and bus operations were assessed, and mitigation and management measures to minimise impacts proposed.

Operational traffic

Traffic modelling is a core component of the appraisal of the project and has been used to forecast and evaluate traffic impacts of future land use and planned road network improvements in the vicinity of The Northern Road. The operational traffic assessment was planned and executed to support the design of the proposed upgrade. It was also aimed at achieving the key project objectives of:

- Development and demand – support the Western Sydney Airport, land use change and residential growth; balancing functional, social, environmental and value for money considerations
- Connectivity to airport – provide a resilient connection to the Western Sydney Airport site for freight and people
- Integrated network – provide road improvements to support and integrate with the broader transport network
- Customer focus – provide meaningful engagement with customers and stakeholders throughout the program life
- Improving facilities for public and active transport.

To inform the impact assessment of the project an Aimsun microsimulation traffic model was developed. The microsimulation model allows the simulation of detailed interactions between vehicles. The model is part of a wider model of The Northern Road corridor that is being used for assessing the functional performance of The Northern Road Upgrade between Mersey Road, Bringelly and Jamison Road, Penrith.

The Northern Road base models have been validated against travel times recorded during the same period as the turning movement surveys.

As recommended by the Roads and Maritime *Traffic Modelling Guidelines (2013)*, the target for validation of each route in each hour is for the modelled average travel time for each route to be within 1 minute, or 15 per cent (whichever is higher) of observed travel times.

Analysis of travel time and modelled congestion along The Northern Road indicates that the model generally meets the requirements for travel time comparisons, with modelled peak direction travel times being within the required 15 per cent of observed in all cases except one (northbound between 7.00am to 8.00am). This result is close to the target and is not considered a substantial difference from the observed travel time that would affect the model's suitability for this study.

Based on these calibration and validation results, the models are considered adequately validated for the purposes of assessing the project.

Further detail regarding the development, calibration and validation of this model is detailed in *The Northern Road Upgrade Mersey Road, Bringelly to Jamison Road, Penrith Traffic Model Calibration and Validation Report* (Jacobs, 2015) provided in Appendix G.

Sources of input data for the assessment of operational traffic impacts included 2011 census Journey to Work data, demographic and workforce data, Roads and Maritime crash statistics, and traffic count data comprising:

- Intersection turning movement surveys collected in November 2014 and July 2015
- Automatic traffic counts (ATC) collected in July 2015
- SCATS (traffic signal system) detector counts collected in July 2015
- Floating-car travel time surveys undertaken in October 2015.

Future traffic demand used for the traffic and transport assessment was developed based on data provided by Roads and Maritime from the Strategic Traffic Assignment Model (STAM) for the project.

The traffic and transport assessment considered the following scenarios:

- Existing 2015 base case
- 2021 and 2031 without the project (Do minimum)
- 2021 and 2031 with the project.

The 'without The Northern Road Upgrade (between Mersey Road and Glenmore Parkway)' scenario includes the following road upgrades and land uses:

- Proposed M12 Motorway (by 2031)
- Western Sydney Airport (by 2031)
- Realignment of the existing The Northern Road around the Western Sydney Airport site as a two-lane undivided road.

A summary of the options included in each scenario is presented in Table 7-3.

Table 7-3 Summary of options tested for this assessment

Site Name	2015 base case	2021 without the project	2021 with the project	2031 without the project	2031 with the project
M12 Motorway	X	X	X	✓	✓
Western Sydney Airport	X	X	X	✓	✓
The project	X	X	✓	X	✓

Although 2021 has been adopted as the year of opening, the actual year of opening is more likely to be 2019/20. However, adopting the 2021 forecast year as the year of opening is a conservative assumption and acceptable for the purposes of modelling the project.

An assessment of the traffic and transport impacts of the project assesses the traffic and transport impacts for two design years (2021 and 2031) for the weekday peak periods. The cumulative impacts of the increase in background traffic as well as the impacts of road upgrades and the forecast levels of development within the study area have been included in the assessment.

The assessment also considers the impacts on all road users including public transport, pedestrians and cyclists.

7.1.2 Existing environment

The following sections outline the existing environmental conditions relevant to traffic and transport conditions. This is considered to provide a baseline of existing traffic conditions from which potential impacts from the project have been modelled and assessed.

The Northern Road is a State road within Sydney's road network and is one of the main north–south connections in south-western Sydney. It stretches from Narellan, west of Campbelltown, via Penrith to Bligh Park south-east of Richmond.

For the majority of its length between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park, The Northern Road is a two-lane rural road on a single carriageway. North of Glenmore Parkway, on approach to the M4 Western Motorway, The Northern Road widens to two lanes in each direction. The Northern Road is generally 80 km/h between Mersey Road and Glenmore Parkway, dropping to 60 km/h through Luddenham town centre.

Within the context of the study area, the regional road network comprises The Northern Road and Elizabeth Drive, which are the key north–south and east–west routes for regional trips. All other roads in the study area are considered to be local roads. Other regional routes in western Sydney (e.g. M4 Motorway, M7 Motorway, Mulgoa Road, Mamre Road) have not been included either because of their distance from the study area, or because they are not considered viable alternatives to a fully upgraded The Northern Road.

Existing traffic volumes

The traffic and transport assessment adopted a study area defined by The Northern Road and its connecting roads:

- Mersey Road
- Dwyer Road
- Eaton Road
- Adams Road
- Park Road
- Elizabeth Drive
- Littlefields Road
- Gates Road
- Vineyard Road
- Longview Road
- Kings Hill Road
- Chain-O-Ponds Road
- Defence Establishment Orchard Hills (DEOH) entry road (private road)
- Bradley Street.

Traffic volumes on the road network within the study area were derived from traffic surveys undertaken between November 2014 and July 2015. These volumes are shown in Table 7-4.

Table 7-4 Existing traffic volumes

Road / location	Between	ADT (vehicles per day)	AM peak 1hr (8.00- 9.00am)	PM peak 1 hr (4.30:5.30pm)
The Northern Road	Glenmore Parkway and Bradley Street	21,982	1,601	1,878
	Chain-O-Ponds Rd and Kings Hill Road	17,499	1,285	1,563
	Littlefields Rd and Elizabeth Drive	15,206	1,097	1,371
	Elizabeth Drive and Park Road	15,737	1,096	1,397
Bradley Street	West of The Northern Road	6,832	534	541
DEOH Access	East of The Northern Road	1,513	168	66
Chain-O-Ponds Road	West of The Northern Road	290	27	16
Kings Hill road	West of The Northern Road	2,532	219	186
Longview Road	East of The Northern Road	Not available	13	15
Gates Road	East of The Northern Road	Not available	19	25
Littlefields Road	West of The Northern Road	1,752	131	144
Elizabeth Drive	East of The Northern Road	11,534	849	919
Park Road	West of The Northern Road	6,342	470	501
Adams Road	East of The Northern Road	Not available	134	161
Dwyer Road	South of The Northern Road	Not available	50	74

Existing travel characteristics – mode of travel

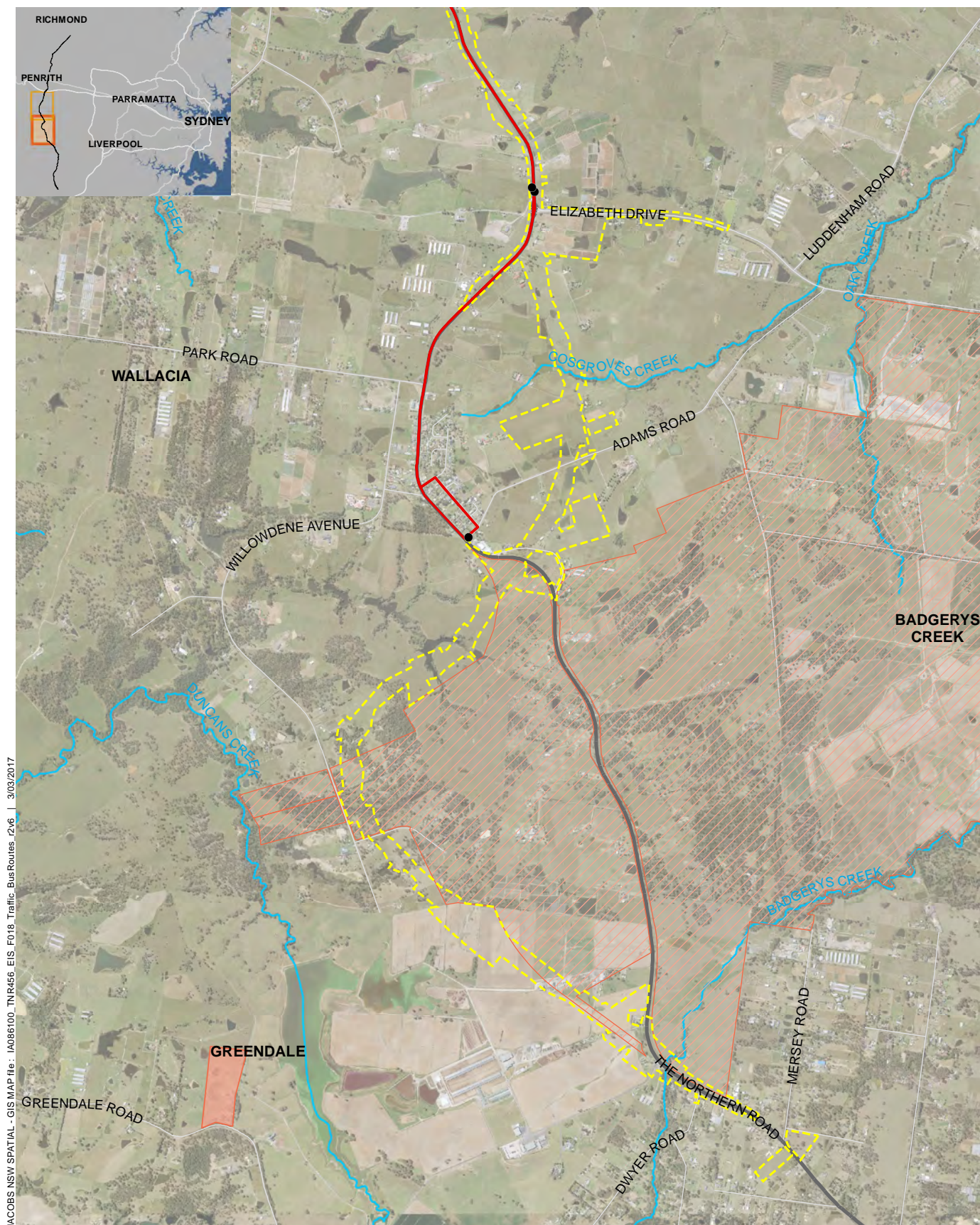
An analysis of the Journey to Work data based on the 2011 census data shows that the car driver and car passenger are the predominant mode of travel for people living and working within the study area. Employment trips provide a good indication of the total mode share of the area and are particularly relevant given the major developments would be employment related.

The Journey to Work data presented in Table 3-3 (Section 3.3.2) indicate that car journeys to work, whether as passenger or driver make up some 90 per cent of the total trips into or out of the study

area. Only two per cent of trips to work in the area are made by public transport. Public transport mode share is higher for residents in the study area who work outside of the study area. Eight per cent of these trips use public transport. Car usage however remains dominant with 88 per cent of trips from the study area involving a car.

Public transport

Public transport in the study area is provided exclusively by bus services. Route 789 operates between Penrith and Luddenham, predominantly along The Northern Road. This is a peak hour only service and only operates twice a day on weekdays. No services are provided on weekends. There are currently fourteen bus stops associated with this bus route within the study area. Route 789 and associated stops within the study area are shown in Figure 7-1.



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F018_Traffic_BusRoutes_r2v6 | 3/03/2017

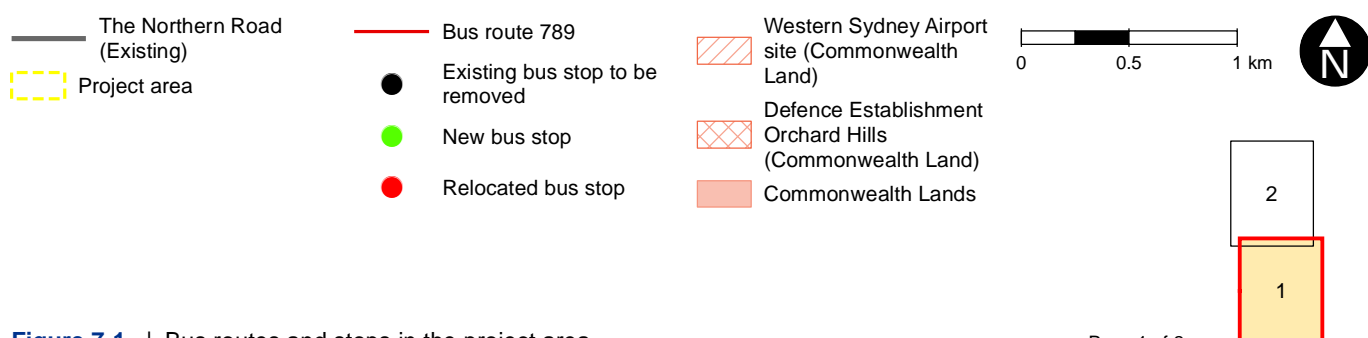
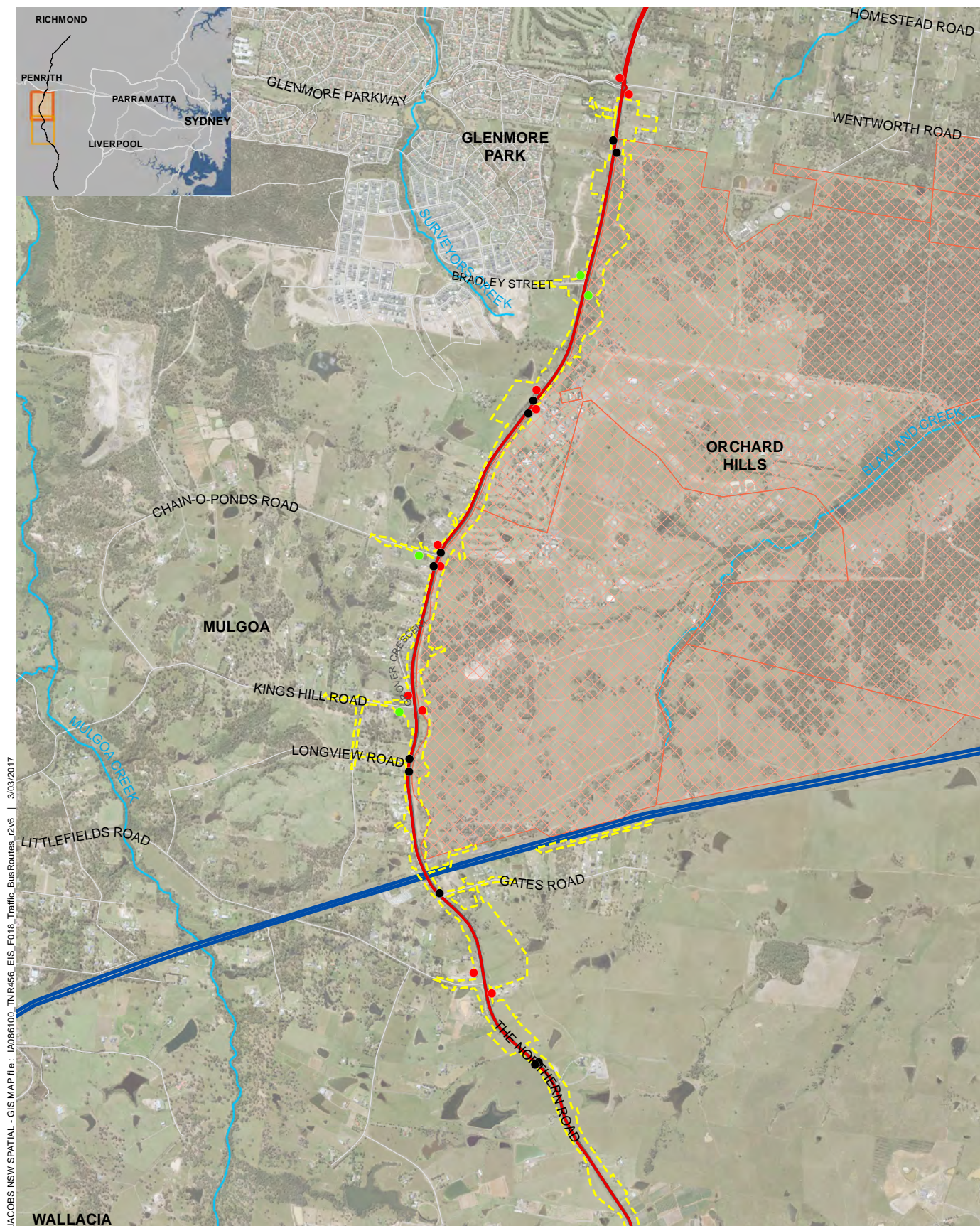


Figure 7-1 | Bus routes and stops in the project area



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456 EIS_F018_Traffic BusRoutes_r2v6 | 3/03/2017

- The Northern Road (Existing)
- WaterNSW supply pipelines
- - - Project area

- Bus route 789
- Existing bus stop to be removed
- New bus stop
- Relocated bus stop

- ▨ Western Sydney Airport site (Commonwealth Land)
- ▨ Defence Establishment Orchard Hills (Commonwealth Land)
- ▨ Commonwealth Lands

0 0.5 1 km

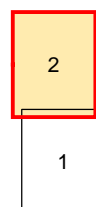


Figure 7-1 | Bus routes and stops in the project area

Pedestrian and cycling network

There is currently limited pedestrian infrastructure provided along The Northern Road. There are no formal continuous footpaths provided along The Northern Road in the majority of the study area. However, a short section of footpath is provided on the western side of the road between Roots Avenue and the service station near Park Road at Luddenham.

There are no formal cycle facilities provided in the study area. The study area is covered by the *Penrith Accessible Trails Hierarchy Strategy (2012)* and the *Liverpool City Council Bike Plan (2009)*; neither of these documents identifies any plans for future cycle facilities in the study area.

The Roads and Maritime Cycleway Finder classifies The Northern Road as a high difficulty on-road environment for cyclists.

Freight routes

The Northern Road forms a significant north–south freight function in the region. The Northern Road is currently approved for 26 metre B-doubles and 4.6 metre high vehicles between Mersey Road and Glenmore Parkway. Elizabeth Drive to the east of The Northern Road and Park Road to the west are also approved routes for 26 metre B-doubles. Analysis of existing heavy vehicle flows shows that heavy vehicles comprise between 11 and 19 per cent of daily traffic along The Northern Road between Mersey Road and Glenmore Parkway. Heavy vehicle volumes are generally higher to the north of Elizabeth Drive and comprise a higher proportion of daily traffic.

Existing road network performance

The performance of the existing road network is largely dependent on the operating performance of intersections that are the critical capacity control points. The 'Level of Service' (LoS) is the standard measure used to assess the operational performance of intersections. Level of Services is ranked from LoS A to LoS F, with LoS A representing the best performance and LoS F the worst.

The criteria used to determine intersection Level of Service on the basis of average delay is outlined in Table 7-5 as defined by Roads and Maritime in the *Guide to Traffic Generating Developments* (2002).

Table 7-5 Level of Service criteria for intersections

Level of Service	Average Delay per Vehicle (sec)	Traffic Lights, Roundabouts	Give Way and Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; incidents would cause excessive delays at signals Roundabouts require other control modes	At capacity, requires other control mode
F	>70	Over capacity; unstable operation	Over capacity; unstable operation

Existing (base case) intersection LoS for key intersections along The Northern Road, derived from the microsimulation traffic model is shown in Table 7-6. The microsimulation model shows that currently all intersections operate satisfactorily during the peak periods.

Table 7-6 Existing intersection performance

Intersection	2015 AM peak		2015 PM peak	
	Average delay (sec)	Level of Service	Average delay (sec)	Level of Service
The Northern Road/Bradley St	27	B	34	C
The Northern Road/DEOH Access	10	A	16	B
The Northern Road/Chain-O-Ponds Rd	8	A	10	A
The Northern Road/Kings Hill Rd	11	A	10	A
The Northern Road/Littlefields Rd	13	A	13	A
The Northern Road/Elizabeth Rd	24	B	19	B
The Northern Road/Park Road	26	B	19	B

Queuing at the intersection of The Northern Road and Bradley Street has been observed increasing as the development of the Glenmore Park residential subdivision has proceeded. Completion of this subdivision is likely to increase traffic flows out of Bradley Street in the morning peak and into Bradley Street in the evening peak and consequently increase delays at this intersection. To address this issue in the short-term, the installation of temporary traffic signals and minor intersection works have been committed to as part of the Glenmore Park Stage 2 development. These traffic signals are in place and would remain until the intersection is reconfigured as part of the project, at which time this would be replaced with a new upgraded signalised intersection.

Existing travel times and travel speeds

Travel times and travel speeds provide an additional means of assessing the functional performance of a road. These have been assessed for the project, the results of which are outlined in Table 7-7. In summary, analysis of observed average speeds (based on floating car travel time surveys) along The Northern Road shows that traffic travels generally slower than the sign posted speed limits. This is due primarily to delays at roundabouts, traffic turning right at priority intersections and delays caused by cars being unable to overtake heavy vehicles. Despite these delays, current observed travel times and average travel speeds correspond to a Level of Service C or better.

Table 7-7 Existing travel speeds along The Northern Road

Segment	Direction	Travel Time (mm:ss)	Average Travel Speed (km/hr)	LoS
Morning Peak				
Between Mersey Road and	NB	06:47	65	B

Segment	Direction	Travel Time (mm:ss)	Average Travel Speed (km/hr)	LoS
Elizabeth Drive	SB	07:27	60	B
Between Elizabeth Drive and Glenmore Parkway	NB	07:22	60	B
	SB	07:03	63	B
Evening Peak				
Between Mersey Road and Elizabeth Drive	NB	06:30	68	B
	SB	07:31	59	C
Between Elizabeth Drive and Glenmore Parkway	NB	07:53	56	C
	SB	06:51	65	B

Road safety and crash history

A total of 121 crashes were recorded on The Northern Road between Mersey Road and Glenmore Parkway over a five-year period from 2009-2010 until 2013-2014. Of these crashes, the main types of crashes were:

- Rear end (40 per cent)
- Head on, not overtaking (13 per cent)
- Off to left - curve (seven per cent)
- Off to left – straight (six per cent).

There were five fatal crashes in the reporting period. The remaining crashes resulted in injury and non-injury crashes:

- Fatal crashes – 5
- Injury – 57
- Non-injury – 59.

Midblock traffic count data from surveys in July 2015 have been used to calculate average daily traffic numbers for this section of The Northern Road. This has allowed for calculation of a crash rate per 100 million vehicle kilometres travelled (VKT) as well as a crash rate per km per year. The observed crash rate was 1.5 crashes per kilometre of road per year with a crash rate frequency of 25.9 crashes per 100 million VKT. The observed casualty crash rate per kilometre of road per year is significantly lower than the average performance for similar roads in NSW.

7.1.3 Assessment of potential construction impacts

Construction sequencing along the alignment has not yet been defined. For the purposes of this assessment, construction of the project is assumed to take place over three stages, delivered through three separate construction contracts as outlined in Section 5.5.

Table 7-8 outlines the indicative duration for the various construction activities for the project. The construction workforce is expected to fluctuate, depending on the construction activity and number of activities occurring concurrently. The timing and duration of construction activities would be confirmed once a construction contractor is appointed to the project, however it is expected that the indicative durations of construction activities outlined in Table 7-8 would apply to the project.

Table 7-8 Indicative construction activity timing

Construction activity	Duration of activity	Work outside standard hours Yes/No	Haulage % at night
Early works	6 months	Y	<1%
Earthworks	18 months	N	N/A
Road work (widening and new roads) and intersection work	4 months	Y	~ 5%
Construction of bridge over Adam Road	6 months	Y	~ 5%
Drainage work	15 months	Y	~ 1%
Pavements	18 months	Y	~ 10%
Utility relocation	15 months	Y	<1%
Finishing work	9 months	Y	<1%

Where reasonable and feasible construction works would be carried out during standard working hours as defined by the Interim Construction Noise Guideline (OEH 2009) and presented in Table 7-9. Most of the noisiest activities would be able to be carried out during standard construction hours. However, a number of construction activities would need to be undertaken outside of standard working hours for reasons including public and construction worker safety and to avoid substantial traffic delays on The Northern Road and surrounding road network (for example, delivery of large items of plant or materials requiring oversize vehicles).

Table 7-9 Standard working hours

Day	Start time	Finish time
Monday to Friday	7am	6pm
Saturday	8am	1pm
Sunday and public holidays	No work	

Up to 21 temporary ancillary facilities are proposed during construction. All ancillary facilities are located within or adjacent to the construction site. Access to the construction site would only be possible from The Northern Road or Elizabeth Drive for heavy vehicles as shown in figure 5-10. Light vehicles would be allowed to additionally access the construction site from Willodene Avenue.

Ancillary facilities located between Glenmore Parkway and Elizabeth Drive can be accessed from the existing TNR or from within the construction site. For ancillary sites located between Elizabeth Drive and Mersey Road they can only be accessed by an internal access track located along the mainline construction.

Proposed site access points to each of the construction ancillary facilities and the likely haulage routes to and from each site are shown in Figure 5-12.

Construction traffic generation

The majority of traffic generated during construction would be from plant equipment and material deliveries including:

- Construction material
- Spoil removal
- Construction plant
- Construction personnel.

Light vehicle movements would be associated with staff movements to and from the site. At any one stage of construction, the peak construction workforce is likely to comprise up to 40 construction, site management personnel and sub-contractors at each of the sites representing the three phases of construction. This equates to 120 personnel for the project in total. The time of greatest impact of construction traffic to the surrounding road network would be during the morning and evening peak period.

Based on arrivals to and departures from site at peak periods each working day, traffic generation is likely to be in the order of 230 additional light vehicle movements per day (115 in the morning and 115 in the afternoon). This figure is derived based on the arrival and departure movements of the (estimated maximum) 120-person work force, with consideration for a vehicle occupancy factor of 1.04 persons per (light) vehicle. Assuming that 80 per cent of these light vehicles arrive (and depart) in the same hour, the likely peak hour volume (rounded) on the busiest days would be in the order of 92 vehicle movements per hour with almost all of these vehicles arriving at the worksite in the morning and leaving in the afternoon.

The majority of this traffic would likely travel along The Northern Road from the north, with a small proportion travelling along Elizabeth Drive from the east. This volume of traffic would be well within the capacity that these roads have been designed for and within the daily fluctuation of observed traffic volumes along The Northern Road and Elizabeth Drive. The increase in traffic due to construction would equate to about 2.2 per cent increase on The Northern Road and about 0.3 per cent increase on Elizabeth Drive, which would be negligible impact. Furthermore, the average traffic generation for any one worksite would be around one third of the peak volume at 62 two-way vehicle trips per day.

The number of truck movements to any one work site is likely to be in the order of 100 trucks per day based on assessment of similar projects. This would equate to about 12-13 truck movements per hour in the peak hours. This number of trucks is unlikely to have a significant traffic impact on the road network. Typically the type of trucks that construction would generate would be truck-and-dog vehicles (19 m), heavy rigid vehicles (12.5 m) and concrete trucks (8.8 m).

About 90 per cent of light and heavy vehicle trips associated with construction are expected to travel along The Northern Road, with the remaining 10 per cent expected to travel along Elizabeth Drive. The likely increase in average daily traffic (ADT) volume as a result of construction activities would be less than five per cent, which is likely to have a negligible impact on the LoS along The Northern Road and Elizabeth Drive.

Impacts on road network operation

Construction activity is likely to impact traffic operation in the following instances:

- Reduced speed limits at traffic switches: During construction of the Mersey Road to Eaton Road section, traffic would be diverted from the existing The Northern Road alignment to a single carriageway on the newly construction alignment to allow for the closure of the existing The Northern Road alignment through the Western Sydney Airport site. Traffic would be required to travel at reduced speeds through locations where traffic would be redirected to the opposing carriageway during construction work

- Construction near live traffic: reduced speed limits and active traffic control would be required wherever construction activities would be taking place near live traffic. That is likely to occur at the locations of tie-in and bridge work and also where widening of the existing corridor is planned
- Temporary traffic calming: A temporary roundabout is likely to be in operation during the construction of traffic signals at the intersection of The Northern Road and Luddenham south access. Reduced speed limits would be required in the vicinity of this temporary roundabout.
- Temporary traffic signals may be required where the existing The Northern road intersects with the proposed new alignment near Eaton Road, Luddenham. These temporary signals would be used to allow safe access to and from the main compound site (C8).

In general, as about half of the project is being constructed offline to the existing The Northern Road, and adjacent arterial roads, impacts to traffic operation on the existing road network would be minimised.

Access impacts

Access to some properties may be affected by the construction activities, particularly in areas where construction would be occurring along the existing The Northern Road corridor. This could be either through the loss of existing access arrangements or the alterations of access arrangements.

Where property access is temporarily affected alternative access arrangements would be made in consultation with residents. A construction plan would be prepared to identify and address access issues that are not already covered by the proposed access plan outlined in Section 7.1.4.

Parking

Staff parking is likely to be provided on site at each construction compound. It is not expected that surplus parking demand from construction activities would reduce the availability of surrounding public parking, or parking for customers of commercial premises within the project study area.

Impacts on road safety

Construction activity along The Northern Road is likely to have the following impacts on road safety without effective mitigation:

- Reduced traction or control on temporary pavement surfaces
- Increased likelihood of conflicts between cars, trucks and construction vehicles
- Reduced lane widths and increased proximity to barriers increasing potential of collisions
- Increased potential for driver distraction around construction activities
- Decreased visibility of temporary line marking and other traffic control measures
- Increased potential of collision at construction site egress points.

Road safety impacts from construction are addressed through the development of an effective Construction Traffic Management Plan (CTMP) as detailed in Section 7.1.6

Impacts on other modes of transport

During construction of the project the following impacts to buses and bus passengers are likely:

- Reductions in speed when travelling through construction activity areas including traffic switches and tie in works. When travelling through these zones, bus speeds would be limited to the prevailing construction speed limit (most likely 40 or 60 km/h subject to the specific construction activity being completed and operational and safety requirements)

- Temporary relocation of stops away from construction zones, particularly where works are being undertaken within the existing The Northern Road corridor. Based on the spacing of stops and the staging of construction activities, this is likely to affect up to three pairs of stops at any one time during construction for a period of up to two years. The maximum additional distance passengers would need to travel as a result of relocated bus stops would be for the bus stop located at Gates Road, where passengers would need to travel up to an additional 650 m to reach the relocated bus stop at Littlefields Road
- Alternative access to relocated bus stops may need to be provided depending of where the bus stops are relocated. This may involve the construction of temporary footpaths adjacent to construction zones
- During construction, pedestrian and cyclists may need to use alternative temporary paths where one side of The Northern Road may be inaccessible. This may involve the provision of temporary alternative access routes to properties in the study area to ensure that safe pedestrian and cycling access is maintained during the course of construction. As construction would take place in stages, these temporary arrangements are likely to be in place for up to three years.

Cumulative construction impacts

A detailed assessment of the likely cumulative impact of the project with other projects in the region is provided in Chapter 9 – Cumulative Impacts. Chapter 9 discusses the project's cumulative impacts in respect of all the key disciplines, for construction and operation phases.

7.1.4 Assessment of potential operational impacts

The assessment criteria for road network planning for the project relate to:

- Provision of adequate capacity on the higher order road network to cater for forecast traffic based on a minimum intersection Level of Service D for morning and evening peak period operation
- Minimising queue length and turn bay overflow along The Northern Road
- Minimising travel times along The Northern Road
- Provision of optimum intersection configurations that are sensitive to physical constraints and land ownership
- Minimising impacts on all other road users such as public transport, pedestrians and cyclists.

Intersection performance criteria are outlined in Section 7.1.2. These criteria have been used to assess the performance of intersections along The Northern Road based on outputs from The Northern Road microsimulation traffic model, with average delays for intersections extracted from Aimsun for the morning (07.30 to 08.30) and evening (16.30 to 17.30) peak one-hour periods. As the M4 Motorway is outside of the project study area, the impacts of the project on the M4 Motorway are not considered in this assessment. These impacts are considered in the Review of Environmental Factors for The Northern Road upgrade between Glenmore Parkway and Jamison Road, which includes the project as one of the key assumptions.

Intersection performance without the project

Table 7-10 summarises intersection operation along the existing The Northern Road corridor under the 'without the project' scenario. In general, testing of the forecast traffic flows on The Northern Road under the future year scenarios shows that intersections along The Northern Road would continue to perform acceptably by 2021, with the exception of The Northern Road and Bradley Street. Delays at this intersection have been observed to increase as development in Glenmore Park proceeds, and this growth is likely to increase delays at this intersection to beyond acceptable levels by 2021. However this impact on performance would be offset by the proposed temporary intersection works including the temporary traffic signals.

Analysis of later future scenarios shows there would be insufficient capacity along The Northern Road under the existing arrangement by 2031. This corresponds with increased traffic associated with the proposed M12 Motorway and the Western Sydney Airport site and development of SWPGA and WSPGA.

Table 7-10 Intersection performance summary 'without the project'

Intersection	2015		2021		2031	
	Av. Delay (sec)	LoS	Av. Delay (sec)	LoS	Av. Delay (sec)	LoS
Morning peak 1 hr						
The Northern Road/Bradley Street	27	B	30	C	>100	F
The Northern Road/DEOH Access	10	A	10	A	57	E
The Northern Road/Chain-O-Ponds Road	8	A	10	A	46	D
The Northern Road/Kings Hill Road	11	A	11	A	>100	F
The Northern Road/Littlefields Road	13	A	15	B	>100	F
The Northern Road/M12	-	-	-	-	>100	F
The Northern Road/Elizabeth Dr	24	B	20	B	>100	F
The Northern Road/Park Road	26	B	14	A	>100	F
The Northern Road/Western Sydney Airport Access	-	-	-	-	>100	F
Evening peak 1 hr						
The Northern Road/Bradley Street	34	C	58	E	>100	F
The Northern Road/DEOH Access	16	B	17	B	86	F
The Northern Road/Chain-O-Ponds Road	10	A	12	A	59	E
The Northern Road/Kings Hill Road	10	A	9	A	63	E
The Northern Road/Littlefields Road	13	A	15	A	98	F
The Northern Road/M12	-	-			>100	F
The Northern Road/Elizabeth Dr	19	B	18	B	>100	F
The Northern Road/Park Road	19	B	14	A	>100	F
The Northern Road/Western Sydney Airport Access	-	-	-	-	>100	F

Intersection performance with the project

Table 7-11 summarises the performance of intersections under the 'with project' scenarios (2012 and 2031).

The results for The Northern Road as it existed in 2015 (i.e. the base case) are the same as those presented in Table 7-11. In general, testing of the forecast traffic flows with the project shows that the project would relieve the capacity constraints that currently exist along The Northern Road, particularly at the existing give-way and stop sign controlled intersections where traffic signals would be provided or right turn movements would be removed.

Modelled intersection delays also show that the intersections would generally perform with higher delays in 2031 than 2021. This is consistent with the increase in traffic forecast between these years as a consequence of the higher intensity of land use at the Western Sydney Airport, the construction of the M12 Motorway, and development of SWPGA and WSPGA.

Analysis of the intersection performance along The Northern Road with the project shows that most of the intersections within the study area would operate satisfactorily under the 2021 and 2031 future year scenarios with Level of Service (LoS) C or better. The only exception being the intersection of The Northern Road and Elizabeth Drive which would be operating near capacity in the evening peak hour at LoS D by 2021. This is due to the large volumes of conflicting traffic movements that are forecast to travel through this intersection by 2021.

It would be noted from Table 7-10 that some intersections would perform at a worse LoS in 2021 with the project than without the project. The LoS measurement, for a signalised intersection, is based on the weighted average delay of all the vehicles travelling through it. When a (previously unsignalised) intersection becomes signalised, some movements (such as the entry to / exit from side roads) would be provided a share of priority, while others (such as the mainline straight through movement) would have their priority reduced and be subject to occasional delays when lights are red. Because the majority of traffic on The Northern Road is on the mainline / straight through, the average delay would be weighted more heavily against this higher volume of traffic, which would otherwise not be considered if the intersection remained unsignalised. As a consequence, the average delay for the intersection would increase, resulting in a worse LoS.

Intersections are signalised primarily for safety reasons. Over time and as traffic volumes increase (as predicted on The Northern Road), the LoS benefits would be realised as can be seen in Table 7-11 for 2031.

Table 7-11 Intersection performance summary 'with the project'

Intersection	2015		2021		2031	
	Av. Delay (sec)	LoS	Av. Delay (sec)	LoS	Av. Delay (sec)	LoS
Morning peak						
The Northern Road/Bradley Street	27	B	30	C	36	C
The Northern Road/DEOH Access	10	A	22	B	31	C
The Northern Road/Chain-O-Ponds Road	8	A	11	A	17	B
The Northern Road/Kings Hill Road	11	A	15	B	27	B
The Northern Road/Littlefields Road	13	A	17	B	33	C

Intersection	2015		2021		2031	
The Northern Road/M12	- ¹	- ¹	- ¹	- ¹	27	B
The Northern Road/Elizabeth Drive	24	B	41	C	41	C
The Northern Road/Park Road	26	B	-	-	-	-
The Northern Road Existing/The Northern Realigned (southern Luddenham access)	-	-	21	B	26	B
The Northern Road/Western Sydney Airport Access	- ¹	- ¹	- ¹	- ¹	30	C
Evening peak						
The Northern Road/Bradley Street	34	C	33	C	42	C
The Northern Road/DEOH Access	16	B	20	B	25	B
The Northern Road/Chain-O-Ponds Road	10	A	14	A	22	B
The Northern Road/Kings Hill Road	10	A	26	B	32	C
The Northern Road/Littlefields Road	13	A	15	B	18	B
The Northern Road/M12	- ¹	- ¹	- ¹	- ¹	33	C
The Northern Road/Elizabeth Drive	19	B	44	D	45	D
The Northern Road/Park Road	19-	B-	-	-	-	-
The Northern Road Existing/The Northern Realigned (southern Luddenham access)	-	-	18	B	22	B
The Northern Road/Western Sydney Airport Access	- ¹	- ¹	- ¹	- ¹	40	C

1. M12 Motorway and Western Sydney Airport would be built after 2021

Travel times with and without The Northern Road upgrade

Table 7-12 provides a comparison of modelled travel times along the existing The Northern Road corridor with and without the project, averaged over the morning peak hour (07.30 to 08.30). The modelled travel times indicate that the project would result in reduction of travel times in both directions along The Northern Road when comparing the project scenario with the Do Minimum scenario. In this section, northbound travel times are likely to remain similar to those without the project since the project would introduce delays at five new signalised intersections.

Table 7-12 Comparison of modelled travel times 'without the project' and 'with the project'

Segment	Direction	2021 (mm:ss)	2031 (mm:ss)
Morning Peak			
Between Mersey Road and Elizabeth Drive	NB ⁽¹⁾	07:41	>30:00

Segment	Direction	2021 (mm:ss)	2031 (mm:ss)
	NB ⁽²⁾	06:41	07:11
	SB ⁽¹⁾	07:31	26:55
	SB ⁽²⁾	06:03	06:59
Between Elizabeth Drive and Glenmore Parkway	NB ⁽¹⁾	07:35	08:36
	NB ⁽²⁾	05:36	06:40
	SB ⁽¹⁾	08:11	25:39
	SB ⁽²⁾	06:53	08:24
Evening Peak			
Between Mersey Road and Elizabeth Drive	NB ⁽¹⁾	09:30	>30:00
	NB ⁽²⁾	06:57	07:24
	SB ⁽¹⁾	07:55	>30:00
	SB ⁽²⁾	06:11	06:27
Between Elizabeth Drive and Glenmore Parkway	NB ⁽¹⁾	11:06	11:05
	NB ⁽²⁾	05:44	06:27
	SB ⁽¹⁾	11:58	>30:00
	SB ⁽²⁾	07:08	08:40

(1) Without the project, (2) With the project

Impacts on local roads and access

The project would include the provision of a wide central median that would remove existing right turns at some intersections and property accesses. Table 7-13 summarises the changes to access as a result of the project and also outlines the maximum additional travel distance and time that would result from changes to access.

Table 7-13 Summary of key access changes

Access impact location	Affected movement	Maximum additional travel distance (km)	Maximum additional travel time (min:sec)
Mersey Road to Western Sydney Airport access	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road	1.6	2:32

Access impact location	Affected movement	Maximum additional travel distance (km)	Maximum additional travel time (min:sec)
	Right turn into The Northern Road (to travel south) from properties to the west of The Northern Road	1.6	2:32
	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	1.7	2:37
	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	0.9	2:01
Western Sydney Airport access to Luddenham southern access	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	8.8	9:10
	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	5.8	5:40
Luddenham southern access to Eaton Road	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	4.7	4:52
	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	1.0	2:03
Eaton Road access to Elizabeth Drive	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	4.9	5:02
	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	0.4	0:58
Elizabeth Drive to Littlefields Road	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	4.4	4:39
	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	4.2	4:28
	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road	4.8	4:54

Access impact location	Affected movement	Maximum additional travel distance (km)	Maximum additional travel time (min:sec)
	Right turn into The Northern Road (to travel south) from properties to the west of The Northern Road	4.9	5:02
Existing Elizabeth Drive	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	1.2	2:14
	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	1.5	2:29
Littlefields Road to Longview Road	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road	3.4	3:12
	Right turn into The Northern Road (to travel south) from properties to the west of The Northern Road	4.3	3:54
	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	3.0	2:54
	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	2.3	2:24
	Right turn into Gates Road from The Northern Road (coming from the south)	0.3	0:54
	Right turn out of Gates Road into The Northern Road (to travel north)	1.7	1:54
Longview Road to Kings Hill Road	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road and properties along the existing Vineyard Road	1.2	1:36
	Right turn into The Northern Road (to travel south) from properties to the west of The Northern Road and properties along the existing Vineyard Road	0.9	1:18
Kings Hill Road to Chain-O-Ponds Road	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road	2.5	3:12

Access impact location	Affected movement	Maximum additional travel distance (km)	Maximum additional travel time (min:sec)
	Right turn into The Northern Road (to travel south) from properties to the west of The Northern Road	1.7	2:37
	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	1.0	2:05
	Right turn to The Northern Road (to travel north) from properties to the east of The Northern Road	2.5	3:12
Chain-O-Ponds Road to DEOH	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road	2.1	2:12
	Right turn to The Northern Road (to travel south) from properties to the west of The Northern Road	2.1	2:12
DEOH to Bradley Street	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road	1.1	1:30
	Right turn into The Northern Road (to travel south) from properties to the west of The Northern Road	1.6	1:54
	Right turn into DEOH from the Northern Road (coming from the south)	-	0:42
	Right turn out of DEOH to the Northern Road (to travel north)	-	0:42
Bradley Street to Glenmore Parkway	Right turn from The Northern Road (coming from the north) into properties to the west of The Northern Road	2.4	2:30
	Right turn into The Northern Road (to travel south) from properties to the west of The Northern Road	3.2	3:06
	Right turn from The Northern Road (coming from the south) into properties to the east of The Northern Road	1.3	1:36
	Right turn into The Northern Road (to travel north) from properties to the east of The Northern Road	2.2	2:18

Plots of each of the proposed alternative access outlined in Table 7-13 are provided in Appendix G.

Impacts on public transport and active transport

The project includes the provision of a dedicated kerbside bus lane in each direction between Mersey Road and Glenmore Parkway. This bus lane would allow buses to travel north and south along The Northern Road without being affected by general traffic congestion and delays.

Impacts to the existing 789 bus route through the area would generally be minimal, with benefits being provided through the provision of a dedicated bus lane. The signalisation of intersections on The Northern Road between Elizabeth Drive and Glenmore Parkway may add up to two minutes of delay to this route; however this is well within the variability of long cross-regional bus route.

The majority of existing bus stops would be relocated nearby, for example from the entry side to the exit side of an intersection. However bus stops between Kings Hill Road and Littlefields Road would be relocated a substantial distance from existing bus stops. The maximum additional distance passengers would need to travel as a result of relocated bus stops would be for the bus stop located at Gates Road, where passengers would need to travel up to an additional 650 m to reach the relocated bus stop at Littlefields Road. Some additional bus stops would also be provided. The location of proposed bus stops for the project is shown in Figure 7-1.

As shown in Figure 7-1, the relocated bus stops have been placed at or near intersections of The Northern Road and adjoining side roads, rather than mid-block. Moving the bus stops closer to side roads would make them more accessible to a greater number of the surrounding properties and provides a signalised intersection provides controlled pedestrian crossing point close to the bus stop to enhance passenger safety. While some bus users would be required to travel further to reach the nearest bus stop, others would conversely have a shorter distance to travel.

These bus lanes would support the operation of a high-frequency, 'rapid' tier bus service between Liverpool and Penrith via the Western Sydney Airport, providing the operating conditions required to deliver the travel speed and reliability that customers would expect from a higher-order, centre-to-centre public transport connection.

The project would introduce a number of substantial improvements for pedestrians and cyclists along The Northern Road, which would serve to partially offset the increased distances some residents would be required to travel to reach their nearest bus stop. These improvements include:

- A shared path along the western side of The Northern Road between Mersey Road and Glenmore Parkway
- A five metre wide footway would be provided on the eastern side of The Northern Road between Mersey Road and Glenmore Parkway, with a 1.5 metre wide footpath provided as warranted such as between bus stops and adjacent intersections
- New signalised pedestrian crossings at all upgraded intersections where traffic lights are to be provided.

The project would facilitate the following cyclist and pedestrian routes:

- The Northern Road between Mersey Road and Glenmore Parkway.

The project would facilitate cycle and pedestrian connectivity of the following communities:

- Glenmore Park
- Orchard Hills golf course
- Luddenham town centre including Holy Family Catholic Primary School and Luddenham Public School.

The shared path along the length of the project would connect with similar facilities planned or under construction along The Northern Road north of Glenmore Parkway, Glenmore Park, and south of Mersey Road, Bringelly. The shared path would also provide opportunities for future connection to the following pedestrian and cycle networks:

- Shared path facilities that may be included as part of the M12 Motorway

- Pedestrian and cycle access to the Western Sydney Airport.

Overall, the project would improve the accessibility and safety for pedestrians and cyclists along The Northern Road by providing dedicated space for cyclists and pedestrians that is separated from traffic and reducing the potential of conflicts with cars. Formal pedestrian and cycle crossing facilities would also be provided at all signalised intersections, which would improve safety for pedestrians and cyclist to cross roads that would otherwise be uncontrolled.

Impacts on parking

With the exception of the section of The Northern Road through Luddenham, parking is not currently permitted along the length of The Northern Road between Mersey Road and Glenmore Parkway. The project would not remove parking availability through Luddenham.

Impacts on freight transport and aviation

The project would improve reliability and travel times for freight traffic currently travelling on The Northern Road by providing additional traffic capacity and relieving existing traffic constraints, particularly at existing priority and roundabout intersections along The Northern Road. The project would also reduce travel time and improve reliability for freight travelling to the Sydney Motorway network via the M4 Western Motorway and providing an alternative route for freight traffic travelling to and from the Western Sydney Airport.

In the future, The Northern Road would become a route for construction traffic from the Western Sydney Airport and proposed M12 Motorway and would become the primary route from these construction activities to the Sydney Motorway network. The project would ensure that this construction traffic would have a safe and reliable route to the M4 Western Motorway.

Design of the project has been undertaken based on requirements to conform to restrictions associated with height and visibility when in close proximity to the Western Sydney Airport. Furthermore, the design accounts for an access to the Western Sydney Airport and consequently there is unlikely to be any impact of the project on associated aviation activities.

Impacts on road safety

The project would result in the following improvements to road safety:

- The Northern Road would be upgraded with additional lanes and a divided carriageway, removing the need for opposing-lane overtaking and the associated risk of head-on crashes
- Reduced congestion at intersections, which would reduce the likelihood of vehicle crashes at intersections, especially rear-end type crashes
- The new alignment of The Northern Road would be designed to a higher design speed allowing for safer travel along the corridor with intersection designs accommodating B-double trucks
- Many existing priority-controlled intersections would be upgraded to signal control. This would provide more formal opportunities for making right hand turns onto and off The Northern Road. Other uncontrolled right hand turns would be removed, reducing conflicts along The Northern Road
- Formal pedestrian crossings would be provided at all signalised intersections and a wide off-road shared path would be provided along the length of the project. This would reduce conflicts between pedestrians, cyclists and cars
- Realignment of The Northern Road around Luddenham Town Centre would reduce the volumes of cars and trucks travelling through this area and reduce conflicts with local traffic and pedestrians in this higher pedestrian activity area
- New heavy vehicle inspection areas would be constructed as part of the project at Grover Crescent and south of Longview Road. These stations would increase safety of heavy vehicle operations along The Northern Road and wider Sydney road network by ensuring heavy vehicles are compliant and roadworthy.

Performance against traffic and transport objectives

The upgrade and realignment of The Northern Road has been developed in response to the traffic and transport objectives. Specifically, to provide a road that connects to the Western Sydney Airport at Badgerys Creek, supports major land use changes and urban growth, and integrates with the broader transport network.

The overall traffic and transport assessment for the operational phase of the project has been conducted in parallel with the concept design, as part of an iterative process where the design has been guided by outputs from a number of specialist assessments. The design has aimed to achieve a number of objectives relating to the capacity and connectivity of the road, while the traffic and transport assessment has modelled various operating scenarios so as to provide reliable forecasts on which to base the design of the road and its intersections with other connecting roads.

One of the objectives of the project has been the need to identify a new alignment for that part of The Northern Road directly impacted by the Western Sydney Airport at Badgerys Creek. The section of The Northern Road that is now proposed to be realigned, between Dwyer Road, Bringelly and Elizabeth Drive, Luddenham, accommodates the planned airport site.

The project has been designed to accommodate the future growth that is planned for western Sydney, including the Western Sydney Airport, and the South West and Western Sydney Priority Growth Areas. It would achieve this partly through the alignment and intersections that have been designed, and partly through the connectivity with the existing and planned surrounding road network. The Northern Road main carriageway and intersections are designed to accommodate the forecast growth in traffic to 2041, during which time major changes are planned in land use and intensity of development. The traffic and transport assessment has produced forecasts of traffic demand, based on assumptions about this future growth, to inform and influence key aspects of the design in terms of the number of lanes, location and configuration of intersections, and connections to adjoining local roads and private properties.

The project would provide a resilient, long-term connection to the airport site via the proposed signalised service entry point. The design has taken account of existing land use, through the local access strategy outlined in this section (above), to ensure that access to private property is maintained and made safer. While the project area currently provides no facilities for active transport, and limited public transport facilities, the project design incorporates and integrates active transport infrastructure that would connect to the planned shared path network along The Northern Road to the north of Glenmore Parkway, Glenmore Park, and to the south of Mersey Road, Bringelly. The proposed active transport facilities would play a critical strategic role through the provision of a north–south ‘spine’ to which future active transport connections can be made, for example along the future M12 Motorway corridor, and the Bringelly Road corridor.

Similarly, the project’s design for the upgrade of public transport infrastructure along The Northern Road would provide a strategic north–south connection, as well as critical links to the planned airport, from which future services could expand along other existing and planned east–west routes.

The traffic and transport assessment documented in this section has accounted for all of these key factors and the project’s design, which is described in detail in Chapter 5, incorporates these considerations in response to the findings of the traffic and transport assessment. The project’s likely operational impacts on traffic and transport therefore have been managed through the design, to achieve the overall objectives of the project such that any residual impacts (see Section 7.1.7) are minimal. On balance, when weighed against the project’s overall benefits, the residual impacts discussed in Section 7.1.7 are considered to be justified because of the improvements to safety, connectivity and transport capacity that the project would bring.

7.1.5 Summary of impacts to the environment of Commonwealth land

A summary of potential traffic and transport impacts to the environment of Commonwealth land as a result of construction and operation of the project is provided in this section. Affected Commonwealth land includes the DEOH land, and land that has been acquired by the Commonwealth for the purposes of developing the Western Sydney Airport at Badgerys Creek.

Potential construction impacts

The potential impacts on traffic and transport on Commonwealth land during construction is discussed and assessed in Section 7.1.3. Further to the assessment in Section 7.1.3, construction impacts on Commonwealth land would be limited to temporary changes to access to the DEOH land, with no change to access to land within the site of the Western Sydney Airport.

The temporary access changes to the DEOH site would be necessary to facilitate construction of the widened The Northern Road, which would comprise a new signalised intersection at the main DEOH entrance, and a new u-turn bay on the western side of The Northern Road at the DEOH entrance intersection. During construction, traffic switches and temporary changes to access would be managed in accordance with the overall staging of construction, with DEOH access being maintained continuously through each stage of construction. Overall, the project's construction would have little or no impact on traffic and transport on Commonwealth land, over and above the impacts already described and assessed in Section 7.1.3.

Potential operation impacts

The alignment bypasses the proposed site for the Western Sydney Airport at Badgerys Creek. The proponent for the development and operation of the airport is the Australian Government Department of Infrastructure and Regional Development (DIRD).

The road alignment has been progressively reviewed by DIRD to assess for compliance with the relevant aviation guidelines, including the standards for the International Civil Aviation Organization (ICAO) and Federal Aviation Administration (FAA).

The road design has taken into account the short-term one runway airport layout and the longer term two way airport layout developed by DIRD. The road design has been developed with consideration of the constraints imposed by the Glide Path Building Restriction Area, Obstacle Limitation Surface, Public Safety Zones, High Intensity Approach Lighting (HIAL) Systems, Aircraft Isolation and Compass Calibration Areas.

The project's long-term operational impacts on traffic and transport on Commonwealth land would be positive. Access to the DEOH site would be improved through the upgrading and signalling of the intersection at the site's main entrance. Further, the project's design includes formalising access to the site of the Western Sydney Airport, which would facilitate access for service vehicles and deliveries.

7.1.6 Environmental management measures

Expected environmental outcomes

Options development and concept design investigations described in Chapter 4 have sought to minimise traffic and transport impacts as far as possible. Additionally, the majority of long-term impacts of the project have been addressed through design and subsequent design stages.

Project-specific management measures identified in Table 7-14 have been developed with the aim of effectively minimising or mitigating, as far as practical, traffic and transport impacts described above. Specific outcomes that would be achieved through the implementation of effective environmental management measures include:

- Undertake works in accordance with the relevant Traffic Management Plans and associated traffic control plans
- Ensure safe and continuous traffic movement for construction workers and the general public
- Maintain the capacity of existing roads where possible during construction in order to minimise road user delays
- Maintain continuity of access to local roads and properties
- Appropriate consultation with impacted residents and businesses and stakeholders
- Compliance with the relevant legislative requirements and project conditions of approval.

Expected effectiveness

Roads and Maritime are experienced in managing all modes of traffic throughout construction of road projects. The measures contained in the CTMP and outlined in Table 7-14 are based on previous road projects and are designed to effectively mitigate construction related impacts.

The CTMP would be prepared in accordance with the requirements in the NSW Centre for Road Safety publication *Guidelines for Road Safety Audit Practices* and AGRS06 *Austrroads Guide to Road Safety Part 6: Road Safety Audit*. The CTMP would form part of the overall Construction Environmental Management Plan.

In addition, prior to opening of any temporary traffic management measure outlined within the CTMP, a person who is qualified in the RMS “Design and Inspect Traffic Control Plans” course would carry out an inspection to verify that any pavement markings, road signs and other traffic control devices have been installed in accordance with the CTMP. The CTMP would be amended as applicable should any measures not be considered effective.

Access would be maintained during the construction period. While access arrangements would be outlined in the CTMP, the effectiveness of those arrangements and the need for any alternative and/or temporary access arrangements would be agreed with affected property managers/owners.

For the operational phase, the road design including intersection layouts has been modelled using the Aimsun microsimulation traffic model. As shown in Section 7.1.4, the project effectively caters for increased traffic demand in 2021 and 2031 from land use changes, as well as providing new and upgraded infrastructure for pedestrians, cyclists and public transport.

Table 7-14 outlines environmental management measures that have been developed to specifically manage potential impacts which have been predicted as a result of the proposed works.

Table 7-14 Traffic and transport environmental management measures

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
Construction impacts	T-1	<p>A Construction Traffic Management Plan (CTMP) would be developed, approved, implemented and monitored as part of the project. The TMP would:</p> <ul style="list-style-type: none"> • Outline the general principles and procedures for the development of specific construction traffic control plan (CTP's), taking into consideration where possible other construction works utilising similar haulage and access routes • Ensure safe and continuous traffic movement for construction workers and the general public • Maintain the capacity of existing roads where possible • Identify the requirements for temporary speed restrictions where traffic may pose a safety risk to workers • Maintain continuity of access to local roads and properties, particularly along the existing alignment of The Northern Road (may require temporary u-turn facilities). Where access is affected, RMS would consult with residents for alternative access arrangements • Details of access to construction sites including measures to prevent construction vehicles queuing on public roads 	Construction contractor	Pre-construction	<p>Proven to be effective.</p> <p>Monitoring and reporting requirements of the CTMP to confirm effectiveness of measures.</p>

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
		<ul style="list-style-type: none"> • Provide temporary traffic control where necessary • Provide appropriate warning and signage for traffic in the vicinity of work areas • Include methods to minimise road user delays such as undertaking works around live traffic including tie-in and bridge work outside of peak periods • Undertake construction activities off-line where possible to minimise the requirement to operate temporary traffic control and reduced speed zones • Develop a communication plan to advise local residents and businesses of any changes to traffic conditions during construction • Consult with bus operators regarding temporary bus stop relocations during construction and proposed bus stops during operation. 			
Construction staging	T-2	Staging plans to be prepared in consultation with adjoining contractors and for each stage of the upgrade.	Construction contractor	Construction	<p>Proven to be effective.</p> <p>The requirements for staging plans would be outlined within the TMP. Monitoring and reporting requirements of the TMP to confirm effectiveness of measures.</p>

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
Road damage	T-3	Undertake a pre-construction dilapidation survey of local roads used for construction. Defects caused by construction activities would be rectified prior to completion of construction.	Construction contractor	Construction	Proven to be effective.
Property access	T-4	Access to properties along affected roads would be maintained during construction. The need for any alternative and/or temporary access arrangements would be agreed with affected property managers/owners.	Construction contractor	Construction	<p>Proven to be effective.</p> <p>Access arrangements would be outlined in the TMP, the effectiveness of those arrangements and the need for any alternative and/or temporary access arrangements would be agreed with affected property owners.</p>

7.1.7 Residual impacts

The environmental management measures identified would generally be effective in mitigating the traffic and access impacts of the project both during construction and in operation to an acceptable level. However it is expected that a residual impact would remain following implementation of the environmental management measures. A summary of these residual impacts is presented below, including reasoning as to why avoidance or mitigation of these impacts would not be able to be achieved.

Construction

Potential residual traffic impacts that may occur as a result of construction of the project would include:

- Reduced travel speeds and increased delays through construction areas. This would be necessary to ensure that construction work is carried out safely in and around operational roads. This impact is considered to be minor and not significant.
- Temporary changes to accessibility for pedestrians and cyclists when access to roadside areas may need to be restricted during construction. This would require pedestrians and cyclists to potentially travel further to reach their destination and would be necessary to undertake construction in these locations. This impact is considered to be minor and not significant.
- Temporary changes to the location and accessibility of bus stops during relocation and construction. This would result in passengers not being able to board or alight from buses at the locations they are used to and may require them to travel further to and from temporary or relocated bus stops (conversely, some passengers would benefit through closer proximity to temporary or relocated bus stops). The temporary or relocated bus stops would be necessary to enable construction in these areas. This impact is not considered to be significant.

Operation

Potential residual traffic impacts that may occur following the completion of the project when it is in operation would include:

- Access to and from properties along The Northern Road would generally be restricted to left in and left out access arrangements due to the construction of a median between the carriageways of The Northern Road. This would restrict right turn movements to intersections and u-turn bays, which would require motorists to travel further to access these facilities. Overall, this would result in longer travel distances and times for trips for those affected by this change in access. It would also increase traffic along the local roads that provide these turning facilities. This would be necessary as part of the design which includes a solid median along The Northern Road for the length of the project. The median would assist in improving road safety by removing the need for opposing-lane overtaking and the associated risk of head-on crashes. The additional travel distance is considered to be moderate, for those motorists affected by traffic detours, but is not considered to be significant.
- Bus stops would be relocated along The Northern Road. For some passengers, these stops may be closer to their destination, however for others they could potentially be further increasing the distance and time travelled to reach their bus stop, by as much as 650 m. This is necessary to place bus stops at strategic locations along the corridor, coinciding with major intersections to provide safe crossing points for passengers to get to and from bus stops and areas of primary public transport demand. This impact is not considered to be significant.
- Immediately after construction, it is likely that delays along The Northern Road would increase at existing intersections where traffic signals are proposed. These traffic signals would delay vehicles travelling north or south along The Northern Road; however this is unlikely to be the case for vehicles entering or exiting The Northern Road. Over time, as traffic growth is realised, this residual impact of traffic signal installation would decline. This would be necessary to maintain safe and efficient operation of these intersections under the proposed design speed,

geometry and forecast future traffic volumes. This impact is considered to be minor and not significant.

Traffic volumes along The Northern Road through Luddenham town centre are likely to decrease as a result of the project, as the project would provide a faster alternative for vehicles travelling between Eaton Road and Elizabeth Drive. This is a consequence of providing a high speed and high capacity alternative route past Luddenham town centre. This impact is considered to be positive, but is not considered to be significant.

7.2 Noise and vibration

This chapter identifies the noise and vibration impacts from construction and operation of the project. This chapter also recommends environmental management measures to reduce the impacts of the project.

The working paper summarises the Noise and Vibration Assessment (Appendix H) chapter.

Table 7-15 sets out the Secretary's Environmental Assessment Requirements (SEARs) and requirements of the Commonwealth EIS Guideline as they relate to noise and vibration impacts and states where in this EIS these have been addressed.

Table 7-15 Secretary's Environmental Assessment Requirement for noise and vibration

Requirements	Where addressed in the EIS
Secretary's Environmental Assessment Requirements (NSW EP&A Act)	
Noise and Vibration — including: <ul style="list-style-type: none"> an assessment of the noise impacts of the proposal during operation, consistent with the Road Noise Policy (DECCW 2011), NSW Industrial Noise Policy (EPA 2000) and relevant guidelines. The assessment must include specific consideration of impacts to receivers (such as, but not limited to, dwellings, child and aged care centres, educational establishments, hospitals, motels, nursing homes, places of worship, or recreation), including specific consideration of sleep disturbance and, as relevant, the characteristics of noise (e.g. low frequency noise), and identify reasonable and feasible mitigation measures; 	<p>Section 7.2.6</p> <p>Appendix H – Noise and vibration Assessment</p>
<ul style="list-style-type: none"> an assessment of construction noise and vibration impacts, consistent with the Interim Construction Noise Guideline (DECCW 2009) and Assessing Vibration: a technical guideline (DEC 2006). The assessment must have regard to the nature of construction activities (including transport, tonal or impulsive noise-generating works and the removal of operational noise barriers, as relevant), the intensity and duration of noise and vibration impacts, cumulative effects of construction works undertaken concurrently, the nature, sensitivity and impact to potentially affected receivers, the need to balance timely conclusion of noise and vibration-generating works with periods of receiver respite, and other factors that may influence the timing and duration of construction activities (such as traffic management), and mitigation and management measures; 	<p>Section 7.2.5</p> <p>Appendix H – Noise and vibration Assessment</p> <p>Cumulative noise impacts are addressed Chapter 9</p>

Requirements	Where addressed in the EIS
<ul style="list-style-type: none"> if blasting is required, addressing the relevant requirements of Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZECC, 1990); and 	Blasting would not be required for the project
<ul style="list-style-type: none"> if relevant, an indication of potential for works outside standard working hours, including predicted levels and exceedances, justification for the activity and discussion of available mitigation and management measures. 	Section 7.2.8
Commonwealth EIS Guidelines (Commonwealth EPBC Act) Requirements	
<p>Impacts to the environment (as defined in section 528) should include but not be limited to the following:</p> <ul style="list-style-type: none"> Road noise and vibration impacts on everyday activities and on sensitive environmental receptors (all sensitive receptors within the community and natural environment). Discussion and quantification/modelling of road noise impacts should include the range and frequency of noise, noise contours, cumulative exposure, peak noise and variations in noise patterns due to seasonal and meteorological factors Noise and vibration from construction activities and machinery. 	<ul style="list-style-type: none"> Section 7.2.6 (operational) Section 7.2.5 (construction) <p>Appendix H – Noise and vibration Assessment</p>

7.2.1 Policy framework and relevant guidelines

This assessment of impact has been prepared in accordance with the following regulatory guidelines:

- Road Noise Policy (RNP) (DECCW, 2011)
- Noise Criteria Guideline (Roads and Maritime Services, 2015)
- Noise Mitigation Guideline (Roads and Maritime Services, 2015)
- Model Validation Guideline (Roads and Maritime Services 2016)
- Industrial Noise Policy (NSW EPA, 2000)
- Procedure: Preparing an operational traffic and construction noise and vibration assessment report (RTA, 2011)
- Environmental Noise Management Manual (Roads and Maritime Services, 2001)
- Calculation of Road Traffic Noise (UK Department of Transport, 1988)
- Construction Noise and Vibration Guideline (Roads and Maritime Services, 2016)
- Interim Construction Noise Guideline (ICNG) (Department of Environment and Climate Change NSW, 2009)
- Assessing Vibration: a technical guideline (DEC, 2006)
- AS1055 Acoustics - Description and measurement of environmental noise (Standards Australia, 1997)

- AS IEC 61672.1—2004 - Electroacoustics—Sound level meters, Part 1: Specifications (Standards Australia, 2004)
- BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2 (BSI, 1993)
- DIN 4150:Part 3-1999 Structural vibration - Effects of vibration on structures (Deutsches Institute fur Normung, 1999).

7.2.2 Assessment methodology

The assessment methodology for noise and vibration impacts involved:

- Identifying the study area including:
 - Identification and classification of sensitive receivers. Receivers were classified using a combination of recent aerial and ground photography, web based information sources, cadastral data (government database) and field work
 - Grouping noise receivers into Noise Catchment Areas (NCA). This grouping is directed by procedures in the Interim Construction Noise Guideline (ICNG) and is primarily based on the measured background noise levels, types of receivers in the area and potential noise impacts from localised construction activities.
- Background noise monitoring to identify existing noise levels. Background noise is measured at multiple locations throughout the study area using calibrated, industry standard, type 1 noise loggers. The noise loggers measure for a period of at least one week to obtain an average noise level applicable to the day, evening and night-time periods
- Validation of noise models using data from concurrent background noise and traffic surveys. The noise and traffic data are combined and compared through a detailed 3D noise model. Variations between the model and the measured parameters are compared using the RMS Model Validation Guideline. Using the validated model with project specific traffic data provides operational noise predictions that satisfy the guideline tolerances
- Modelling of operational noise, and construction noise and vibration. Operational noise is modelled and predicted using project specific traffic data verified by the project traffic engineering consultants. Construction noise is modelled and predicted using construction sound power levels as per the RMS Construction Noise and Vibration Guideline and construction scenarios which assume worst-case scenarios for construction activities: sources operating concurrently, minimum offset distances between source and receiver and no mitigation measures
- Assessment of those noise predictions against relevant construction and operational noise criteria. For construction, the guidelines are the EPA Interim Construction Noise Guideline (ICNG) and the RMS Construction Noise and Vibration Guideline (CNVG). For operational noise the applicable guidelines are the EPA Road Noise Policy and the RMS Noise Criteria Guidelines (NCG)
- Identification of mitigation measures for any operational noise impacts identified as per the RMS Noise Mitigation Guideline (NMG)
- Identification of feasible and reasonable environmental management measures. The Interim Construction Noise Guideline (Department of Environment and Climate Change (DECC) 2009) (ICNG) defines 'feasible' and 'reasonable' as:
 - Feasible: A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements
 - Reasonable: Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the cost of applying.

The study area and noise and vibration sensitive receivers

Table 7-16 summarises the number and type of the noise and vibration sensitive receivers within the 600 m study area. These are the habitable buildings and parks that may potentially be impacted by noise or vibration from construction or operation of the project. The counts provided relate to the number of receivers included within the construction noise study area specifically. The operational noise study area is a smaller subset of this wider study area, primarily as it does not extend beyond the northern and southern extents of the road project, and extends only to 600 m from the project (other than where receivers at which the Relative Increase Criterion may be triggered). These receivers have been identified from aerial photography, GIS databases and information gathered from site visits.

Table 7-16 Summary of noise sensitive receivers considered in this assessment

Receiver type	Number of buildings
Residential properties	1306
Commercial properties	23
Educational buildings	10
Places of worship	4
Outdoor recreational areas	4
Industrial buildings	2
TOTAL	1349

Noise Catchment Areas

Receivers are grouped into Noise Catchment Areas (NCAs) to enable a logical grouping of receivers affected by the same works to assist with the assessment, consultation or notification. The NCA's used in this assessment are detailed in Table 7-17 and indicated in Figure 7-2.

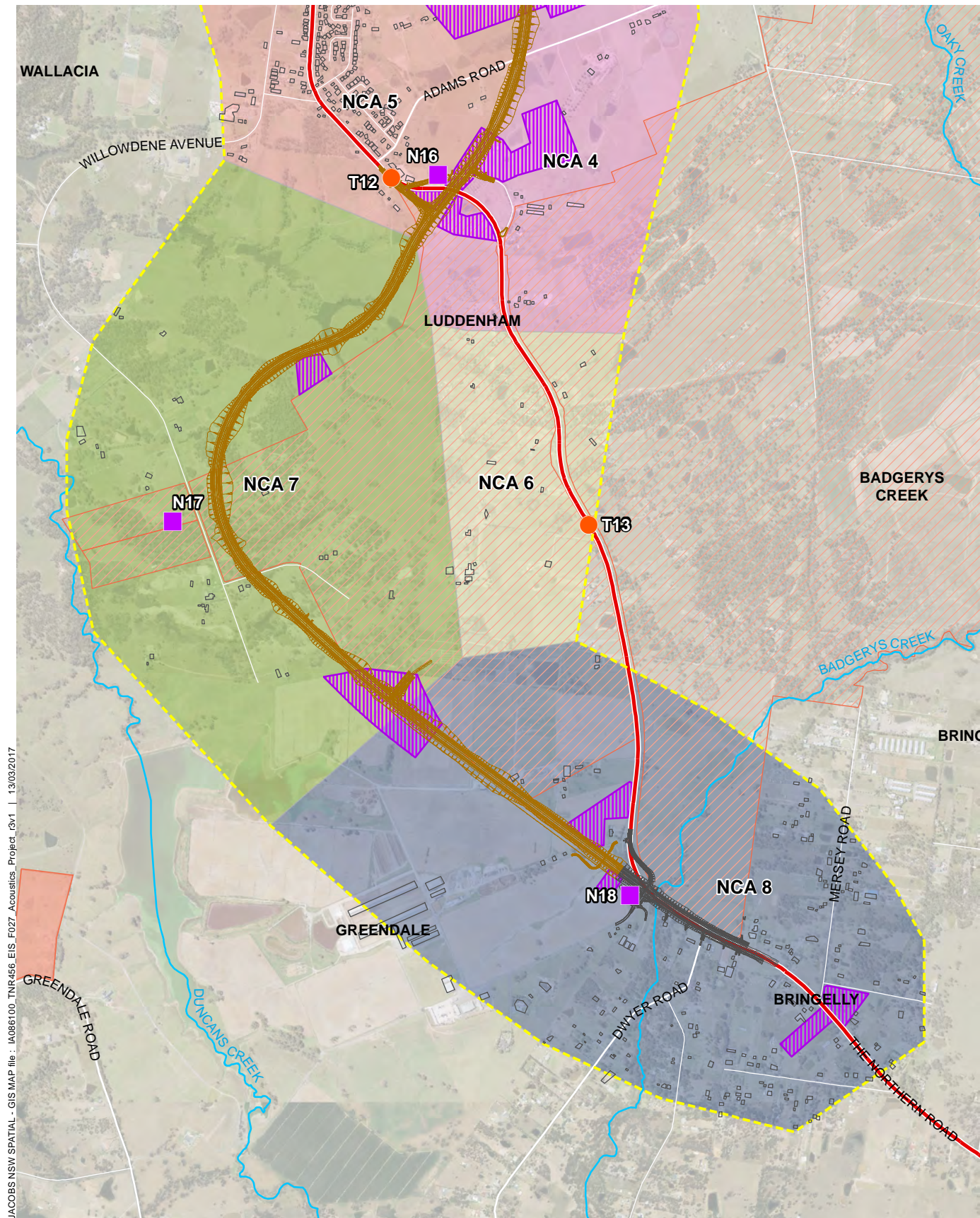
NCA boundaries were determined by considering:

- Factors affecting how construction noise would propagate into a given area (eg topography and screening by buildings)
- The level of background noise in that area
- The type(s) of receivers within that area (eg residences, commercial or industrial premises etc.)
- The grouping of receivers into bands of similar construction noise impact.

Table 7-17 Noise Catchment Areas used in this assessment

NCA	Description
NCA 1	Properties in suburban Glenmore Park and semi-rural Orchard Hills (north) at which background noise is determined by traffic conveyed on The Northern Road, Glenmore Parkway and the M4 Motorway

NCA	Description
NCA 2	Semi-rural properties located between Bradley Street, Glenmore Park and Elizabeth Drive, Luddenham at which background noise is determined by traffic on The Northern Road
NCA 3	Semi-rural properties located near the junction between The Northern Road and Elizabeth Drive in Luddenham, at which background noise is determined by traffic on The Northern Road and Elizabeth Drive
NCA 4	Semi-rural properties east of Luddenham, presently removed from major roads. Background noise is determined by rural noise sources
NCA 5	Properties in suburban Luddenham and its semi-rural surrounds. Existing background noise to these receivers results from traffic on The Northern Road
NCA 6	Semi-rural properties in Badgerys Creek at which background noise is determined by traffic on The Northern Road
NCA 7	Semi-rural properties located adjacent to new section of the project with minimal exposure to traffic noise on The Northern Road
NCA 8	Semi-rural properties in Greendale and Bringelly at which background noise is determined by traffic on The Northern Road



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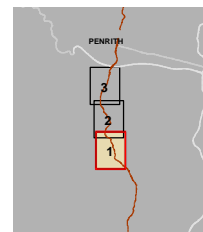
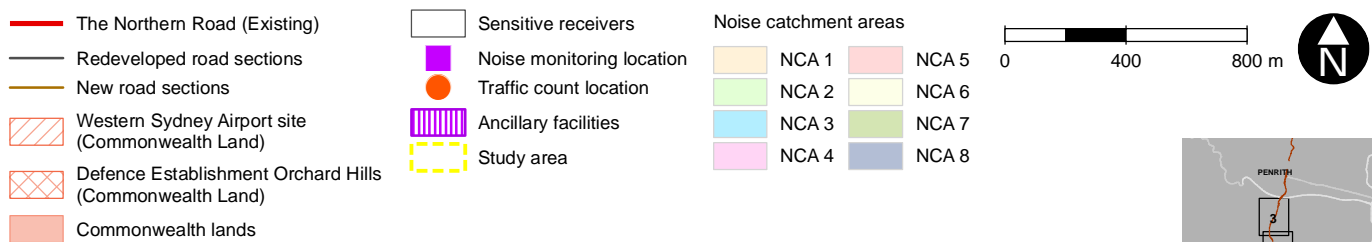


Figure 7-2 | Project context indicating sensitive receivers, noise monitoring and traffic count locations

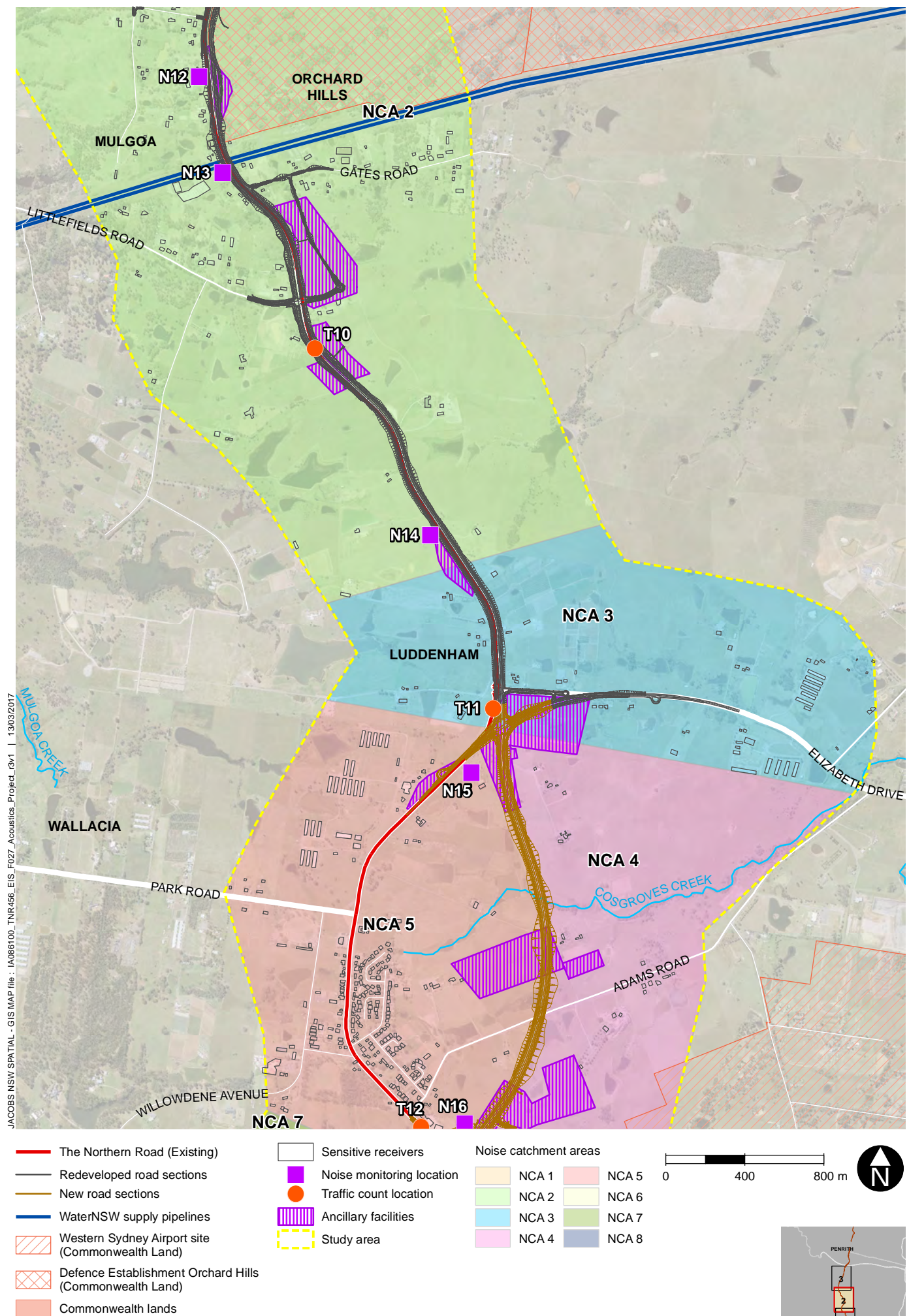


Figure 7-2 | Project context indicating sensitive receivers, noise monitoring and traffic count locations

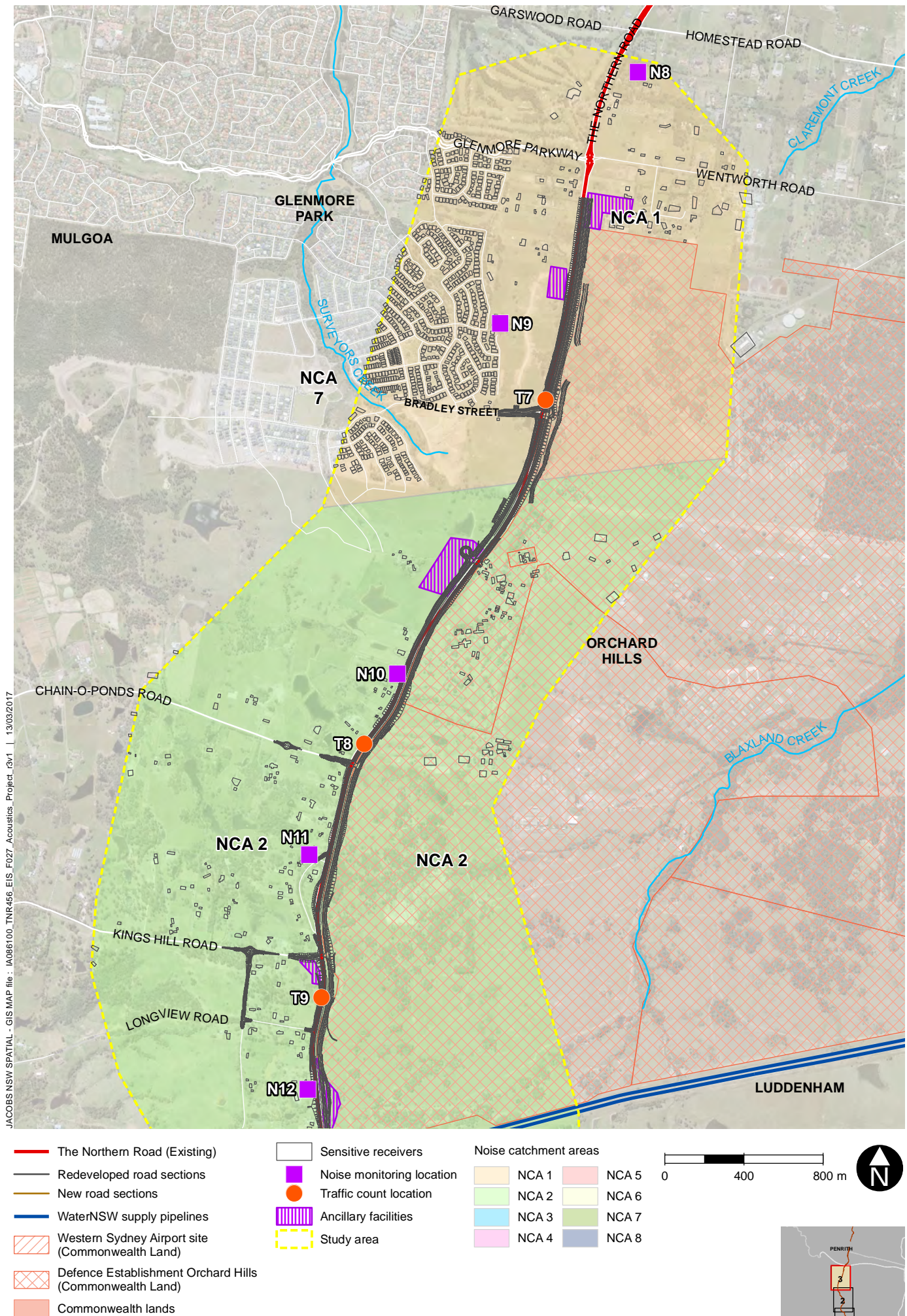


Figure 7-2 | Project context indicating sensitive receivers, noise monitoring and traffic count locations

7.2.3 Criteria

Construction noise and vibration criteria

The effects of construction noise on the community relate to the type, timing and duration of the works, existing background noise level, and the intensity and character (eg, whether a constant or impulsive noise) of the noise from the works. This section outlines the assessment of noise from construction of the project in accordance with the Roads and Maritime Construction Noise and Vibration Guideline (CNVG), the Roads and Maritime application of the Interim Construction Noise Guideline (ICNG). Where impact is predicted, “reasonable and feasible” noise mitigation is outlined in Section 7.2.8.

The following noise and vibration assessment criteria are relevant to the construction of the project:

- Noise Management Levels (NML's) applied to the assessment of surface construction activities and construction sites
- Sleep disturbance criteria applied to the assessment of construction activities that may be carried out during the night-time (10pm to 7am)
- Construction traffic noise criteria
- Construction vibration criteria.

Construction noise management levels

The CNVG specifies that each sensitive receiver potentially impacted by construction of the project be assigned a Noise Management Level (NML) which is defined by the ICNG's noise goals.

For residential receivers, the NMLs are defined as an allowable emergence above the Rating Background Level (RBL). The RBL for each NCA have been conservatively determined from the lowest measured representative background noise data for the area. Where the night-time background monitoring was found to be influenced by extraneous noise sources (eg, noise from insects), RBLs were determined from the monitoring data of nearby and similarly located noise loggers. Non-residential receivers are assigned fixed-value NML's.

The CNVG requires that all feasible and reasonable mitigation measures be applied where construction noise is predicted to exceed the NML.

Table 7-18 outlines how NMLs are determined for residential receivers potentially impacted by noise from construction of the project.

Table 7-18 also outlines how receivers that may be 'highly noise affected' by the project's construction works may be identified. In such instances, restrictions to construction hours may apply to minimise these impacts.

Table 7-18 Construction Noise Management Levels for residential receivers

Time of day	Noise Management Level (NML) $L_{Aeq}(15 \text{ min})^*$	How to apply
Recommended standard hours Monday to Friday 7.00am to 6.00pm Saturday	Noise affected (RBL + 10dB(A))	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq}(15 \text{ min})$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and the duration, as well as contact

Time of day	Noise Management Level (NML) $L_{Aeq(15\ min)}^*$	How to apply
8.00am to 1.00pm		details.
No work on Sundays or public holidays	Highly noise affected (75 dB(A))	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <p>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:</p> <ol style="list-style-type: none"> 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected (RBL + 5dB(A))	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.</p> <p>For guidance on negotiating agreements see Section 7.2.2 of the ICNG (DECC, 2009).</p>

Source: Interim Construction Noise Guideline (DECC 2009)

The following NML's apply for non-residential receivers:

- Industrial premises: external $L_{Aeq}(15min)$ 75 dB(A)
- Offices, retail outlets: external $L_{Aeq}(15min)$ 70 dB(A)
- Classrooms: internal $L_{Aeq}(15min)$ 45 dB(A)
- Places of worship: internal $L_{Aeq}(15min)$ 45 dB(A)
- Active recreational areas; external $L_{Aeq}(15min)$ 65 dB(A)

Sleep disturbance screening criterion

The assessment of the potential for sleep disturbance within residences from night-time construction works is taken from the Interim Construction Noise Guideline (ICNG), which prescribes the following sleep disturbance “screening criterion”:

$$L_{Amax} \leq L_{A90}(15min) + 15dB(A)$$

This screening criterion indicates that sleep disturbance may be possible where the L_{Amax} maximum noise level from construction exceeds the background noise level by more than 15 dB(A). Where this screening criterion is not met, more detailed analysis is required at the detailed design stage.

Project specific construction noise management levels

The construction NMLs and sleep disturbance screening criterion for residential receivers adopted in this assessment are summarised in Table 7-19. As a conservative measure, the lowest of all RBLs within any one NCA has been used to determine the NML.

Table 7-19 Construction Noise Management Levels (NMLs) and sleep disturbance criteria

NCA	Monitored or determined RBL dB(A)				Noise Management Level (NML) L _{Aeq} (15 minute) dB(A)				Sleep disturbance screening criterion L _{Amax} dB(A) (RBL+15dB)
					Standard hours (RBL+10dB)		Out-of-hours (OOH) (RBL+5dB)		
	Standard hours	OOH Day	OOH Evening	OOH Night	Day	Day	Evening	Night	
1	48	51	49	44	58	56	54	49	59
2	47	48	43	36	57	53	48	41	51
3	46	53	46	35	56	58	51	40	50
4	37	38	38	37	47	43	43	42	52
5	42	44	43	34	52	49	48	39	49
6	42	44	43	34	52	49	48	39	49
7	37	38	38	37	47	43	43	42	52
8	48	53	47	42	58	58	52	47	57

* Out-of-hours periods refers to Saturday 1pm-6pm

The NML for each non-residential receiver within the study area is detailed in Table 7-20.

Table 7-20 Non-residential receivers within project area

Non Residential Receiver	No. of buildings	Land Use	NCA	NML* L _{Aeq} (15 minute) dB(A)
Penrith Anglican College	4	Educational	1	45 (Internal)
Luddenham Public School	5	Educational	5	45 (Internal)
Holy Family Catholic Primary School	1	Educational	5	45 (Internal)
St James Anglican Church	1	Place of Worship	5	45 (Internal)
Sacred Heart Parish	1	Place of Worship	5	45 (Internal)
Luddenham Uniting Church	2	Place of Worship	5	45 (Internal)
Glenmore Ridge Dr Park	N/A	Active Recreation	1	65
Sales Park	N/A	Active Recreation	5	65
Willmington Reserve	N/A	Active Recreation	5	65
Luddenham Showground	N/A	Active Recreation	5	65
Penrith Golf and Recreation Club	3	Commercial	1	70
Produce Direct and Pet Care	3	Commercial	1	70
Orchard Hills Veterinary Hospital	1	Commercial	1	70
Horse N Around	3	Commercial	2	70
The Honey Shed	1	Commercial	3	70
Sydney Society of Model Engineers	1	Commercial	3	70
Caltex Service Station	2	Commercial	5	70
Quality Meats Butcher	1	Commercial	5	70
2903 The Northern Road, Luddenham	1	Commercial	5	70
Luddenham Auto Repairs	1	Commercial	5	70

Non Residential Receiver	No. of buildings	Land Use	NCA	NML* L _{Aeq} (15 minute) dB(A)
Ali's Bakery	1	Commercial	5	70
Shell Service Station	1	Commercial	5	70
IGA	3	Commercial	5	70
David's Stall Fruit and Veg	1	Commercial	5	70
Luddenham Progress Hall	1	Commercial	5	70
Board my Paws	1	Commercial	8	70
Water Filtration Plant	1	Industrial	1	75
Power Station 2552 The Northern Road	1	Industrial	2	75
Luddenham Showground	1	Stables	23	N/A
2042-2550 The Northern Road, Orchard Hills	81	Military	2	N/A

* When in use

Construction traffic noise criteria

The assessment of noise impact arising from construction vehicles on public roads (as opposed to when they operate within a construction site) is assessed in accordance with the CNVG, which states that where construction traffic would not increase existing traffic noise levels by more than 2 dB(A), then no further assessment is required. Where the increase in existing traffic noise due to construction traffic is predicted to be greater than 2 dB(A) then further assessment using the NCG is required.

Vibration criteria - preservation of human comfort

Vibration from construction activities should comply with the EPA vibration guideline and AS2670.2 (DEC 2006). The NSW EPA classifies vibration as one of three types:

- Continuous – Where vibration occurs uninterrupted and can include sources such as machinery and constant road traffic;
- Impulsive – Where vibration occurs over a short duration (typically less than 2 seconds) and occurs less than three times during the assessment period, which is not defined. This may include activities such as occasional dropping of heavy equipment or loading / unloading activities;
- Intermittent – Occurs where continuous vibration activities are regularly interrupted, or where impulsive activities recur. This may include activities such as rock hammering, drilling, pile driving and heavy vehicle or train pass-bys.

Maximum and preferred values for continuous and impulsive vibration are defined in Table 7-21. Application of the criteria considers the level as well as the duration of exposure and the time of day, and similar to the noise criteria, also has separate values for residential and non-residential receivers.

Table 7-21 Preferred and maximum weighted Roads and Maritime values for continuous and impulsive vibration acceleration (m/s²) 1-80 Hz

Location	Assessment period	Preferred values		Maximum values	
		z-axis	x and y axis	z-axis	x and y axis
Continuous vibration					
Critical areas ²	Day or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical areas ²	Day or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92
Daytime is 7.00am to 10.00pm and night-time is 10.00pm to 7.00am Such as hospital operating theatres or precision laboratories.					

Intermittent vibration impact may be present when continuous vibration sources operate sporadically throughout the assessment period. This type of impact is assessed using vibration dose values (VDVs). The VDV method is more sensitive to peaks in the acceleration waveform and makes corrections to the criteria based on the duration of the source's operation. The VDV is calculated using the overall weighted Roads and Maritime acceleration of the vibrating source in each orthogonal axis and the duration which the vibration occurs. Preferred and maximum VDVs are defined in Table 7-22.

Table 7-22 Acceptable vibration dose values for intermittent vibration (ms-1.75)

Locations	Daytime (7.00am – 10.00pm)		Night-time (10.00pm – 7.00am)	
	Preferred values	Maximum values	Preferred values	Maximum values
Critical areas ¹	0.10	0.20	0.10	0.02
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60
Includes operating theatres, precision laboratories and other areas where vibration sensitive activities may occur.				

Vibration criteria - structural damage

The OEH vibration guideline does not address the potential for damage to structures. Instead, the Australian Standard AS2187.2-2006 Explosives – Storage, Transport and Use provides guidance for the assessment of structural damage to buildings caused by vibration. This section of the standard is based on the British Standard 7385: Part 2 Evaluation and measurement of vibration in buildings and is used as a guide to assess the likelihood of building damage from ground vibration including piling, compaction, construction equipment and road and rail traffic. The standard recommends levels at which ‘cosmetic’, ‘minor’ and ‘major’ categories of damage might occur based on the type of structure affected.

The standard uses the peak particle velocity (PPV) parameter to quantify vibration and specifies damage criteria for frequencies within the 4 Hz to 250 Hz range for buildings. The criteria levels identified in the standard are outlined in Table 7-23.

Table 7-23 BS 7385 Structural damage criteria

Group	Type of structure	Peak particle velocity (PPV) - mm/s		
		4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 to 20	20 to 50	50

The levels for structural damage outlined in the standard refer to non-continuous vibration sources and are considered ‘safe limits’ up to which no damage due to vibration effects are expected to occur for the various building types. Where vibration is continuous these levels may be reduced by up to 50 per cent and additional assessment against the standard would be necessary.

Where heritage structures are impacted, the German DIN Standard 4150-3 Structural Vibration, Part 3: Effects of Vibration on Structures can be used for guidance. This standard recommends guideline values for short-term vibration impact on heritage structures and have been summarised in 7-24.

Table 7-24 DIN 4150-3 Vibration guidelines for heritage buildings

Type of structure	Guideline values for velocity - mm/s			
	Vibration at the foundation at a frequency of			Vibration at the horizontal plane of the highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	
Heritage buildings	3	3 – 8	8 – 10	8

Operational noise criteria

Operational noise refers to the noise from traffic using the road once it is opened to the public – the ‘operational’ phase of the project. The potential for operational noise impacts is assessed against the RMS Noise Criteria Guideline (NCG) which describes the Roads and Maritime implementation of the Road Noise Policy (RNP).

A residence may be assigned new road, redeveloped road, transition zone or relative increase criteria depending on how the project would influence noise levels.

Under this project a new road is defined as a bypass road where the road extends beyond the existing road corridor. In this project the bypass around Luddenham is assessed as a new road. Receivers adjacent to the new section of road are assigned new road criteria: 55 dB(A) during the daytime and 50 dB(A) during the night-time.

A redeveloped road is when a road is upgraded by widening and or duplication to increase its traffic carrying capacity. Receivers adjacent to the redeveloped sections of road are assigned redeveloped road criteria: 60 dB(A) during the daytime and 55 dB(A) during the night-time.

Where new and redeveloped roads meet a criteria transition zone is required to described the change between the new and redeveloped criteria. The transition zone describes a linear, propagation based change between the two criteria in 1 dB steps. Receivers in the transition zone are assigned the lowest transition criteria affecting the property.

An additional test - known as the relative increase criteria is applied to protect residences within quiet areas from large (more than 12 dB(A)) increases in noise due to the project. For the purposes of assessment against the NCG, the project is a redeveloped road except for the following two new road segments:

- The Luddenham bypass between Dwyer Road in the south and Elizabeth Drive in the north;
- The upgraded Elizabeth Drive approach lanes which “substantially realign” the existing approach lanes.

The project includes transition zones at:

- The junction of the redeveloped road and new bypass road segments 400 m north-west of Dwyer Road, Greendale
- The junction of the redeveloped road and new bypass road segments immediately south of Elizabeth Drive
- The interface of the redeveloped and new segments of the Elizabeth Drive approach to the project.

Further detail on NCG transition zones and NCG controlling criteria type (ie new, redeveloped, transition zone or relative increase criteria) attributed to each residential receiver as part of this assessment are provided Appendix H. This was used to determine the noise assessment criteria for residential receivers as summarised in 7-25.

Table 7-25 NCG noise criteria for residences

Road category	Type of project/land use	Assessment Criteria	
		Daytime (7am-10pm)	Night-time (10pm-7am)
Freeway/arterial/sub-arterial roads	Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	55 dB(A) LAeq (15hour) (external)	50 dB(A) LAeq (9hour) (external)
	Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	60 dB(A) LAeq (15hour) (external)	55 dB(A) LAeq (9hour) (external)
	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
	Existing residences affected by increases in traffic noise of 12 dB(A) or more from new freeway/arterial/sub-arterial roads	Existing LAeq (15hour) (external) + 12 dB(A) [capped at 55 dB(A)]	Existing LAeq (9hour) (external) + 12 dB(A) [capped at 50 dB(A)]
	Existing residences affected by increases in traffic noise of 12 dB(A) or more from redeveloped freeway/arterial/sub-arterial roads	Existing LAeq (15hour) (external) + 12 dB(A) [capped at 60 dB(A)]	Existing LAeq (9hour) (external) + 12 dB(A) [capped at 55 dB(A)]
Local roads	Existing residences affected by noise from new local road corridors	55 dB(A) LAeq (1hour) (external)	50 dB(A) LAeq (1hour) (external)
	Existing residences affected by noise from redevelopment of existing local roads		

Noise criteria for non-residential land uses are presented in Table 7-26 .

These criteria are based on the level of impact, below which, normal operations or use can continue with minimal interruption or disturbance. These criteria are applied in the assessment of eligibility of residences for mitigation where predicted operational noise levels exceed these criteria. This is further discussed in Appendix H, the outcomes of which are summarised in Section 7.2.6.

No motels, aged care facilities or hospital wards were identified within the study area of this assessment.

Table 7-26 NCG noise criteria for non-residential land uses

Existing sensitive land use	Assessment criteria dB(A)		Additional Considerations
	Day (7 a.m.– 10 p.m.)	Night (10 p.m.– 7 a.m.)	
School classrooms	40 $L_{Aeq,1hour}$ (internal) when in use	–	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia 2000).
Places of Worship	40 $L_{Aeq,1hour}$ (internal)	40 $L_{Aeq,1hour}$ (internal)	The criteria are internal, ie the inside of a church. Areas outside the place of worship, such as a churchyard or cemetery, may also be a place of worship. Therefore, in determining appropriate criteria for such external areas, it should be established what is in these areas that may be affected by road traffic noise.
Open space (active use)	60 $L_{Aeq,15hour}$ (external) when in use	–	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion. Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, eg playing chess, reading. For areas where there may be a mix of passive and active recreation, eg school playgrounds, the more stringent criteria apply. Open space may also be used as a buffer zone for more sensitive land uses.

Assessing potential for sleep disturbance

Roads and Maritime's Environmental Noise Management Manual (ENMM) Practice Note iii indicates that:

- Maximum internal noise levels below 50–55 dB(A) are unlikely to cause awakening reactions, and
- One or two noise events per night with maximum internal noise levels of 65–70 dB(A) are not likely to significantly affect health and wellbeing.

Given the that it is generally accepted that the level of traffic noise within a dwelling having its windows open is 10 dB(A) lower than the corresponding noise level immediately outside the facade (refer ICNG), these internal noise goals may be re-expressed as external noise goals as follows:

- Maximum external noise levels below 60–65 dB(A) are unlikely to cause awakening reactions, and
- One or two noise events per night with maximum external noise levels of 75-80 dB(A) are not likely to significantly affect health and wellbeing.

A "maximum noise event" is defined as any vehicle pass-by for which

- $L_{Amax} - L_{Aeq}(1 \text{ hour}) \geq 15 \text{ dB(A)}$

Practice Note iii states that the maximum noise level assessment should be used as a tool to help prioritise and rank mitigation strategies, but should not be applied as a decisive criterion in itself.

7.2.4 Existing environment

Presently, daytime and night-time ambient noise within the study area is determined by traffic conveyed on the existing The Northern Road, and secondarily, on adjoining roads such as the M4 Western Motorway and Elizabeth Drive.

The existing (or baseline) noise environment was established by carrying out long-term, unattended noise surveys along the study corridor to determine the existing level of background noise at all receivers potentially affected by the project. These monitoring results are also used to establish construction noise parameters.

Traffic count surveys were undertaken concurrently with the long term unattended noise monitoring surveys. The traffic data and average traffic speeds collected during the tube counts are detailed in Appendix H. These traffic counts have been used only for the specific purpose of calibrating the noise model and do not form part of the traffic modelling undertaken for the project's traffic and transport assessment as outlined in Section 7.1. The locations in which background noise monitoring surveys and traffic count surveys were carried out are shown on Figure 7-2.

Background noise level data have been used to determine the RBL, which are used to define the NML's) in accordance with the Interim Construction Noise Guideline. The noise surveys were also used to determine the existing daytime (15 hour) and night-time (9 hour) traffic noise levels, which were also used to validate the noise model.

The results of unattended noise monitoring are presented in Table 7-27 and Table 7-28.

Analysis of audio recordings of the ambient noise sources present during the background noise monitoring indicated the presence of insect noise during night periods at some monitoring locations. Given that insects may not be present during winter months, further analysis was undertaken to ensure noise contributed by insects was excluded when determining the true background noise level. Where this was not possible, background noise levels were conservatively estimated from comparable logger locations.

Table 7-27 Unattended monitoring results (Construction noise parameters)

Traffic count location	Location	Monitored noise level dB(A)			Typical LAmax noise levels from environmental noise sources dB(A) ¹
		RBL	L _{Aeq}	L _{Amax}	
Daytime					
N9	2095/2113 The Northern Road, Glenmore Park	48	55	64	HV intermittent (60), LV constant (55),
N10	2289 / 2293 The Northern Road, Mulgoa	46	61	75	HV frequent (70-75) LV constant (60-65)
N11	1 Grover Crescent, Mulgoa	47	55	69	HV frequent (55-60), LV common (50)
N12	2519 / 2527 The Northern Road, Mulgoa	48	62	74	HV including idling (65-75), LV constant (50-55)
N13	2567 The Northern Road, Mulgoa	48	61	76	HV common (65-80) LV constant (55-60),

Traffic count location	Location	Monitored noise level dB(A)			Typical L _{Amax} noise levels from environmental noise sources dB(A) ¹
		RBL	L _{Aeq}	L _{Amax}	
N14	2785 The Northern Road, Luddenham	46	61	72	HV frequent (70-80), LV frequent (55-60)
N15	2426 The Northern Road, Luddenham	37	54	67	Distant traffic constant (40), HV occasional (50-55)
N16	18 Eaton Road, Luddenham	42	56	70	LV occasional (40-45), Trucks occasional (<75)
N17	295 Willowdene Avenue, Luddenham	37	47	65	Distant traffic
N18	1675 The Northern Road, Greendale	48	59	72	HV occasional (<75) LV common (50)
Evening					
N9	2095/2113 The Northern Road, Glenmore Park	49	55	62	Motorbikes (70-75) HV infrequent (55-65), LV (55)
N10	2289 / 2293 The Northern Road, Mulgoa	44	58	72	HV frequent (65-75) LV frequent (60)
N11	1 Grover Crescent, Mulgoa	43	55	65	HV frequent (60-70), LV frequent (50-55), residential noise infrequent (70)
N12	2519 / 2527 The Northern Road, Mulgoa	43	58	72	LV frequent (50-55), HV frequent (65-70), Motorbike occasional (70-75), residential noise (55-60)
N13	2567 The Northern Road, Mulgoa	44	58	73	HV frequent (70-80) LV occasional (55-60)
N14	2785 The Northern Road, Luddenham	46	56	68	HV occasional (<90), residential noise (50), LV infrequent
TN15	2426 The Northern Road, Luddenham	35	43	56	HV (55), LV constant (35-40)
N16	18 Eaton Road, Luddenham	43	57	68	Infrequent LV (55), HV (<75)
N17	295 Willowdene Avenue, Luddenham	38	45	59	

Traffic count location	Location	Monitored noise level dB(A)			Typical LAmax noise levels from environmental noise sources dB(A) ¹
		RBL	L _{Aeq}	L _{Amax}	
N18	1675 The Northern Road, Greendale	47	58	68	HV (<75), LV (55-50)
Night-time					
N9	2095/2113 The Northern Road, Glenmore Park	44	54	60	HV occasional (50-60) LV intermittent (50-55),
N10	2289 / 2293 The Northern Road, Mulgoa	33	58	71	HV (65-75), LV common (55-60)
N11	1 Grover Crescent, Mulgoa	36	50	61	HV infrequent (55-60)
N12	2519 / 2527 The Northern Road, Mulgoa	38	56	68	HV occasional (65-70) LV infrequent (60)
N13	2567 The Northern Road, Mulgoa	36	56	71	HV occasional (75), LV infrequent (55)
N14	2785 The Northern Road, Luddenham	35	54	67	HV frequent (<75) LV infrequent (55)
N15	2426 The Northern Road, Luddenham	36	45	53	LV infrequent (35-40), infrequent HV (50-55)
N16	18 Eaton Road, Luddenham	34	55	66	Occasional HV idling (65-70)
N17	295 Willowdene Avenue, Luddenham	37 **	46	54	Local traffic (65)
N18	1675 The Northern Road, Greendale	42	54	67	HV (<75), LV (55-60)

1. HV Heavy Vehicles, LV Light Vehicles

Table 7-28 Unattended noise monitoring results (Traffic noise parameters)

Traffic count location	Site	LAeq (15hour)	LAeq (9hour)	LAmax (15hour)	LAmax (9hour)
N9	2095/2113 The Northern Road, Glenmore Park	55	54	64	61
N10	2289 / 2293 The Northern Road, Mulgoa	61	58	74	72
N11	1 Grover Crescent, Mulgoa	55	50	67	63
N12	2519 / 2527 The Northern Road, Mulgoa	60	56	74	69

Traffic count location	Site	LAeq (15hour)	LAeq (9hour)	LAmix (15hour)	LAmix (9hour)
N13	2567 The Northern Road, Mulgoa	61	56	75	72
N14	2785 The Northern Road, Luddenham	61	54	71	67
N15	2426 The Northern Road, Luddenham	53	45	65	56
N16	18 Eaton Road, Luddenham	56	55	69	67
N18	1675 The Northern Road, Greendale	59	54	70	68

7.2.5 Assessment of potential construction impacts

Construction noise modelling

Prediction of construction noise levels at sensitive receivers was modelled using the Soundplan (Version 7.3) noise modelling software based on the ISO9613 prediction algorithm. This three-dimensional model accounts for noise source and receiver locations, ground and air absorption as well as any acoustic shielding provided by intervening topography and structures.

The sound power level adopted for each item of plant and equipment in the modelling of construction noise is indicated in Table 7-29. The schedule of plant and equipment to be used would be confirmed with the final construction program. Predictions of construction noise impact consider, variously, each works stage running concurrent with all 21 ancillary facilities operating simultaneously.

Table 7-29 also indicates the periods of exposure to any particular activity any one receiver may expect. These periods would vary according to a receiver's set back and line of view to the works between buildings.

Table 7-29 Plant sound power levels used in the modelling of construction noise

Construction phase	Typical plant and equipment	Sound Power Level dB(A) L _{Aeq} (15min)
Early Works (indicative time of exposure to any one receiver: 2-6 weeks)	Truck mounted crane Light vehicles Excavator Generator Bobcat Dump trucks	104 88 109 101 104 111
Earthworks (indicative time of exposure to any one receiver: 4-12 weeks)	Excavator Dump trucks Vibratory roller (20-30T) Light vehicles Bulldozer Grader Water cart Bobcat	109 114 110 * 88 112 112 107 104

Construction phase	Typical plant and equipment	Sound Power Level dB(A) $L_{Aeq(15min)}$
Road work (indicative time of exposure to any one receiver: 2-12 weeks)	Excavator Bulldozer Water cart Grader Dump truck Spray sealing equipment Concrete truck and pump Asphalt paver (plus truck) Concrete saw Vibratory roller (20-30T) Franna crane Slip-forming machine	109 112 107 112 111 103 108 108 114 110 * 99 102
Bridge construction (indicative time of exposure to any one receiver: 12-26 weeks)	Excavators Light vehicles Generator Rock breaker Concrete trucks and pump Welding equipment Mobile crane Impact piling Oxy-cutting equipment	109 88 101 126 * 108 105 104 121 * 98
Drainage work (indicative time of exposure to any one receiver: 2-12 weeks)	Excavator Light vehicles Generator Jackhammer Concrete truck and pump Truck mounted crane Vibratory roller (20-30T)* Bored piling Bobcat	109 88 101 118 * 108 104 110 112 104
Paving (indicative time of exposure to any one receiver: 2-8 weeks)	Excavator Light vehicles Generator Asphalt paver (plus truck) Concrete trucks and pump Concrete saw Vibratory roller (20-30T) Slip-forming machine Truck mounted crane	109 88 101 108 108 119 * 110 * 102 104
Utility Relocation (indicative time of exposure to any one receiver: 2-8 weeks)	Excavator Bored piling Light vehicles Truck mounted crane Generators Dump trucks Plate compactor Concrete trucks and pump	109 112 88 104 101 111 106 108

Construction phase	Typical plant and equipment	Sound Power Level dB(A) $L_{Aeq(15min)}$
Finishing work (indicative time of exposure to any one receiver: 2-8 weeks)	Excavator	109
	Generator	101
	Light vehicles	88
	Dump trucks	111
	Concrete trucks and pump	108
	Hydromulching equipment	116
	Truck mounted crane	104
	Water cart	107
	Vibratory roller(20-30T)	110 *
	Bobcat	104
	Road marking machine	108
	Welding equipment	105
Concurrently operating Ancillary Facilities		
Ancillary Facilities	Front end loader	112
	Excavator	109
	Road truck	108
	Compressor	109
	Welding equipment	105
	Light vehicles	88
	Generator	101
Ancillary Facilities C5 and C8 (each incorporating a pugmill)	Front end loader	112
	Excavator	109
	Road truck	108
	Compressor	109
	Welding equipment	105
	Light vehicles	88
	Generator	101
	Pugmill*	110

* Note: these levels include a 5dB(A) penalty for annoying noise characteristics

Predicted construction noise impacts

Construction noise impacts have been assessed based on the indicative timeframes and staging of works as presented in Chapter 5, which also outlines the justification for works outside standard hours in Section 5.4.14.

Due to the nature of construction works, impacts during construction are generally considered to be short-term, where construction noise levels at any receiver would reduce as works progress away from a receiver. This increases where receivers are located next to ancillary facilities impacting the same receiver for a longer period of time. However for the most part, construction noise impacts are considered short-medium term.

As a conservative approach, noise modelling has assumed that all 21 ancillary facilities (as outlined in Chapter 5) would operate simultaneously for the entire duration of the construction program. Noise modelling has also considered the noise impacts that may arise from the operation of ancillary facilities alone. This allows for the assessment of worst case impacts, as well as any longer term impacts arising from the operation of ancillary facilities even once mainline road works have moved beyond a sensitive receiver.

Construction of the project would be contained to standard construction hours where it is feasible and reasonable to do so. However, some works would likely need to be undertaken during evening, night or weekend periods as required to ensure safe work practices or to avoid unacceptable impacts on traffic and disruptions to the road network (refer to Chapter 5). Two construction activities have been assessed for out-of-hours work, namely bridgeworks and paving. Bridgeworks

is confined to Adams Road bridge, while paving would occur at tie-ins, cross overs, and any sections of The Northern Road that is under traffic.

The predicted L_{Aeq} noise level from all standard hours (daytime) and out-of-hours (Saturday afternoons, evenings and nights) construction works is presented in full for each receiver in Appendix H. This includes noise contours and NML exceedances at receivers predicted to result from the two loudest out-of-hours work scenarios being night-time paving and bridge works.

All predictions are based on the assumption that the standard project-specific noise mitigation measures are applied as outlined in Section 7.2.8. In instances where after the application of standard noise mitigation measures there still remain receivers at which NMLs are exceeded (as summarised in the table below), the CNVG directs that the project should consider implementing the additional mitigation measures detailed in Appendix C of the CNVG where feasible and reasonable. These are summarised in Appendix H and should be considered in the application of management measures during construction.

A summary of potential impacts to receivers grouped per NCA is presented in Table 7-30 for impacts during standard hours and Table 7-31 for impacts outside standard hours. These tables indicate the worst case construction noise levels predicted for the least and most affected residences and also indicate the count of residences at which the NML is exceeded.

In summary, during standard hours works, it is predicted that:

- The NML will not be exceeded at any time for most receivers (>60 per cent) within NCAs 1, 6 and 8
- Across the entire study area, noise from even the loudest works will comply with the NML at 80 per cent of all residences
- Of all works scenarios, road works and paving are expected to generate the greatest number of NML exceedances at residences, which are mostly located in NCAs 1, 2 and 5
- The highest NML exceedances are predicted to occur at residences within NCA 2
- At 195 residences (11 per cent of all residences) within the study area the worst case exceedance of the NML from any standard hours works would be 10 dB(A) or less. At such times of peak impact, construction noise would be clearly audible
- At 118 residences within the study area (7 per cent) the worst case exceedance of the NML would be between 10-20 dB(A). At such times of peak impact, construction noise would be moderately intrusive
- At 29 residences within the study area (2 per cent) the worst case exceedance may be more than 20 dB(A). At such times of peak impact, construction noise would be highly intrusive
- At times of the loudest works (road works and paving) 39 residences are predicted to be highly noise affected (noise levels > 75dB(A)). Fewer residences would be highly noise affected during quieter works (eg, 0 residences during bridge works). NCA 2 is predicted to have the highest number of highly noise affected receivers (25 during paving works)
- Within most NCAs, it is expected that noise from the nearest ancillary facility (in isolation of noise from any other mainline works) may exceed the NML by up to 10 dB(A) at a small number of receivers (up to 12 receivers within NCA 5) when that facility is operating at peak capacity. Additionally, one receiver in each of NCA 4 and NCA 5 may be exposed to noise levels up to 20 dB(A) above the NML during times of peak operations.

In summary, during out-of-hours work, it is predicted that:

- Across the entire study area, noise from even the loudest works will comply with the NML at 60 per cent of all residences
- Paving is the out-of-hours work predicted to generate the greatest number of NML exceedances at residences, which are mostly located in NCAs 1, 2, 5 and 8
- The highest NML exceedances are predicted to occur at residences within NCA 2

- At 209 residences (12 per cent of all residences) within the study area the worst case exceedance of the NML from any out-of-hours work would be 5 dB(A) or less. At such time of peak impact, construction noise would be noticeable
- At 313 residences within the study area (18 per cent) the worst case exceedance of the NML would be between 5-15 dB(A). At such times of peak impact, construction noise would be clearly audible
- At 99 residences within the study area (6 per cent) the worst case exceedance of the NML would be between 15-25 dB(A). At such times of peak impact, construction noise would be moderately intrusive
- At 73 residences within the study area (4 per cent) the worst case exceedance may be more than 25 dB(A). At such times of peak impact, construction noise would be highly intrusive
- Noise from the ancillary facilities (in isolation of noise from any other mainline works) may give rise to exceedances of the NML at up to 539 residences when nearby facilities are operating at peak capacity. The NML exceedance is predicted to be greater than 15 dB(A) at 31 of these residences.

Exceedances of the sleep disturbance screening criterion are predicted to be highest from paving works and for residences within NCAs 2, 3 and 5.

Over all NCAs, 87 residences may be exposed to exceedances of more than 15 dB(A) and 22 residence to exceedances of more than 25 dB(A) above the sleep disturbance screening criterion when paving works are most adjacent to those receivers.

Over all NCAs, noise from ancillary facilities alone may give rise to exceedances of the sleep disturbance criterion within 225 residences.

Exceedances of the NML from standard hours works are predicted at the following non-residential receivers within the study area. The noise levels reported relate to periods when works are nearest to the subject site:

- Power Station - minor exceedances of up to 2 dB(A)
- Horse N Around – moderate exceedances of up to 11 dB(A) at the most affected building
- Shell Service Station – moderate exceedances of up to 17 dB(A)
- IGA Luddenham – moderate exceedances of up to 12 dB(A)
- Luddenham Public School - minor exceedances of up to 4 dB(A)
- St James Anglican Church - moderate exceedances of up to 11 dB(A)
- Luddenham Uniting Church – minor exceedances of up to 2 dB(A).

A summary of construction and operational impacts per NCA is provided in Section 7.2.6. A detailed assessment is provided in Appendix H.

All construction impacts are based on the defined NMLs, representative worst-case noise construction scenarios which are used to predict the noise emission from construction activities. These worst-case scenarios typically assume all equipment / ancillary facilities operate concurrently, minimal offset distances between equipment and receivers and reference equipment sound power levels as per the RMS CNVG.

The construction contractor may develop different NMLs, construction scenarios, timings, offset distances, equipment and concurrent / overlapping activities. The construction impacts in this case will likely be different to the impacts assessed as part of this report. In all cases, during the detailed design stages, the construction contractor will be responsible for re-assessing all construction noise and vibration impacts in accordance with the ICNG and RMS CNVG and providing a detailed Construction Noise and Vibration Management Plan (CNVMP), which describes the construction impacts and the necessary noise, vibration and management mitigation measures which will be

implemented throughout the project. The CNVMP will also reference the project specific Environmental Protection Licence (EPL) which may require specific mitigation measures.

Table 7-30 Summary of predicted construction noise impacts at each NCA during standard hours

NCA	NML (Standard Hours)	Construction Stage									Ancillary Facilities only
			Early works	Earthworks	Roadwork-	Bridge work	Drainage	Paving	Utility Relocation	Finishing Works	
1	58	Range of predicted noise levels (dB(A))	34-77	38-82	40-84	30-63	39-83	40-84	36-80	39-83	27-63
		Complying	1194	1179	1164	1204	1175	1164	1188	1175	1204
		Number of Residences									
		0-10 dBA above NML	16	27	41	7	31	41	20	31	7
		10-20 dBA above NML	1	4	5		4	5	2	4	
2	57	20+ dBA above NML		1	1		1	1	1	1	
		Highly noise affected	≥75dBA	1	1	1	1	1	1	1	
		Range of predicted noise levels (dB(A))	39-78	44-83	46-85	34-61	45-84	46-85	42-81	45-84	34-61
		Complying	63	47	39	128	44	39	55	44	128
		Number of Residences									
3	56	0-10 dBA above NML	39	30	34	9	32	34	32	32	9
		10-20 dBA above NML	33	50	50		49	50	46	49	
		20+ dBA above NML	2	10	14		12	14	4	12	
		Highly noise affected	≥75 dBA	4	15	25	17	25	10	17	
		Range of predicted noise levels (dB(A))	43-73	48-78	50-80	43-61	49-79	50-80	46-76	49-79	35-61
4	47	Complying	10	6	4	20	4	4	7	4	20
		Number of Residences									
		0-10 dBA above NML	5	8	7	3	10	7	8	10	3
		10-20 dBA above NML	8	7	9		7	9	8	7	
		20+ dBA above NML		2	3		2	3		2	
4	47	Highly noise affected	≥75dBA	2	6		3	6	1	3	
		Range of predicted noise levels (dB(A))	49-63	50-68	52-67	52-65	51-66	52-67	50-63	51-66	46-60
		Complying									1
		Number of Residences									14
		0-10 dBA above NML	13	9	8	6	8	8	10	8	1
4	47	10-20 dBA above NML	3	6	7	10	8	7	6	8	
		20+ dBA above NML		1	1			1			
		Highly noise affected	≥75 dBA								

NCA	NML (Standard Hours)	Construction Stage									Ancillary Facilities only	
		Early works	Earthworks	Roadwork-	Bridge work	Drainage	Paving	Utility Relocation	Finishing Works			
5	52	Range of predicted noise levels (dB(A))	39-83	43-88	45-90	45-72	44-89	45-90	41-86	44-89	38-69	
		Complying	177	146	117	23	131	117	162	131	211	
		Number of Residences	0-10 dBA above NML	33	54	75	199	69	75	44	69	12
		10-20 dBA above NML	10	19	23	1	18	23	13	18	1	
		20+ dBA above NML	4	5	9	1	6	9	5	6		
Highly noise affected		≥75dBA	4	5	5		5	5	4	5		
6	52	Range of predicted noise levels (dB(A))	40-48	44-53	46-55	43-51	45-54	46-55	42-51	45-54	39-47	
		Complying	14	12	11	14	12	11	14	12	14	
		Number of Residences	0-10 dBA above NML		2	3		2	3		2	
		10-20 dBA above NML										
		20+ dBA above NML										
Highly noise affected		≥75 dBA										
7	47	Range of predicted noise levels (dB(A))	43-64	48-69	50-71	40-49	49-70	50-71	46-67	49-70	40-49	
		Complying	4			17			1		17	
		Number of Residences	0-10 dBA above NML	12	8	5	2	6	5	14	6	2
		10-20 dBA above NML	3	10	13		12	13	4	12		
		20+ dBA above NML		1	1		1	1		1		
Highly noise affected		≥75dBA										
8	58	Range of predicted noise levels (dB(A))	41-69	46-74	48-76	41-66	47-75	48-76	44-72	47-75	41-66	
		Complying	83	78	72	93	74	72	80	74	93	
		Number of Residences	0-10 dBA above NML	20	16	22	12	20	22	17	20	12
		10-20 dBA above NML	2	11	11		11	11	8	11		
		20+ dBA above NML										
Highly noise affected		≥75 dBA			2		1	2		1		

Table 7-31 Summary of predicted construction noise impacts at each NCA during out-of-hours work

NCA	NML OOH (Night)	OOH Work Stage			Ancillary Facilities only	Sleep Disturbance Screening Criterion	OOH Work Stage		Ancillary Facilities only
			Bridge work	Paving			Bridge work	Paving	
1	49	Range of predicted noise levels (dB(A))	30-63	35-79	27-63	59	33-66	39-83	30-66
		Complying	1138	1034	1138		1199	1178	1199
		0-5 dBA above NML	57	137	57		10	21	10
		5-15 dBA above NML	16	35	16		2	11	2
		15-25 dBA above NML		4				1	
		≥25dBA above NML		1					
2	41	Range of predicted noise levels (dB(A))	34-61	41-80	34-61	51	37-64	45-84	37-64
		Complying	22	1	22		79	15	79
		0-5 dBA above NML	44	11	44		39	24	39
		5-15 dBA above NML	60	43	60		19	34	19
		15-25 dBA above NML	11	32	11			50	
		≥25dBA above NML		50				14	
3	40	Range of predicted noise levels (dB(A))	35-61	45-75	35-61	50	38-64	49-79	38-64
		Complying	6		6		12	2	12
		0-5 dBA above NML	6		6		4	2	4
		5-15 dBA above NML	7	7	7		7	7	7
		15-25 dBA above NML	4	8	4			9	
		≥25dBA above NML		8				3	
4	42	Range of predicted noise levels (dB(A))	46-60	50-62	46-60	52	49-63	53-68	49-63
		Complying					1		1
		0-5 dBA above NML	1		1		11	8	11
		5-15 dBA above NML	14	11	14		4	7	4
		15-25 dBA above NML	1	5	1			1	
		≥25dBA above NML							
5	39	Range of predicted noise levels (dB(A))	38-69	40-85	38-69	49	41-72	44-89	41-72
		Number of Complying	1		1		125	44	126

NCA	NML OOH (Night)	OOH Work Stage			Ancillary Facilities only	Sleep Disturbance Screening Criterion	OOH Work Stage		Ancillary Facilities only
			Bridge work	Paving			Bridge work	Paving	
		Residences	0-5 dBA above NML	60	18	62	84	109	83
			5-15 dBA above NML	151	159	150	14	48	14
			15-25 dBA above NML	11	33	10	1	18	1
			≥25dBA above NML	1	14	1		5	
6	39	Range of predicted noise levels (dB(A))		39-47	41-50	39-47	42-50	45-54	42-50
		Complying					12	8	12
		Number of Residences	0-5 dBA above NML	12	6	12	2	6	2
			5-15 dBA above NML	2	8	2			
			15-25 dBA above NML						
			≥25dBA above NML						
7	42	Range of predicted noise levels (dB(A))		40-49	45-66	40-49	43-51	49-70	43-51
		Complying		9		9	19	4	19
		Number of Residences	0-5 dBA above NML	8	3	8		2	
			5-15 dBA above NML	2	13	2		12	
			15-25 dBA above NML		3			1	
			≥25dBA above NML						
8	47	Range of predicted noise levels (dB(A))		41-66	43-71	41-66	44-71	47-75	44-71
		Complying		34	20	34	76	63	76
		Number of Residences	0-5 dBA above NML	31	34	31	21	22	21
			5-15 dBA above NML	36	37	36	8	13	8
			15-25 dBA above NML	4	14	4		7	
			≥25dBA above NML						

Chapter 7 – Assessment of key Issues

The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park
Environmental impact statement / draft Environmental Impact Statement

Construction traffic noise impact

The volumes of construction traffic predicted to be generated by the project are outlined in Section 7.1 above. The project's construction traffic would access construction sites using only designated heavy vehicle routes such as the M4 Motorway, Elizabeth Drive and The Northern Road. Based on this information, predicted noise impacts as a result of construction traffic have been assessed and provided graphically in Appendix H.

This assessment indicates that construction traffic would not increase existing traffic noise levels by more than 2dB, and therefore no further assessment of construction traffic noise impacts is required.

Table 7-32 summaries the increase in traffic noise levels at receivers adjacent to the project arising from the addition of peak construction traffic volumes to existing traffic volumes.

Table 7-32 Predicted increase in traffic noise due to additional construction traffic

Haul Route	Existing Traffic Volumes				Proposed Additional Construction Traffic Volumes				Increase in traffic noise	
	Day (7am-10pm)		Night (10pm-7am)		Day (7am-10pm)		Night (10pm-7am)		Day	Night
	L	H	L	H	L	H	L	H	dB(A)	dB(A)
Along The Northern Road, between...										
Glenmore Parkway and Bradley Street	16,764	2,354	2,347	503	197	176	10	49	0.2	0.3
Chain-O-Ponds Rd and Kings Hill Road	13,685	1,480	1,972	355	197	176	10	49	0.3	0.4
Littlefields Rd and Elizabeth Drive	11,859	1,357	1,667	319	197	176	10	49	0.3	0.4

Table 7-32 shows that construction traffic will not increase existing traffic noise levels by more than 0.5 dB. Mitigation measures are only required if construction noise increases are greater than 2 dB. Therefore, no construction traffic mitigation measures are required as a result.

Construction vibration

The potential for vibration impact to either residents or buildings from the project may reasonably be expected to be contained to the construction phase of the project. The construction program is expected to include the use of equipment such as rock breakers, vibratory rollers and impact piling rigs that could give rise to vibration impact.

Vibration from the project's construction processes could potentially impact humans, buildings or other vibration-sensitive 'special uses' such as medical imaging or electronics facilities. However, all non-residential uses (including commercial properties) are sufficiently well removed from the project such that no impact is predicted. Residential receivers are the only type of receiver within the study area potentially affected by construction vibration.

The project's construction activities may give rise to three types of vibration impact, each of which is assessed against different standards. Vibration from construction works may:

- Adversely affect human comfort: this is assessed EPA, Assessing Vibration: A Technical Guideline (DEC 2006)
- Cause cosmetic damage (eg surface cracks) to conventional buildings such as residences and light commercial buildings: this is assessed against the guidance of Australian Standard AS2187.2-2006 Explosives – Storage, Transport and Use provides guidance for the assessment of structural damage to buildings caused by vibration, or
- Cause cosmetic damage to buildings or structures of “particular sensitivity” (eg, heritage or structurally unsound items): for such structures, the assessment is made against German Standard DIN 4150: Part 3-1999.

No blasting is expected to be required in the construction of the project.

Safe work distances are presented in Table 7-33.

Table 7-33 Safe working distances for vibration intensive plant (TfNSW 2013)

Plant item	Rating/description	Safe working distance	
		Cosmetic damage (British Std 7385)	Human response (DECCW)
Vibratory roller	<50 kN (typically 1-2 t) <100 kN (typically 2-4 t) <200 kN (typically 4-6 t) <300 kN (typically 7-13 t) >300 kN (typically 13-18 t) >300 kN (> 18 t)	5 m 6 m 12 m 15 m 20 m 25 m	15 m to 20 m 20 m 40 m 100 m 100 m 100 m
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Medium hydraulic hammer	900 kg – 12 to 18t excavator	7 m	23 m
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤800 mm	2 m	n/a
Jackhammer	Hand held	1 m	Avoid contact with structure

The safe working distances presented in Table 7-33 are indicative and would vary depending on the item of plant and local geotechnical conditions. The cosmetic damage thresholds apply to typical buildings under typical geotechnical conditions and vibration monitoring is recommended at specific sites. Where structures are more sensitive such as heritage items, more stringent conditions may be applicable and should be considered individually.

In relation to human response, the safe working distances relate to continuous vibration. For most construction activities, vibration emissions are intermittent and higher vibration levels over shorter periods are acceptable. Additional assessment should be undertaken where the human response criteria are exceeded.

Vibration intensive plant scheduled to be operated during the construction program include:

- Vibratory rollers during earthworks, bridge construction and other stages

- Jack hammers during drainage works
- Impact piling and rock breaking during bridgeworks.

Based on the safe working distances to preserve the structural integrity of dwellings recommended in Table 7-33, structural damage criteria would be complied with where vibratory rolling or rock breaking is operated not closer than 22 m from any dwelling or sensitive structure. Impact piling required for bridge works is expected to occur not closer than 190 m to the nearest residence, and so, is not predicted to cause structural damage.

Vibratory rolling is expected to be undertaken within 100 m of residences (for various stages of works) and so may impact human comfort within those residences. In these cases, the procedures outlines in Appendix C of the CNVG are to be followed in order to mitigate any such potential impacts. These measures include notification strategies, vibration monitoring, offering of periods of respite and offering of alternative accommodation.

Although the precise location of vibration-intensive works and the final section of plant would need to be confirmed during detailed design, Table 7-34 indicates the number of vibration-sensitive receivers expected to be situated within the 22 m (preservation of structural integrity of buildings) and 100m (protection of human comfort) safe working distances.

Table 7-34 Indicative count of receivers within safe working distances of vibration-intensive works

Noise Catchment Area	Number of receivers within Safe Working Distance for...					
	Preservation of structural integrity of buildings (22m buffer zone)			Protection of human comfort (100m buffer zone)		
	Residential	Commercial	Military	Residential	Commercial	Military
NCA 1	1			8		
NCA 2	20	2	35	63	3	44
NCA 3				6	1	
NCA 4				1		
NCA 5	4	2		15	3	
NCA 6						
NCA 7				1		
NCA 8	2			12		
Total	27	4	35	106	7	44

The heritage assessment identifies that the general and site-specific mitigation measures listed would minimise impacts on non-Aboriginal heritage to an acceptable level to proceed with the project as assessed.

7.2.6 Assessment of potential operational impacts

Assessment scenarios

Assessment of the project's operational noise impacts compares the modelled traffic noise levels resulting from the "Build" and "No Build" (or "Do Nothing") options. Note that the "Do Nothing" option is based on the assessment of The Northern Road in its existing alignment, rather than its

diverted alignment (the “Do Minimum” option) as described in Chapter 4 of the EIS. This provides a more conservative approach for the assessment of noise impacts.

In accordance with the RNP, the following four scenarios were modelled, where 2021 is taken to be the year of opening of The Northern Road project:

Year of Opening – 2021, No Build (Do Nothing)

Modelling is based on 2021 traffic on the existing road network

Year of Opening – 2021, Build

Modelling is based on 2021 traffic volumes for the road network that includes the newly-upgraded The Northern Road and the diversion around the Western Sydney Airport.

10 Years after Opening – 2031, No Build (Do Nothing)

Modelling is based on the 2031 traffic volumes on an unchanged road network (i.e. The Northern Road is not upgraded). This future traffic scenario includes the additional trips generated by forecast land use changes (ie Western Sydney Airport and Western Sydney Priority Growth Area) and other road network changes (proposed M12, Bringelly Road upgrade, etc).

10 Years after Opening – 2031, Build

Modelling is based on the 2031 traffic volumes based on a road network that includes The Northern Road, the diversion around the Western Sydney Airport. This future traffic scenario includes the additional trips generated by forecast land use changes (ie Western Sydney Airport and Western Sydney Priority Growth Area) and other road network changes (proposed M12, Bringelly Road upgrade, etc).

Each of these scenarios is modelled for both daytime (7am-10pm) and night-time (10pm-7am) periods.

Identifying receivers that qualify for consideration of noise mitigation

Noise impacts predicted during operation of the project are considered long-term impacts as they would occur for the lifetime of the project.

Any of the following three triggers qualify a receiver for consideration of noise mitigation. Note that these do not prescribe that a receiver shall receive mitigation necessarily, as there are matters of the “reasonableness and feasibility” of the measures to also consider. These triggers are:

- The predicted total noise level to a receiver in the project “Build year” is 5 dB(A) or more above the relevant NCG noise criterion (the cumulative limit) and it is the project road noise that contributes most to this increase; or
- The noise level contribution from the road project is “acute”, which is to say, greater than either 65 dB(A) $L_{eq,15hour}$ during daytime periods or 60 dB(A) $L_{eq,15hour}$ during night periods (regardless of the level of noise contributed from non-project roads)
- The predicted total noise level to a receiver for the project Build year both exceeds the NCG noise criterion AND the increase in noise created by the project (i.e. the Build minus the No Build noise level) is greater than 2 dB(A).

Operational noise impacts prior to consideration of mitigation

Detailed predictions of the project’s operational noise at each receiver within the operational noise assessment area are presented in Appendix H – Noise and vibration assessment. Of these, there are 77 receivers which qualify for the consideration of noise mitigation as outlined in Table 7-35.

Table 7-35 Summary of receivers that qualify for consideration of noise mitigation

Noise Catchment Area	Number of receivers assessed	Number of receivers exceeding NCG Criteria	Number of receivers qualifying for consideration of mitigation	Mitigation Trigger			
				1	2	3	4
NCA 1	647	17	4			1	3
NCA 2	108	41	25			6	19
NCA 3	15	10	5			1	4
NCA 4	32	14	5			4	1
NCA 5	238	92	9			5	4
NCA 6	20	9					
NCA 7	20	17	17			10	7
NCA 8	39	15	12			7	5
Total	1 103	215	77	0	0	34	43

Mitigation trigger: 1) Cumulative limit, 2) Acute, 3) >2dB(A) increase, 4. Combination of triggers

In summary, the following unmitigated traffic noise impacts were identified:

- Most receivers in the study area are expected to experience some increase in traffic noise. For receivers close to the alignment, the increase may result in an exceedance of the operational noise criteria
- The receivers expected to be subject to the greatest increase in traffic noise are the:
 - semi-rural receivers adjacent to the new bypass alignment in the vicinity of Willowdene Avenue, and
 - Semi-rural receivers located near either the bypass' northern or southern junctions with the existing The Northern Road. These receivers will have noise exposure to both the existing Northern Road and the new bypass
- Operational noise mitigation is not required for 1026 receivers (93 per cent of all receivers) within the study area
- There are 77 receivers (74 unique buildings) which qualify for consideration of noise mitigation. All triggering receivers are residences other than three classroom buildings at Luddenham Public School. These 77 mitigation-qualifying receivers are shown in Appendix H
- With reference to the mitigation qualification triggers, of these 77 receivers:
 - none were triggered by the cumulative limit (alone)
 - 34 were triggered by the "Build minus No Build > 2 dB(A)" test (only), and
 - 43 receivers were triggered due to a combination of both triggers
- No receivers were identified as acute alone (in absence of other triggers).

The preferred operational noise mitigation options for these receivers are discussed below.

Consideration of operational noise mitigation

This section identifies options for mitigating the operational noise impacts predicted for the 77 receivers identified in Table 7-35. The method for determining a receiver's eligibility for mitigation is outlined in Roads and Maritime *Noise Mitigation Guideline* (NMG). The potential noise mitigation

measures that may be applied by Roads and Maritime to those receivers that qualify for consideration of additional noise mitigation measures are outlined below in order of preference of application given in the RNP:

1. Low noise pavement surfaces
2. Noise mounds
3. Noise walls
4. At-property treatments.

At source mitigation - low noise pavement

The use of low-noise pavement is a preferred form of noise mitigation on road projects, as this form of mitigation reduces noise levels external to receivers and also provides benefit to the wider community, rather than only to individually targeted receivers. The use of Open Graded Asphalt or Stone Mastic Asphalt pavements can reduce noise levels by -2 dB(A) compared to Dense Graded Asphalt.

Whilst the use of low noise pavement is preferable as it reduces external noise levels and provide benefit to the wider community, it is not considered feasible due on-going maintenance requirement given that it is located close to an intersection. However, a quieter pavement in the form of dense graded asphaltic concrete would be used.

Noise attenuation through noise barriers (mounds or walls)

A noise barrier (e.g. noise mound) provides similar benefits to those provided by a quieter pavement surface through reducing both external and internal levels of noise.

As there are no groupings of four or more closely-spaced receivers of those eligible for consideration of mitigation, the use of noise barriers has not been identified as a mitigation measure for this project.

Where there are four or more closely spaced receivers that would benefit, a combination of noise treatment options, where feasible and reasonable, would be investigated further in detailed design in accordance with the NMG.

Noise mitigation to the 77 mitigation-eligible receivers will need to be provided by means of at-property acoustic treatments.

Additional noise mitigation option: at-property treatments

Where noise barriers and/or low noise pavements are not considered feasible and/or reasonable, noise impacts at affected dwellings would be mitigated by at-property treatments. The objective of this form of mitigation is to provide building treatments that reduce internal traffic noise to levels that would have prevailed had the external traffic noise criteria been able to be achieved.

The specific form of acoustic building treatment applied to achieve these reductions is considered on an individual basis in response to the existing construction of the dwelling. Building element treatments are more effective when applied to masonry structures than to lightly clad timber frame structures. Caution should be exercised before providing treatments for buildings in a poor state of repair, as they may be less effective in these cases and may not provide any appreciable noise reduction benefit.

Any treatments proposed would be considered in consultation with the landowner.

The NMG identifies that the treatments provided by the Roads and Maritime would be limited to:

- The installation of courtyard screen walls
- Fresh air ventilation systems that meet Building Code of Australia requirements with the windows and doors shut

- Upgraded windows and glazing and solid core doors on the exposed facades of masonry structures only (these techniques would be unlikely to produce any noticeable benefit for light frame structures with no acoustic insulation in the walls)
- Upgrading window and door seals and treatment of sub floor ventilation
- The sealing of wall vents
- The sealing of the underfloor below the bearers
- The sealing of eaves.

At-property treatments are considered the most reasonable form of noise mitigation for the 77 receivers (housed within 74 buildings) for which exceedances of operational noise criteria have been predicted by this assessment. These 77 receivers eligible for at-property treatments are shown on Table 7-36. A summary of the predicted noise impacts at these 77 receivers qualifying for consideration of noise mitigation is provided in Table 7-36.

Table 7-36 Summary of receivers eligible for at-property treatment

Address	Flr	Land Use	Predicted noise level dB(A) NO Build				Predicted noise level dB(A) Build				NCG Criteria		Predicted Exceedance dB(A) Build			
			2021		2031		2021		2031				2021		2031	
			D	N	D	N	D	N	D	N	D	N	D	N	D	N
Receivers located within NCA 1																
2019 The Northern Rd Glenmore Park	GF	Residential	65	59	66	59	65	58	66	60	60	55	5	3	6	5
2023 The Northern Rd Glenmore Park	GF	Residential	64	58	64	58	64	57	65	59	60	55	4	2	5	4
1 Bradley St Glenmore Park	GF	Residential	63	56	63	57	63	56	65	58	60	55	3	1	5	3
2032 The Northern Rd Orchard Park	GF	Residential	60	53	60	54	62	55	63	57	60	55	2	0	3	2
Receivers located within NCA 2																
2-18 Littlefields Rd (1) Luddenham	GF	Residential	61	54	60	55	61	54	63	56	60	55	1	0	3	1
2-18 Littlefields Rd (1) Luddenham	F1	Residential	63	56	63	57	65	58	67	60	60	55	5	3	7	5
2785-2787 The Northern Rd Luddenham	GF	Residential	63	56	63	57	63	56	65	58	60	55	3	1	5	3
2627-2635 The Northern Rd Mulgoa	GF	Residential	60	53	60	54	63	56	65	58	60	55	3	1	5	3
2627-2635 The Northern Rd Mulgoa	F1	Residential	62	55	63	56	65	58	67	60	60	55	5	3	7	5
2575-2579 The Northern Rd Mulgoa	GF	Residential	58	51	59	52	60	53	62	55	60	55	0	0	2	0
2567-2573 The Northern Rd (1) Mulgoa	GF	Residential	63	56	63	57	65	58	67	60	60	55	5	3	7	5
2561 The Northern Rd (1) Mulgoa	GF	Residential	57	50	57	51	59	52	61	54	60	55	0	0	1	0
2529-2537 The Northern Rd Mulgoa	GF	Residential	64	57	65	58	64	56	65	59	60	55	4	1	5	4
2 Longview Rd (3) Mulgoa	GF	Residential	64	57	64	58	63	55	65	58	60	55	3	0	5	3
4 Grover Cr (1) Mulgoa	F1	Residential	58	51	59	52	59	52	61	54	60	55	0	0	1	0
2359-2365 The Northern Rd Mulgoa	GF	Residential	65	58	66	59	65	58	66	60	60	55	5	3	6	5

Address	Flr	Land Use	Predicted noise level dB(A) NO Build				Predicted noise level dB(A) Build				NCG Criteria		Predicted Exceedance dB(A) Build			
			2021		2031		2021		2031				2021		2031	
			D	N	D	N	D	N	D	N	D	N	D	N	D	N
2351-2357 The Northern Rd (4) Mulgoa	GF	Residential	66	60	67	61	65	58	67	60	60	55	5	3	7	5
2345-2349 The Northern Rd Mulgoa	GF	Residential	65	58	66	60	64	57	66	59	60	55	4	2	6	4
2309-2317 The Northern Rd (1) Mulgoa	GF	Residential	65	59	66	60	64	57	66	59	60	55	4	2	6	4
2289-2293 The Northern Rd (1) Mulgoa	GF	Residential	65	58	65	59	64	57	66	59	60	55	4	2	6	4
Lot3/DP29081	GF	Residential	66	59	66	60	65	58	66	60	60	55	5	3	6	5
2297-2307 The Northern Rd (2) Mulgoa	GF	Residential	67	60	67	61	65	58	67	60	60	55	5	3	7	5
2373-2379(4) The Northern Rd Mulgoa	GF	Residential	68	61	69	62	66	59	68	61	60	55	6	4	8	6
1 Gates Rd (1) Mulgoa	GF	Residential	61	54	61	55	62	55	64	57	60	55	2	0	4	2
2580-2592 The Northern Rd Mulgoa	GF	Residential	63	57	64	58	65	58	68	61	60	55	5	3	8	6
2751 The Northern Rd Luddenham	GF	Residential	60	53	60	54	61	54	63	56	60	55	1	0	3	1
2751 The Northern Rd (1) Luddenham	GF	Residential	65	58	66	59	67	60	69	62	60	55	7	5	9	7
2587 The Northern Rd (1) Luddenham	GF	Residential	64	57	65	59	66	58	68	61	60	55	6	3	8	6
2295 The Northern Road Mulgoa	GF	Residential	66	59	66	60	64	57	66	59	60	55	4	2	6	4
Receivers located within NCA 3																
2843-2857 The Northern Rd (4) Luddenham	GF	Residential	63	56	63	57	64	57	66	58	60	55	4	2	6	3
2825-2841 The Northern Rd (5) Luddenham	GF	Residential	64	57	64	58	65	58	67	60	60	55	5	3	7	5
2311-2337 Elizabeth Dr (1) Luddenham	GF	Residential	61	57	63	54	62	55	64	56	56	51	6	4	8	5
2311-2337 Elizabeth Dr (1) Luddenham	F1	Residential	65	56	65	58	64	57	66	58	56	51	8	6	10	7
2859 The Northern Rd (1) Luddenham	GF	Residential	57	50	56	49	56	49	58	51	56	51	0	0	2	0

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Address	Flr	Land Use	Predicted noise level dB(A) NO Build				Predicted noise level dB(A) Build				NCG Criteria		Predicted Exceedance dB(A) Build			
			2021		2031		2021		2031				2021		2031	
			D	N	D	N	D	N	D	N	D	N	D	N	D	N
Receivers located within NCA 4																
140 Adams Rd (1) Luddenham	GF	Residential	46	39	45	39	58	51	60	53	55	50	3	1	5	3
2422-2430 The Northern Rd (3) Luddenham	GF	Residential	52	45	49	45	55	48	57	50	55	50	0	0	2	0
2420 The Northern Rd (2) Luddenham	GF	Residential	49	42	48	42	57	49	58	51	55	50	2	0	3	1
105-115 Adams Rd Luddenham	GF	Residential	47	40	47	41	55	48	57	50	55	50	0	0	2	0
125 Adams Rd (3) Luddenham	GF	Residential	48	41	50	43	54	47	56	49	55	50	0	0	1	0
Receivers located within NCA 5																
Luddenham Public School (2)	GF	Educational	57	52	49	51	52	47	51	50	50	-	2	-	1	-
Luddenham Public School (3)	GF	Educational	58	53	48	51	53	48	51	51	50	-	3	-	1	-
Luddenham Public School (1)	GF	Educational	57	52	48	51	52	47	51	50	50	-	2	-	1	-
2320-2390 The Northern Rd (2) Luddenham	GF	Residential	51	44	49	43	58	51	59	52	55	50	3	1	4	2
18 Eaton Road Luddenham	GF	Residential	59	49	59	53	61	51	62	56	55	50	6	1	7	6
16 Eaton Rd Luddenham	GF	Residential	60	53	59	53	60	53	61	55	55	50	5	3	6	5
14 Eaton Rd Luddenham	GF	Residential	60	53	59	54	59	52	60	54	55	50	4	2	5	4
2215 The Northern Rd (1) Luddenham	GF	Residential	56	49	51	49	54	47	56	50	55	50	0	0	1	0
45 Adams Rd (1) Luddenham	GF	Residential	50	41	51	44	61	54	62	56	55	50	6	4	7	6
Receivers located within NCA 6																
No receivers qualify																

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Address	Flr	Land Use	Predicted noise level dB(A) NO Build				Predicted noise level dB(A) Build				NCG Criteria		Predicted Exceedance dB(A) Build			
			2021		2031		2021		2031				2021		2031	
			D	N	D	N	D	N	D	N	D	N	D	N	D	N
Receivers located within NCA 7																
230A Willowdene Ave (1) Luddenham	GF	Residential	39	32	32	33	44	37	45	38	44	42	0	0	1	0
500 Willowdene Ave (1) Luddenham	GF	Residential	40	33	40	34	54	47	55	49	52	45	2	2	3	4
405 Willowdene Ave (1) Luddenham	GF	Residential	34	32	38	33	49	44	52	45	45	44	4	0	7	1
365 Willowdene Ave (1) Luddenham	GF	Residential	40	34	40	34	55	48	56	50	52	45	3	3	4	5
365 Willowdene Ave (3) Luddenham	GF	Residential	40	33	39	33	51	44	53	46	51	45	0	0	2	1
325 Willowdene Ave (1) Luddenham	GF	Residential	31	32	37	32	45	42	50	44	43	43	2	0	7	1
295 Willowdene Ave (1) Luddenham	GF	Residential	38	32	34	33	47	40	47	42	46	44	1	0	1	0
350 Willowdene Ave (2) Luddenham	GF	Residential	38	31	37	32	51	44	52	45	49	43	2	1	3	2
260 Willowdene Ave Luddenham	GF	Residential	32	32	32	33	47	41	48	43	44	43	3	0	4	0
320 Willowdene Ave (1) Luddenham	GF	Residential	39	32	39	33	53	46	54	47	49	42	4	4	5	5
Lot1/DP838361	GF	Residential	39	31	38	32	51	44	53	46	50	43	1	1	3	3
Lot1/DP838361	GF	Residential	36	30	36	30	52	45	54	47	48	42	4	3	6	5
Lot1/DP838361	GF	Residential	36	30	36	30	52	45	53	47	48	42	4	3	5	5
5 Vicar Park Lane, Luddenham	GF	Residential	40	33	39	34	54	47	55	49	43	42	11	5	12	7
400 Willowdene Ave Luddenham	GF	Residential	42	35	43	37	56	49	57	50	53	47	3	2	4	3
460 Willowdene Ave (1) Luddenham	GF	Residential	40	33	39	34	60	53	61	55	51	45	9	8	10	10

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Address	Flr	Land Use	Predicted noise level dB(A) NO Build				Predicted noise level dB(A) Build				NCG Criteria		Predicted Exceedance dB(A) Build			
			2021		2031		2021		2031				2021		2031	
			D	N	D	N	D	N	D	N	D	N	D	N	D	N
300-315 Willowdene Ave Luddenham	GF	Residential	36	27	36	30	50	43	51	44	45	42	5	1	6	2
Receivers located within NCA 8																
165 Greendale Rd (4) Greendale	GF	Residential	49	42	48	42	55	48	57	50	55	50	0	0	2	0
165 Greendale Rd (3) Greendale	GF	Residential	49	43	49	43	58	51	59	52	55	50	3	1	4	2
165 Greendale Rd (2) Greendale	GF	Residential	52	45	51	45	61	54	62	56	55	50	6	4	7	6
1592 The Northern Rd (1) Bringelly	GF	Residential	59	53	59	53	62	55	63	57	60	55	2	0	3	2
1602 The Northern Rd (3) Bringelly	GF	Residential	60	53	59	54	63	56	64	57	60	55	3	1	4	2
2 Dwyer Rd Bringelly	GF	Residential	63	56	63	57	64	57	65	58	60	55	4	2	5	3
1635 The Northern Rd (1) Bringelly	GF	Residential	60	53	60	54	62	55	63	56	60	55	2	0	3	1
1655 The Northern Rd (2) Bringelly	GF	Residential	59	52	58	53	61	54	62	55	60	55	1	0	2	0
165 Greendale Rd (1) Greendale	GF	Residential	57	50	57	51	59	53	61	54	55	50	4	3	6	4
165 Greendale Rd (1) Greendale	GF	Residential	59	52	59	53	64	57	65	59	60	55	4	2	5	4
165 Greendale Rd (2) Greendale	GF	Residential	60	53	59	53	63	56	64	58	60	55	3	1	4	3
1615 The Northern Rd (1) Bringelly	GF	Residential	62	55	62	56	63	56	65	58	60	55	3	1	5	3

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Sensitivity analysis

A sensitivity analysis of the noise modelling results was undertaken in order to ensure that the proposal adequately accounts for potential variations in actual future vehicle speeds and/or traffic mix.

A sensitivity factor of between 0.5-2.0 dB(A) has been added iteratively to all predicted noise levels. Incrementing sensitivity by 1 dB(A) allows for an increase in speed of about 15 km/h to 20 km/h or a corresponding increase in heavy vehicle volumes of about 15 to 20 percent for the upgraded and bypass sections of the project respectively.

Figure 7-3 indicates the change in the number of at-property treatments that would be recommended by this assessment if 0.5 dBA is incrementally added to or subtracted from the assessment's noise level predictions.

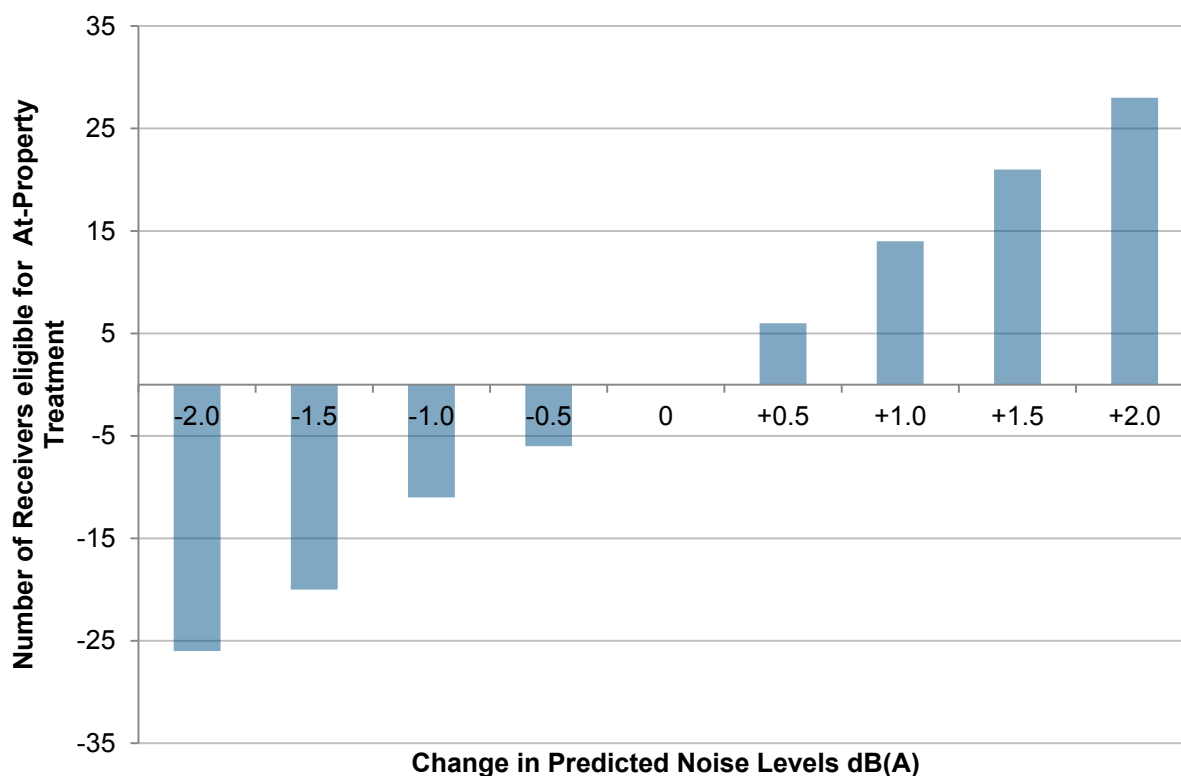


Figure 7-3 Noise assessment sensitivity analysis

Maximum noise level assessment

Investigating the frequency of maximum noise level events seeks to quantitatively indicate both potential for sleep disturbance within residences and whether noise impacts may be expected from the project during night periods. Investigating the frequency, extent and temporal distribution of maximum noise level events assists in the prioritisation of any mitigation (triggered by other considerations).

The assessment of maximum noise level events is based on the night-time traffic noise data acquired from noise monitoring location 12. This dataset was chosen for the assessment as the monitoring location from which it was acquired best reflects the exposure of receivers likely to be most impacted from the project's night-time traffic movements.

The number and distribution of existing night-time maximum noise events are shown in Figure 7-4 and Figure 7-5.

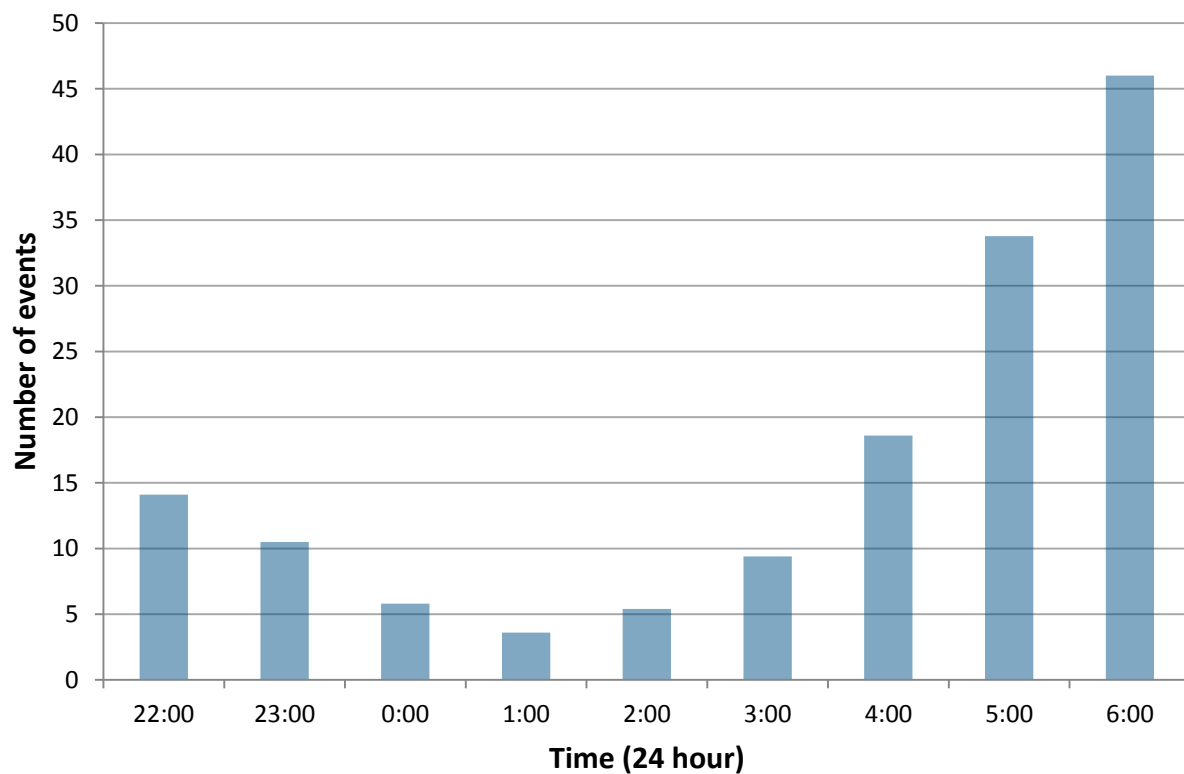


Figure 7-4 Number of noise events greater than 65dB(A) (Night-time)

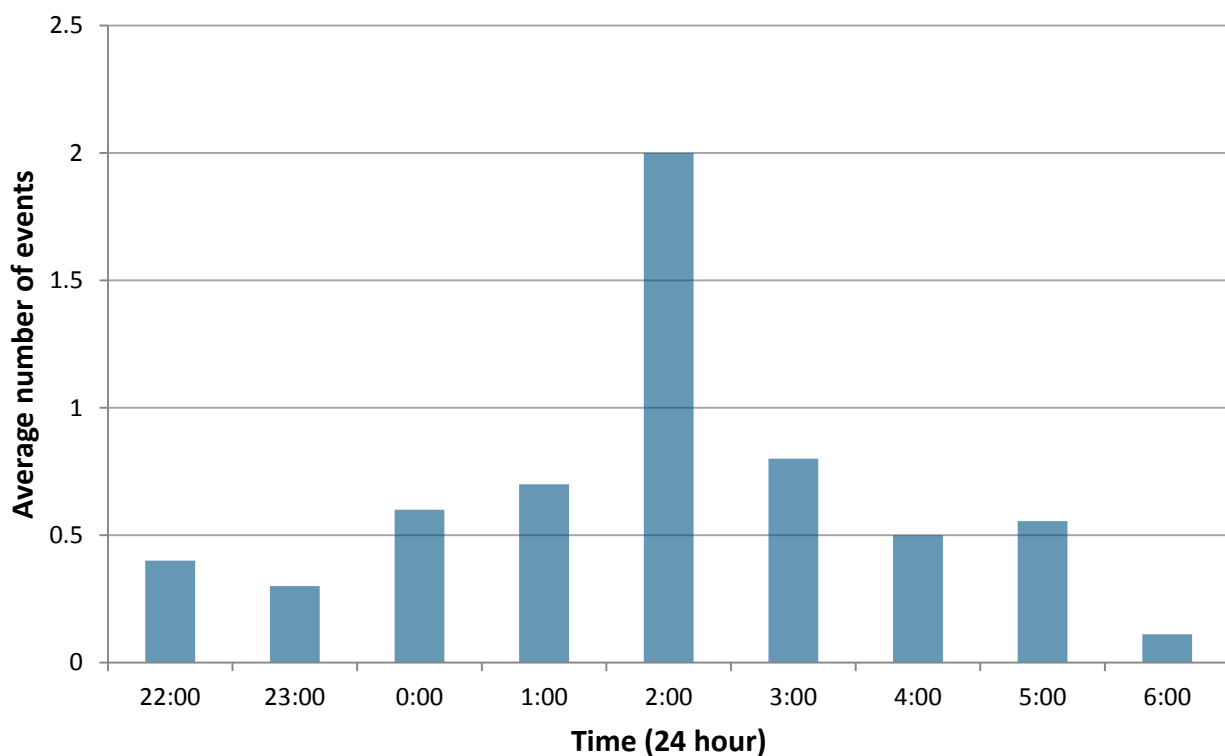


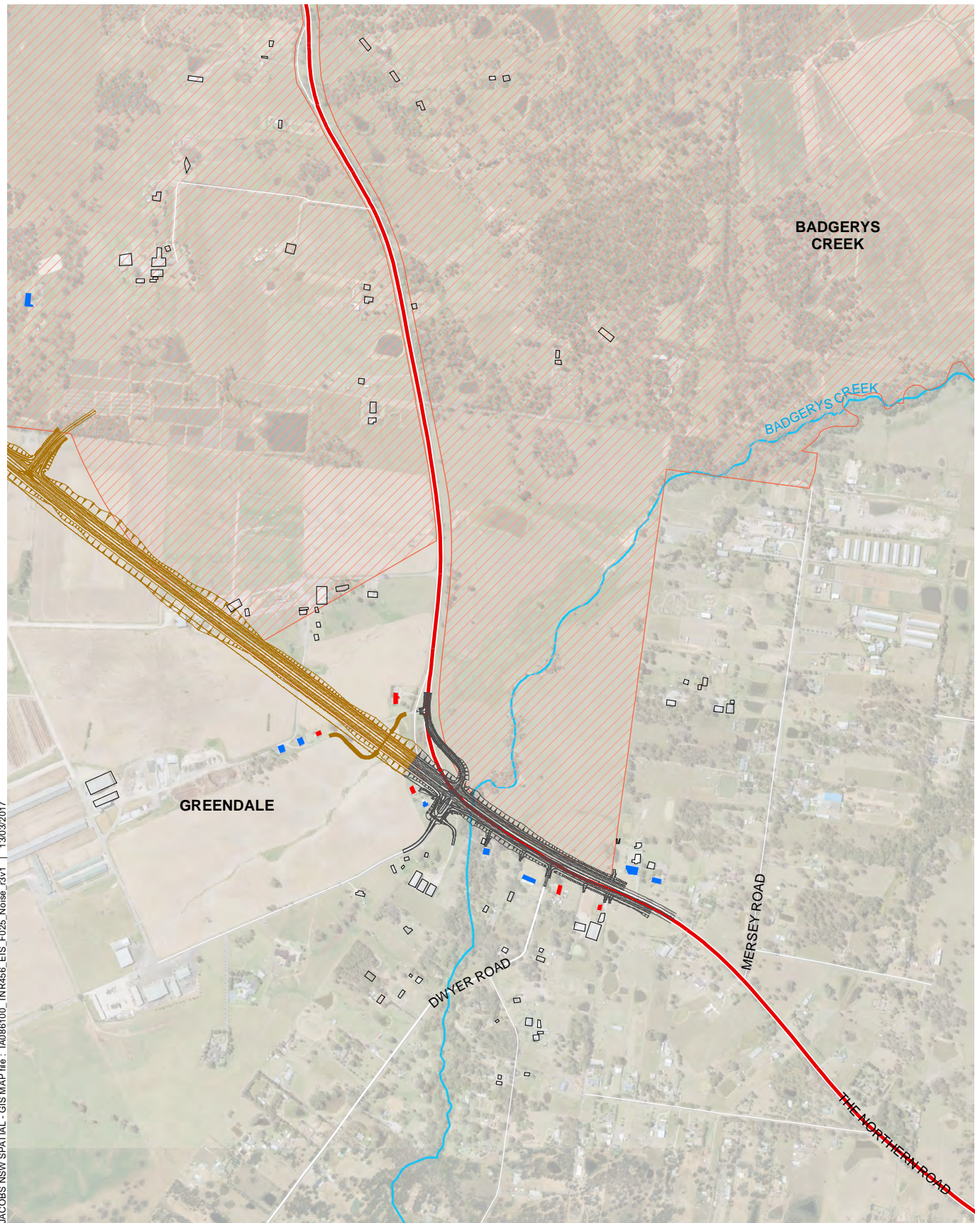
Figure 7-5 Average number of events when LAMax - LAeq > 15dB(A) (Night-time)

Figure 7-4 indicates that the number of existing maximum noise events greater than 65dB(A) during night periods presently is relatively low during the early and middle periods of the night, but increases substantially in the period 4am-7am.

Figure 7-5 indicates that there are presently few maximum noise events during night periods (about four per cent of all measured noise events greater than 65dB(A)). The number of maximum noise events is greatest at 2am and reduces in the early morning hours.

From the traffic noise monitoring data, maximum noise levels within those residences closest to the road may be expected to exceed 65 dB(A) for about 147 noise events during an average night. Typically, in any single night period, six of these 147 events would exceed the prevailing LAeq noise level by more than 15 dB(A).

Given that the project is expected to increase the number of night-time heavy vehicle movements and also that it proposes seven new signalised intersections along the alignment including at South Luddenham and Glenmore Park, the design would likely increase the number of engine compression braking events and the incidence of start-stop traffic.



- The Northern Road (Existing)
- Redeveloped road sections
- New road sections
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth lands

- Receivers qualifying for consideration of noise mitigation (by mitigation trigger)
- >2dB(A) increase
 - Combination of triggers
 - Receivers not qualifying for mitigation

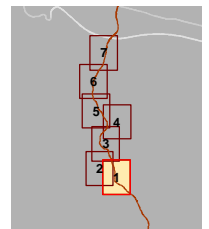
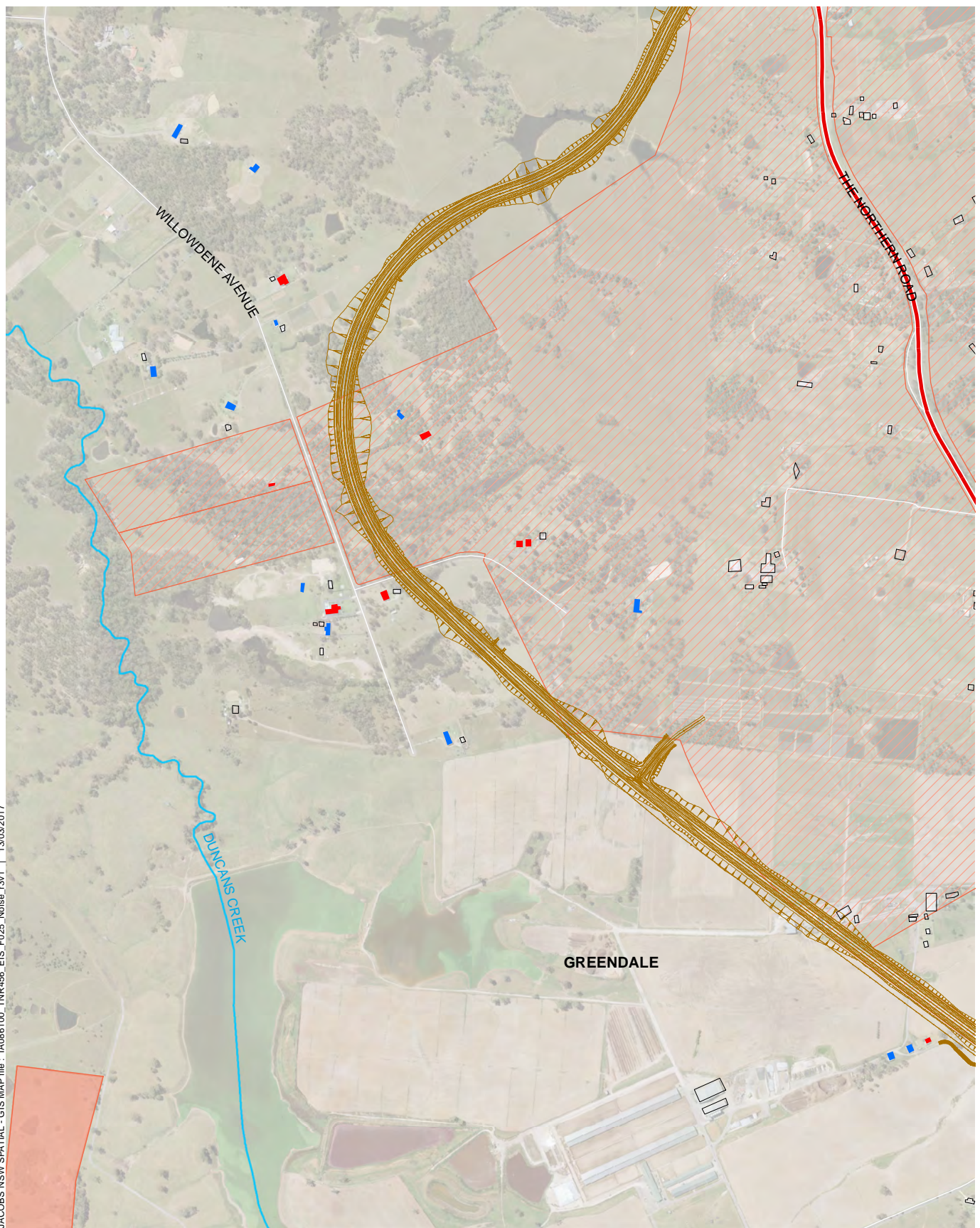


Figure 7-6 | Receivers qualifying for consideration of noise mitigation



- The Northern Road (Existing)
- Redeveloped road sections
- New road sections
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth lands

- Receivers qualifying for consideration of noise mitigation (by mitigation trigger)
- >2dB(A) increase
 - Combination of triggers
 - Receivers not qualifying for mitigation

0 200 400 m

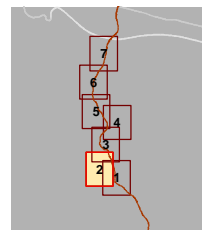


Figure 7-6 | Receivers qualifying for consideration of noise mitigation



- | | |
|---|---|
| — The Northern Road (Existing) | Receivers qualifying for consideration of noise mitigation (by mitigation trigger) |
| — Redeveloped road sections | ■ >2dB(A) increase |
| — New road sections | ■ Combination of triggers |
| ▨ Western Sydney Airport site (Commonwealth Land) | □ Receivers not qualifying for mitigation |
| ▩ Defence Establishment Orchard Hills (Commonwealth Land) | |
| ■ Commonwealth lands | |

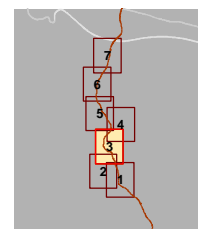
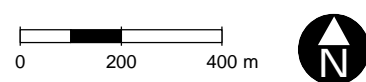
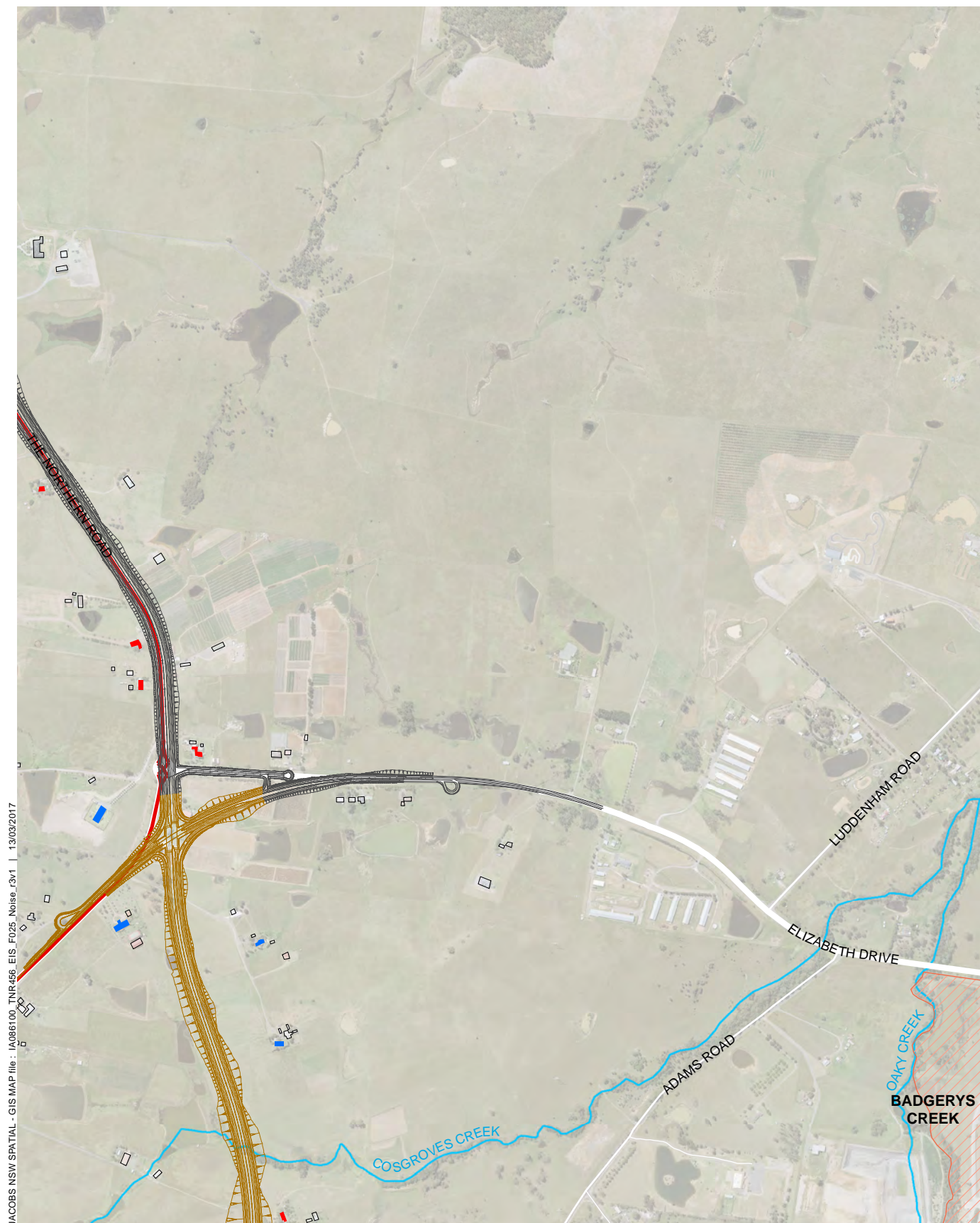


Figure 7-6 | Receivers qualifying for consideration of noise mitigation



JACOBS NSW SPATIAL - GIS MAP file : I:\086100_TNR456_EIS_F025_Noise_r3v1 | 13/03/2017

- The Northern Road (Existing)
- Redeveloped road sections
- New road sections
- ▨ Western Sydney Airport site (Commonwealth Land)
- ▨ Defence Establishment Orchard Hills (Commonwealth Land)
- ▨ Commonwealth lands
- WaterNSW supply pipelines

- Receivers qualifying for consideration of noise mitigation (by mitigation trigger)
- >2dB(A) increase
 - Combination of triggers
 - Receivers not qualifying for mitigation

0 200 400 m

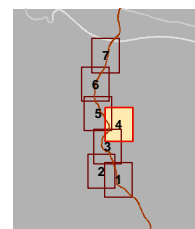


Figure 7-6 | Receivers qualifying for consideration of noise mitigation



- The Northern Road (Existing)
- Redeveloped road sections
- New road sections
- ▨ Western Sydney Airport site (Commonwealth Land)
- ▨ Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth lands
- WaterNSW supply pipelines

- Receivers qualifying for consideration of noise mitigation (by mitigation trigger)
- >2dB(A) increase
 - Combination of triggers
 - Receivers not qualifying for mitigation

0 200 400 m

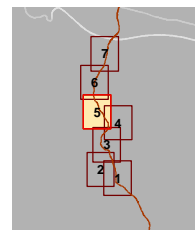
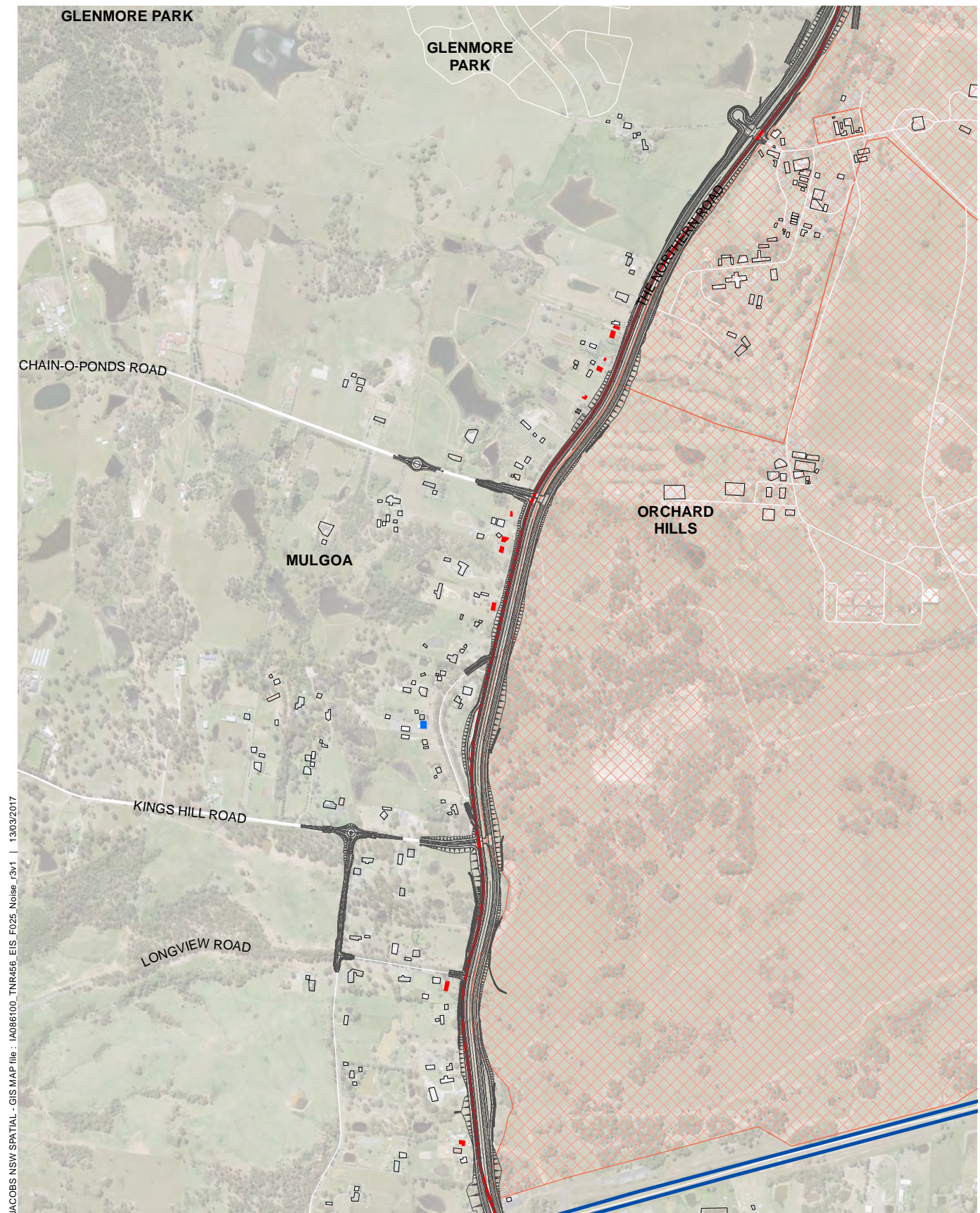


Figure 7-6 | Receivers qualifying for consideration of noise mitigation



- The Northern Road (Existing)
 - Redeveloped road sections
 - New road sections
 - Western Sydney Airport site (Commonwealth Land)
 - Defence Establishment Orchard Hills (Commonwealth Land)
 - Commonwealth lands
 - WaterNSW supply pipelines
- Receivers qualifying for consideration of noise mitigation (by mitigation trigger)**
- >2dB(A) increase
 - Combination of triggers
 - Receivers not qualifying for mitigation

0 200 400 m

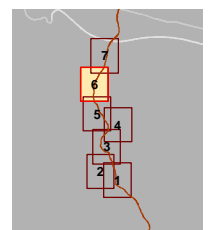
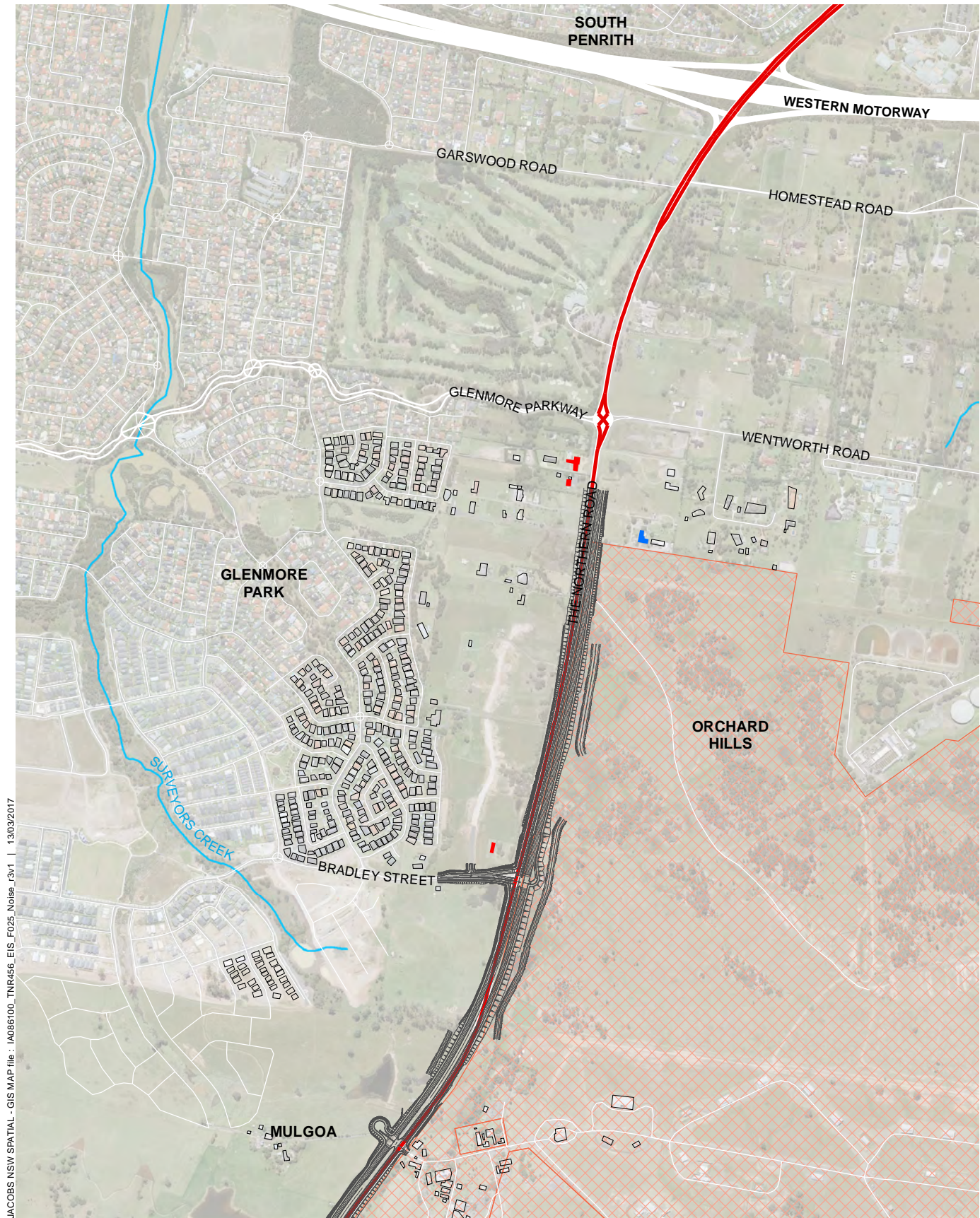
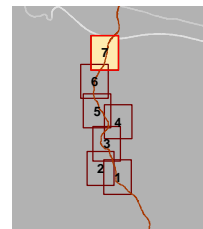


Figure 7-6 | Receivers qualifying for consideration of noise mitigation



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F025_Noise_r3v1 | 13/03/2017

Figure 7-6 | Receivers qualifying for consideration of noise mitigation



7.2.7 Summary of impacts to the environment of Commonwealth Land

The potential noise and vibration impacts to the environment of Commonwealth land as a result of construction and operation of the project are outlined below.

Potential noise and vibration impacts related to the operation of the project are outlined in Section 7.2.6. Operational noise impacts to receivers located on Commonwealth land are summarised as:

- Six receivers located on Commonwealth land have been identified as being eligible for mitigation of the project's operational noise impacts. Of the six receivers, five are located on Commonwealth owned land at the planned western Sydney airport site. One other receiver is located on Commonwealth land located west of Willowdene Avenue
- At-property treatments are considered the most reasonable form of mitigation for all six receivers.

Potential noise and vibration impacts related to the construction of the project are outlined in Section 7.2.5. The potential for construction impacts to receivers located on Commonwealth land are summarised as:

- Of the 43 receivers within the study area situated on Commonwealth land, 38 may be impacted by noise from construction processes to some extent at some stage
- Worst case impacts are predicted from daytime paving works. Worst case exceedances of NMLs during such works would typically be between 8-15 dB(A) for most of these receivers, although exceedances of up to 18 dB(A) may occur at one receiver closest to the works. Most impacted receivers are located within NCA 2. These worst case impacts would occur only at times of peak construction activity, when all plant is operating concurrently at the location nearest each receiver. These levels of exposure are expected only infrequently, as paving works are expected to pass any single receiver within one or two weeks. It is expected that any NML exceedances would not exceed 10 dB(A) for much of the construction program, and separately, that no noise exceedances would results for the majority of the project's total construction program
- Predicted worst case construction noise levels from out-of-hours work (including the simultaneous operation of all 21 ancillary facilities) would exceed night-time NMLs at most receivers within Commonwealth land. During worst case night-time works, exceedances of night-time NMLs of up to 15-28 dB(A) may result for many receivers. Again, this represents a conservative worst case scenario when all plant is operating at a point nearest a given receiver. These worst case impacts would occur for only limited periods while works passed at their nearest point to these receivers.

7.2.8 Environmental mitigation measures

Expected environmental outcomes

Where possible, the project has been designed and planned to avoid and minimise construction and operational noise and vibration impacts.

Despite this, noise and vibration impacts would occur during construction of the project, and road traffic noise impacts would occur during operation.

Noise management throughout construction of the project would aim to achieve the NMLs throughout the alignment. Where these cannot be satisfied, construction noise impacts will be mitigated using reasonable and feasible noise and management mitigation measures as per the ICNG and RMS CNVG.

Specific outcomes that would be achieved through the implementation of environmental management measures include:

- Limiting the impact of construction related noise both within and outside standard construction hours

- For construction works beyond standard construction hours, take reasonable and feasible measures to minimise potential impacts to achieve the noise goals stated in this EIS
- Potentially affected property owners and occupants are to be notified well in advance (7 days or more) as to the scale, extent and duration of construction works, as required by the consultation and communications program
- Minimise potential operational noise from road traffic noise for newly exposed properties.
- Ensuring appropriate management and mitigation measures are implemented to comply with all relevant legislation.

Expected effectiveness

Roads and Maritime have experience in managing potential noise and vibration impacts as a result of road developments of similar scale and scope to this project.

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared during the detailed design stage of the project and applied to all construction processes throughout the project. The CNVMP would be developed in accordance with Roads and Maritimes *Construction Noise and Vibration Guideline* (April 2016) The *Construction Noise and Vibration Guideline* was developed in accordance with the *NSW Interim Construction Noise Guideline* and calls for the application of feasible and reasonable measures to mitigate construction noise and vibration.

The CNVMP would include the requirement to monitor the effectiveness of construction mitigation measures at sensitive receivers. The frequency of monitoring would be outlined in the plan but would include the requirement for additional monitoring should complaints be received. The monitoring would be carried out to determine if construction methods or techniques need to be refined to minimise noise.

Ongoing spot checks of noise intensive plant and equipment would be carried out throughout construction to ensure compliance with manufactures specifications. Where actual noise levels are found to exceed the predicted worst case levels, the source of excessive noise generations would be identified, and any additional feasible and reasonable measures available would be implemented to either reduce noise emissions or reduce the impacts on receivers.

Construction activities associated with road construction are inherently noisy and are likely to result in exceedances of noise criteria.

Within 12 months of the commencement of operation of the project an operational noise review would be undertaken that would include monitoring to compare actual noise performance of the project against predicted noise performance. This review would assess the effectiveness of applied noise mitigation measures and if necessary provide reassessment of all feasible and reasonable mitigation measures.

Audits and reporting of the effectiveness of construction management measures is generally carried out to show compliance with management plans and other relevant approvals and would be outlined in detail in the CEMP and Construction Noise and Vibration Management Plan prepared for the project.

Table 7-37 outlines environmental management measures that have been developed to specifically manage potential impacts which have been predicted as a result of the proposed works.

Table 7-37 Environmental Management Measures – Noise and vibration

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
Construction noise impacts	NV-1	<p>Construction Noise and Vibration Management Plan (CNVMP) would be prepared during the detailed design stage of the project and applied to all construction processes throughout the project. The CNVMP would be prepared in accordance with the requirements in the ICNG and RMS CNVG.</p> <p>The CNVMP would nominate:</p> <ul style="list-style-type: none"> • noise goals at all sensitive receivers • restrictions on the hours of construction activity including an out-of-hours work procedure • works programming that has the aim of minimising impacts on sensitive receivers • noise and vibration mitigation measures consistent with the RMS CNVG • the project's commitments to noise and vibration monitoring and reporting • protocols for engaging with and notifying residents of any work processes that may impact them • Describe an out-of-hours work procedure (with proforma) to be applied to all construction assessments, which is consistent with the applicable Environmental Protection Licence (EPL) for the project. 	Construction contractor	Construction	<p>Expected to be effective.</p> <p>Monitoring and reporting to confirm effectiveness of measures.</p> <p>Continuous improvement to be achieved through ongoing evaluation of monitoring results.</p>

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
		<ul style="list-style-type: none"> a complaints mechanism so that residents may contact the project manager a protocol to enable the project to respond quickly to non-compliances. 			
	NV-2	<p>Viable mitigation measures that would be expected to be deployed by the construction contractor once the final construction sequencing and scheduling is known include:</p> <ul style="list-style-type: none"> Restricting works to standard construction hours as far as practicable, considering safety and traffic management requirements Selecting quieter plant and equipment Erecting temporary acoustic hoarding to reduce noise from works within a confined area Deploying mobile hoardings (eg, acoustic screen curtains mounted on a wheeled trailer) to track moving, but tightly-contained processes Maximising offset distances between receivers and noisy plant or activities Orientating plant and processes away from residences, where reasonably practicable Scheduling works for times outside of heightened sensitivity for the impacted receiver, eg, outside of school hours; 	Construction contractor	Construction	<p>Expected to be effective.</p> <p>Monitoring and reporting to confirm effectiveness of measures. Continuous improvement to be achieved through ongoing evaluation of monitoring results.</p>

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
		<ul style="list-style-type: none"> Scheduling respite periods for noise-intensive processes undertaken near receivers, eg. limiting operation of pavement sawing to three hours at a time Planning any out-of-hours (OOH) works so that noisier works are carried out in the earlier part of the evening or night-time Minimising the number of consecutive nights of works adjacent to any particular set of receivers Restricting heavy vehicle movements, heavy deliveries and loading and unloading processes to daytime periods and to areas well away from receivers Regularly maintaining and monitoring plant and equipment to ensure that their noise emissions are not excessive Minimising the annoyance from reversing alarms by either fitting closed circuit monitors or non-tonal reversing alarms ("quackers") on vehicles or deploying 'spotters' to oversee reversing movements <p>Reducing throttle settings and switching off equipment when it is not being used.</p>			
	NV3	Implement operational noise mitigation early in the construction program, where possible, to minimise construction noise impacts	Roads and Maritime	Construction	Proven to be effective

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
Operational noise impacts	NV4	Where noise barriers and/or low noise pavements are not considered feasible and/or reasonable, noise impacts at affected dwellings would be mitigated by at-property treatments.	Roads and Maritime	Operation	Proven to be effective To be carried out in consultation with affected residents
	NV5	<p>Within 12 months of the commencement of operation of the project an operational noise review would be undertaken. This would include:</p> <ul style="list-style-type: none"> • Monitoring to compare actual noise performance of the project against predicted noise performance (noise criteria) • Background noise monitoring along the alignment with concurrent traffic counts at multiple locations. • A post operation noise model would be developed to include all as-built construction documentation. Final noise wall heights, accurate road survey data and revised receiver locations / types. • The model would be validated against the new background noise and traffic data. • Noise predictions using the at opening 2021 traffic data would be undertaken using the validated post operation noise model. • An assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, reassessment of all feasible and 	Construction contractor	Operation	Proven to be effective

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
		<p>reasonable mitigation measures</p> <ul style="list-style-type: none"> • Identification of any additional feasible and reasonable measures that would be implemented with the objective of meeting the criteria in the NSW Road Noise Policy (DECCW, 2011), when these measures would be implemented and how their effectiveness would be measured and reported. 			

7.2.9 Residual impacts

The project includes mitigation measures for its predicted construction and operational impacts.

Mitigation measures for construction and operational impacts are outlined in Table 7-37.

Residual impacts from the project's construction would likely result given primarily that some loud processes (e.g. saw cutting, rock breaking) are required, and that construction activity shifts over a wide area making screening of those works difficult. Application of project specific mitigation, including notification procedures, complaints handling process, monitoring and application of alternative methods or techniques would be implemented. Where there is still a high residual impact, consideration would be given to offer of alternative accommodation to impacted residents. While Roads and Maritime acknowledge that residual impact would exist, the application of these reasonable and feasible mitigation measures would reduce residual impacts to an acceptable level. These residual impacts would be temporary, and in many cases, of short duration as works pass from one site to another.

Noise and vibration guidelines applied by Roads and Maritime and used throughout the assessment of impacts presented in this EIS assume that a balance between the application of reasonable and feasible mitigations and a level of residual level of noise impacts would be achieved. In particular, The NSW [Interim] Construction Noise and Vibration Guideline calls for the application of feasible and reasonable measures to mitigate construction noise and vibration.

The project would result in a residual level of construction and operational noise despite the application of a range of mitigation measures suggested in Table 7-37. Despite this, Roads and Maritime believes that the level of residual noise as a result of the project is acceptable.

7.3 Biodiversity

This chapter provides an assessment of potential impacts to terrestrial and aquatic biodiversity from construction and operation of the project and recommends environmental management measures to reduce these impacts. Details of the assessment undertaken are presented in Appendix I - Biodiversity Assessment Report (BAR), which includes the Biodiversity Offset Strategy (BOS) for the project.

As outlined in section 2.1.2, the Federal Minister for the Environment and Energy determined on 21 July 2016 that approval is required as the action has the potential to have a significant impact on listed threatened species and ecological communities and Commonwealth land and is therefore a 'controlled action' in accordance with the EPBC Act. The controlled action is considered by the Department of the Environment and Energy likely to have a significant impact on the following EPBC Act listed threatened species and ecological communities:

- Critically endangered – Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Cumberland Plain Woodlands)
- Critically endangered – *Lathamus discolor* (Swift Parrot)
- Critically endangered – *Anthochaera phrygia* (Regent Honeyeater)
- Vulnerable – *Pultenaea parviflora*
- Vulnerable – *Pteropus poliocephalus* (Grey-headed Flying-fox).

Approval of the project is required from the Federal Minister for the Environment and Energy in addition to the planning approvals required under State legislation (refer to Chapter 2 for additional detail regarding the assessment process for the project).

This EIS is subject to a range of legislative and policy requirements as set out in the Secretary's Environment Assessment Requirements (SEARs) and Commonwealth EIS Guidelines issued on 24 August 2016. Table 7-38 sets out the SEARs and Commonwealth EIS Guidelines as they relate to biodiversity and where in the environmental impact statement (EIS) these have been addressed.

Table 7-38 SEARs and Commonwealth EIS Guidelines for Biodiversity

Requirements	Where addressed in the EIS
Secretary's Environmental Assessment Requirements (NSW EP&A Act)	
<p>Biodiversity - including: an assessment of impacts on biodiversity, including terrestrial and aquatic ecology, and riparian corridors, in accordance with the Framework for Biodiversity Assessment (unless otherwise agreed by OEH) and the <i>Policy and Guidelines for Fish Habitat Conservation And Management—Update 2013</i> (NSW Department of Primary Industries 2013). The assessment is to be conducted by a person accredited in accordance with s142B(1)(c) of the <i>Threatened Species Conservation Act 1995</i>.</p> <p><i>Note:</i> This includes a requirement for a Biodiversity Assessment Report and a Biodiversity Offset Strategy.</p>	<p>Section 7.3</p> <p>Section 7.3.3</p> <p>Appendix I - Biodiversity Assessment Report and Biodiversity Offset strategy</p>
Commonwealth EIS Guidelines (Commonwealth EPBC Act) Requirements	
<p>The EIS must include a description of the environment of the proposal site and the surrounding areas that may be affected by the action. It is recommended that this include the following information: Listed threatened species (and suitable habitat) and ecological communities that are likely to be present in all areas of potential impact. To satisfy this requirement details must be presented on the scope, timing/effort (survey season/s) and methodology for studies and surveys used to provide information on the relevant listed threatened species/ecological community/habitat. This includes details of:</p> <ul style="list-style-type: none"> How best practice survey guidelines have been applied How surveys are consistent with (or a justification for divergence from) published Australian Government guidelines and policy statements. 	<p>Section 7.3.2</p> <p>Section 7.3.1</p> <p>Section 7.3.1</p>
<p>A description of the environment in all areas of potential impact, including all components of the environment as defined in Section 528 of the EPBC Act:</p> <ul style="list-style-type: none"> Ecosystems and their constituent parts, including plants and animals, landscapes and soils Natural and physical resources, including water resources. 	<p>Section 7.3.2 and Appendix I</p>
<p>The EIS should also provide a detailed assessment of any likely impact that this proposed action may facilitate MNES at the local, regional, state, national and international scale.</p>	<p>Section 7.3.3, Section 7.3.7 and Appendix I</p>
<p>The controlled action is considered likely to have a significant impact on the following EPBC listed threatened species and ecological communities:</p>	

Requirements	Where addressed in the EIS
<ul style="list-style-type: none"> Critically endangered – Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Cumberland Plain Woodlands) Critically endangered – <i>Lathamus discolor</i> (Swift Parrot) Critically endangered – <i>Anthochaera phrygia</i> (Regent Honeyeater) Vulnerable – <i>Pultenaea parviflora</i> Vulnerable – <i>Pteropus poliocephalus</i> (Grey-headed Flying-fox). 	Section 7.3.3 and Appendix I
<p>Impacts to the environment (as defined in section 528) should include:</p> <ul style="list-style-type: none"> Changes to water quality on site and downstream of the site; Hydrological changes Native flora and fauna habitat removal and degradation (on site and in surrounding areas that may be affected by the action) Vehicle strike (fauna) Lighting impacts on everyday activities and on sensitive environmental receptors (all sensitive receptors within the community and natural environment). 	<p>Section 8.2 Section 7.5</p> <p>Section 7.3.3</p> <p>Section 7.3.3</p>
<p>The EIS must take into account relevant agreements and plans that cover impacts or known threats to a matter protected by a controlling provision (including but not necessarily limited to):</p> <ol style="list-style-type: none"> Any recovery plan and/or conservation advice for the affected species or ecological community Any threat abatement plan for a process that threatens an affected species or ecological community Any wildlife conservation plan for the affected species Any relevant strategic assessment undertaken in accordance with an agreement under Part 10 of the EPBC Act. 	Section 7.3.4
<p>The EIS must include details of an offset package to be implemented to compensate for residual significant impacts associated with the project as well as an analysis of how the offset meets the requirements of the Department's <i>Environment Protection and Biodiversity Conservation Act 1999</i> Environmental Offsets Policy October 2012 (EPBC Act Offset Policy) or a state offsetting policy that has been endorsed by the Commonwealth.</p>	<p>Appendix I</p> <p>Section 7.3.6</p>
<p>The offset package can comprise a combination of direct offsets and other compensatory measures, as long as it meets the requirements of the EPBC Act Offset Policy. Offsets should align with conservation priorities for the impacted protected matter and be tailored specifically to the attribute of the protected matter that</p>	<p>Appendix I</p> <p>Section 7.3.6</p>

Requirements	Where addressed in the EIS
<p>is impacted in order to deliver a conservation gain. Offsets should compensate for an impact for the full duration of the impact. Offsets must directly contribute to the ongoing viability of the protected matter impacted by the project and deliver an overall conservation outcome that maintains or improves the viability of the protected matter, compared to what is likely to have occurred under the 'status quo' (i.e. if the action and associated offset had not taken place). Note: Offsets do not make an unacceptable impact acceptable and do not reduce the likely impacts of a proposed action. Instead, offsets compensate for any residual significant impact.</p>	<p>Appendix I Section 7.3.6</p>
<p>The EIS must provide:</p> <ul style="list-style-type: none"> a) Details of the offset package to compensate for significant residual impacts on a protected matter b) An analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy. 	<p>Appendix I Section 7.3.6</p>
<p>Details in relation to the proposed offsets package, including:</p> <ul style="list-style-type: none"> a) The location and size, in hectares, of any offset site(s) b) Maps for each offset site that clearly show: <ul style="list-style-type: none"> (i) The relevant ecological features (ii) The landscape context (iii) The cadastre boundary c) The current tenure arrangements (including zoning and ownership) of any proposed offset sites d) Confirmed records of presence (or otherwise) of relevant protected matter(s) on the offset site(s) e) Details of studies and surveys used to confirm the presence of individuals and or likely habitat within offset site(s), including the scope, timing/effort (survey season/s) and methodologies employed f) Detailed information regarding the extent (in hectares) and quality of habitat for relevant protected matter(s) on the offset site. The quality of habitat should be assessed in a manner consistent with the approach outlined in the document titled <i>How to use the offset assessment guide</i> available at http://www.environment.gov.au/epbc/publications/environmental-offsets-policy.html. 	<p>Appendix I Section 7.3.6</p>
<p>Provide information and justification regarding how the offsets package will deliver a conservation outcome that will maintain or improve the viability of the protected matter(s) consistent with the EPBC Act environmental offsets policy (October 2012) including:</p> <ul style="list-style-type: none"> a) Management actions that will be undertaken to improve or maintain the quality of the proposed offset site(s) for the relevant protected matter(s). Management actions must be clearly described, planned and resourced as to justify any proposed improvements in quality for the protected matter(s) over time b) The time over which management actions will deliver any 	<p>Appendix I Section 7.3.6</p>

Requirements	Where addressed in the EIS
<p>proposed improvement or maintenance of habitat quality for the relevant protected matter(s)</p> <p>c) The risk of damage, degradation or destruction to any proposed offset site(s) in the absence of any formal protection and/or management over a foreseeable time period (20 years). Such risk assessments may be based on:</p> <ul style="list-style-type: none"> (i) Presence of pending development applications, mining leases or other activities on or near the proposed offset site(s) that indicate development intent (ii) Average risk of loss for similar sites (iii) Presence and strength of formal protection mechanisms currently in place <p>d) The legal mechanism(s) that are proposed to protect offset site(s) into the future and avert any risk of damage, degradation or destruction.</p>	
Provide information regarding how the proposed offsets package is additional to that already required, as determined by law or planning regulations, agreed to under other schemes or programs or required under an existing duty-of-care.	<p>Appendix I</p> <p>Section 7.3.6</p>
<p>The overall cost of the proposed offsets package; including costs associated with, but not necessarily limited to:</p> <ul style="list-style-type: none"> a) Acquisition and transfer of lands/property b) Implementation of all related management actions c) Monitoring, reporting and auditing of offset performance. 	<p>Appendix I</p> <p>Section 7.3.6</p>

7.3.1 Assessment Methodology

The process of assessing the potential impacts of the project and developing impact mitigation measures for the various aspects of this report are outlined below.

The information sources used in carrying out the assessment are identified below, where applicable, and comprise Government databases, certified local data and mapping and previous assessments. A complete list of information sources used in the assessment is provided in the working paper. The assessment methodologies described below identify where those sources of information have been verified through ground-truthing and survey.

The assessment presented is based upon available data and the field surveys and are therefore indicative of the environmental condition of the study area at the time of the survey. It should be recognised that conditions, including the presence of threatened or cryptic species, could change with time. To address this limitation, a precautionary approach has been used which aimed to identify the presence and suitability of the habitat for threatened species. Where additional limitations to the survey have been identified, they are outlined in the methodology below.

Approach to biodiversity assessment

The *NSW Biodiversity Offsets Policy for Major Projects (BOPMP)* (Office of Environment and Heritage 2014b) provides a standard method for assessing impacts of major projects on biodiversity in NSW and determines offsetting requirements. In the State Significant Infrastructure (SSI) application process, the EIS must address the SEARs requested by the DPE and apply the Framework for Biodiversity Assessment (FBA) (NSW Office of Environment and Heritage 2014a). The FBA contains the assessment methodology that is adopted by the policy to quantify and describe the impact assessment requirements and offset guidance that apply to Major Projects.

Under the Commonwealth process, the Commonwealth EIS Guidelines provides for an offset package to be implemented to compensate for residual significant impacts in order to meet the requirements of a state offsetting policy that has been endorsed by the Commonwealth. The FBA has been endorsed by the Commonwealth and has therefore been used to assess the biodiversity impacts of the project, including nationally listed threatened species and threatened ecological communities, and calculating the offsetting requirements.

The FBA adopts the BOPMP and provides an assessment methodology to identify terrestrial biodiversity values, assess impacts and quantify and describe biodiversity offsets required for unavoidable impacts. This comprises of three stages:

- Stage 1 - Biodiversity assessment
- Stage 2 - Impact assessment (biodiversity values)
- Stage 3 - Biodiversity Offset Strategy.

For aquatic biodiversity impacts, the FBA refers to the requirements of the *Fisheries NSW Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries 2013). This assessment has been included in the Biodiversity Assessment Report (BAR) for completeness.

The FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and ecological communities. The Commonwealth EIS guidelines outline the specific assessment requirements for matters of national environmental significance (MNES), impacts to the environment of Commonwealth land and content of the EIS.

The biodiversity assessment was completed in accordance with the requirements specified by the SEARs issued on 28 July 2015, the amended SEARs issued on 9 March 2016 and the Commonwealth EIS Guidelines. The SEARs state that biodiversity impacts related to the proposed development including terrestrial and aquatic ecology, and riparian corridors, are to be assessed in accordance with the FBA (unless otherwise agreed by OEH) and the *Policy and Guidelines for Fish Habitat Conservation And Management—Update 2013* (NSW Department of Primary Industries 2013). This includes a requirement for a BAR and a Biodiversity Offset Strategy (BOS) (see Appendix I).

Potential impacts to biodiversity not considered by the FBA are also addressed in the BAR. This includes aquatic biodiversity, habitat fragmentation (ie the physical dividing up of once continuous habitats into separate smaller 'fragments'), edge effects (ie changes in environmental conditions such as altered light levels, wind speed, temperature that occur along the edges of habitats), injury and mortality to fauna, invasion and spread of weeds, and noise, vibration and dust impacts. These matters were assessed separately and in accordance with the relevant policy and guidelines including the *NSW Fisheries NSW Policy and guidelines for fish habitat conservation and management (update 2013)* (NSW Department of Primary Industries 2013).

Habitat fragmentation *per se* relates to the physical dividing up of once continuous habitats into separate smaller 'fragments'.

Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats.

The BAR addresses impacts on biodiversity values that require further consideration (ie impacts that are considered to be complicated or severe) based on thresholds detailed in Section 9 of the FBA which includes:

- Impacts on landscape features, being:
 - impacts that would reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas, or
 - impacts that would prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state
 - Impacts on native vegetation that are likely to cause the extinction of an Endangered Ecological Community (EEC) / Critically Endangered Ecological Community (CEEC) from an Interim Biogeographically Regionalisation of Australia (IBRA) sub-region or significantly reduce its viability
 - Impacts on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA sub-region or significantly reduce its viability.

The biodiversity assessment was conducted by persons accredited in accordance with s142B (1) (c) of the NSW *Threatened Species Conservation Act 1995* (TSC Act). The biodiversity assessment was prepared in accordance with relevant policies and guidelines and refers to the following:

- Framework for Biodiversity Assessment (NSW Office of Environment and Heritage 2014a)
- NSW Biodiversity Offsets Policy for Major Projects (NSW Office of Environment and Heritage 2014b)
- Policy and guidelines for fish habitat conservation and management (update 2013) (NSW Department of Primary Industries 2013)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (NSW Department of Environment and Conservation 2004)
- NSW Guide to Surveying Threatened Plants (NSW Office of Environment and Heritage 2016)
- Survey Guidelines for Australia's Threatened Orchids: Guidelines for detecting orchids listed as threatened under the EPBC Act 1999 (Department of Environment 2013)
- Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians (NSW Department of Environment and Climate Change 2009)
- Commonwealth Policy Statements on survey guidelines for Australia's threatened fauna including bats birds, frogs, fish, mammals and reptiles (Department of Environment Water Heritage and the Arts 2010a, 2010b, 2010c, 2011a, 2011b)
- Commonwealth's Significant Impact Guidelines 1.1 (Matters of National Environmental Significance)
- Significant Impact Guidelines 1.2 (Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth agencies).

Biodiversity study area

The project is located within the Penrith and Liverpool local government areas (LGAs) and traverses the suburbs of Bringelly, Luddenham, Orchard Hills, Mulgoa and Glenmore Park. The study area is located within the Cumberland sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell, 1995. The study area is located wholly on the Cumberland Plain

Mitchell Landscape as mapped by the NSW National Parks and Wildlife Service (2002) and described by the NSW Department of Environment and Climate Change (2008).

The study area contains the construction and operational footprints for the project. A map of the study area is presented in Figure 7-7. The construction footprint is the area proposed to be impacted, cleared and/or disturbed during construction. For the purposes of this biodiversity assessment, it is assumed that there would be complete vegetation clearance within the construction footprint. This precautionary approach has been taken to the assessment to ensure all potential impacts are captured and assessed as the design is yet to be finalised. The construction footprint has the same meaning as 'development site' for the purposes of the FBA, however for consistency with the rest of the EIS is herein referred to as the construction footprint. The operational footprint for the project is the area that would be physically impacted by the operation of the project, including all operational ancillary infrastructures. The operational footprint is fully contained within the construction footprint.

Desktop assessment

A background review of existing information was undertaken in January 2016 to identify the existing environment of the study area and locality (to establish a baseline). The review focused on database searches, relevant ecological reports pertaining to the study area, property boundaries, and relevant GIS layers. Relevant databases and literature included:

- Atlas of NSW Wildlife
- OEH vegetation information system (VIS) database (Office of Environment and Heritage 2015)
- The federal Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE) (Bureau of Meteorology 2016)
- DPI's database for aquatic TECs (NSW Department of Primary Industries 2016)
- EPBC Act protected matters search tool (Commonwealth Department of the Environment and Energy 2016b)
- Available regional vegetation mapping including The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities (Tozer 2003) and the Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands (Tozer et al. 2010)
- Geology of the Penrith 1:100,000 Sheet 9030 (Clarke & Jones, 1991)
- Soil landscapes of the Penrith 1:100,000 Sheet 9030 (Hazelton et al., 1989)
- Western Sydney Airport EIS Biodiversity Assessment (GHD, 2016).

The percent native vegetation cover within the 550 metre landscape buffer from the centreline of the development footprint was digitised based off aerial photography. A 550 metre buffer area along each side of the centre line of the linear shaped development footprint is used as part of the FBA to assess landscape value for linear shaped developments, or multiple fragmentation impacts. This method was chosen in place of using regional vegetation mapping (e.g. NSW National Parks & Wildlife Service 2004; Tozer 2003) to improve the accuracy of the vegetation cover estimates as these mapping projects are not suitable for use at such fine scales.

Broad scale vegetation mapping of the area including the Native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities (Tozer 2003) and the Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands (NSW National Parks & Wildlife Service 2004) were used to inform the identification of Plant Community Types (PCTs). The Geology of the Penrith 1:100,000 Sheet 9030 (Clarke, N. R. & Jones 1991) and Soil landscapes of the Penrith 1:100,000 Sheet 9030 (Hazelton et al. 1989) were also used in the identification of PCTs. Topography was examined in a GIS using a shaded relief raster (hillshade) created from an elevation layer.

The preliminary vegetation mapping was then rapidly ground-truthed during the preliminary rapid site assessment phase where PCTs and vegetation zones were refined (refer to vegetation field survey methodology below).

The BAR (Appendix I) uses the definition of a groundwater dependent ecosystem (GDE) as outlined by Serov et al. (2012) which is an ecosystem which has its species composition and natural ecological processes wholly or partially determined by groundwater. The location of GDEs within the within the Hawkesbury Nepean management zone is mapped by Kuginis et al. (2012).

Habitat assessment

Target threatened species for assessment were largely identified via the BioBanking credit calculator (BBCC). The BBCC is a decision support system provided by OEH to assist assessors to comply with the requirements of the FBA. An accredited assessor must use the Credit Calculator to undertake an assessment of the impacts of the project on biodiversity values and to prepare a BAR. However, the following database searches were undertaken to identify additional species with potential to occur in the study area and included:

- Atlas of NSW Wildlife
- OEH BioBanking Threatened Species Profile Database
- NSW Department of Primary Industries (DPI) Fisheries Fish Records Viewer
- The federal Department of Environment and Energy's Protected Matters Search Tool
- Critical habitat register.

Rapid habitat assessments were conducted at vegetation plot sites to gather information on the type and condition of the fauna habitats present with a focus on identifying the suitability of the habitat for the list of predicted threatened species generated from the BioBanking Calculator and additional species. Under the FBA, the assessor must undertake a plot-based full floristic survey of the development site that is stratified and targeted to assess the expected environmental variation. The plot-based full floristic survey is based on a 20 m × 20 m quadrat (or 400 m² equivalent for linear areas). At each survey site an assessment was made of the fauna habitat features including the:

- Type and structure of the vegetation, including an assessment of the 'naturalness' in terms of the presence of remnant vegetation or planted and re-growth areas and the extent of modification
- Presence and frequency of large mature trees, tree hollows, standing dead trees (stags) and logs
- Presence of significant keystone species and critical habitat elements for threatened fauna
- Disturbance regimes, both past and ongoing including grazing and weed abundance
- Density of each vegetation strata (structural diversity)
- Presence and quality of wet areas or waterbodies, significant aquatic habitats where present
- Size of remnant patches and extent of connectivity, movement corridors and refuge value.

The habitat assessment data were used to identify the likelihood for predicted species credit species (ie a species that cannot be predicted by habitat surrogates) to occur and inform the detailed survey. Threatened species that cannot reliably be predicted to occur on a development site based on PCT, distribution and habitat criteria are identified by the Threatened Species Profile Database as species credit species.

All threatened species with a moderate to high likelihood of occurrence, that have been identified as requiring survey in the BBCC, or that have been recorded during the surveys are considered target threatened species. The likelihood of occurrence of a threatened species was assessed in accordance with the criteria outlined in Table 7-39.

Table 7-39 Likelihood of occurrence criteria used in the habitat assessment

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10 km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

Field Surveys

Vegetation surveys

The vegetation surveys were completed using field survey methods in line with Chapter 5 of the FBA and implementing the guidelines for *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (NSW Department of Environment and Conservation 2004). The field surveys were undertaken over a period of 11 days from 2 September 2015 to 4 February 2016.

During the initial stages of the assessment a rapid reconnaissance survey was undertaken where the study area was visited to verify and refine the Plant Community Types (PCTs) identified from the desktop assessment. PCTs were classified in accordance with the OEH vegetation information system (VIS) database (Office of Environment and Heritage 2015). Variations in vegetation condition and quality were noted to inform the stratification of PCTs into vegetation zones.

Transects/plots were undertaken in each vegetation zone using a series of 20 x 20 m quadrates nested inside a 20 x 50 m transect. Site attributes were assessed at each transect/plot to obtain a quantitative measure of vegetation condition to be applied for each vegetation zone.

The condition of vegetation patches was assessed according to the criteria provided in the Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Threatened Species Scientific Committee 2009).

The vegetation field survey provided good spatial coverage and survey effort of the development site, meeting the requirements of the FBA. However, the field survey was constrained by landowner permissions and restricted access in some areas. After detailed design and prior to the

finalisation of the offset package for the Project, surveys of these areas would be undertaken and new calculations performed as necessary.

Targeted threatened flora surveys

Targeted threatened flora surveys were undertaken for all identified candidate flora species with suitable habitat based on desktop review. Using data from the Threatened Species Profile Database, the assessor must identify a threatened species as a candidate species for the development site if:

- (a) the species is identified as a species credit species in the Threatened Species Profile Database, and
- (b) the geographic distribution of the species is known or predicted to include the IBRA sub-region in which the development site is located, and
- (c) the development site contains habitat features or components associated with the species, as identified in the Threatened Species Profile Database, OR
- (d) past surveys undertaken at the development site indicate that the species is present.

The targeted flora surveys followed the methods described in the *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft 2004* (NSW Department of Environment and Conservation 2004). The survey timing adhered to the months detailed in the BBCC for each species credit species targeted. The surveys specifically targeted the following species credit species *Pilularia novae-hollandiae*, *Eucalyptus benthamii*, *Dillwynia tenuifolia*, *Acacia pubescens*, *Grevillea juniperina* subsp. *juniperina*, *Marsdenia viridiflora* subsp. *viridiflora* endangered population, *Cynanchum elegans* and *Pimelea spicata*.

For cryptic species (ie *Pimelea spicata*) that are known to be associated with the PCTs within the study area (i.e. potential habitat was present), the field survey included visiting reference populations to ensure visibility in the study area during the survey period.

Targeted threatened fauna surveys

Targeted threatened fauna surveys were undertaken for species identified as having a moderate to high likelihood of occurring in the study area based on desktop review. The survey approach and methods for the fauna surveys were designed to address the methods described in the *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft 2004* and the following guidelines:

- Amphibians – Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (2009) <http://www.environment.nsw.gov.au/resources/threatenedspecies/09213amphibians.pdf>
- Threatened bats – Survey Guidelines for Australia's Threatened Bats, Commonwealth of Australia (2010). <http://www.environment.gov.au/epbc/publications/threatened-bats.html>
- Threatened birds – Survey Guidelines for Australia's Threatened Birds, Commonwealth of Australia (2010) <http://www.environment.gov.au/system/files/resources/107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds.pdf>
- Threatened frogs – Survey Guidelines for Australia's Threatened Frogs, Commonwealth of Australia (2011). <http://www.environment.gov.au/system/files/resources/ff3eb752-482d-417f-8971-f93a84211518/files/survey-guidelines-frogs.pdf>.

Rapid habitat assessments were conducted at vegetation plot sites to gather information on the type and condition of the fauna habitats present, with a focus on identifying the suitability of the habitat for the list of predicted threatened species.

Targeted fauna surveys were undertaken for the Green and Golden Bell Frog, Australasian Bittern, Black Bittern, Cumberland Plain Land Snail, Koala, Regent Honeyeater, and threatened insectivorous bats.

Surveys for birds, including migratory species, were undertaken as part of the field surveys for the EIS. The surveys included area surveys over two hectares for 20 minutes each conducted in late spring and summer during which time most of the listed migratory species are present in eastern Australia. Specific habitats including wetlands were targeted during the survey.

The fauna species which were identified from the background review and habitat assessment that were targeted during the survey are discussed in Table 7-40.

Table 7-40 Targeted fauna survey details

Species	Minimum survey requirements	Survey completed
Green and Golden Bell Frog	<p>All surveys should be undertaken within one week of heavy rainfall (>50 mm in seven days) during spring/summer (October – March)</p> <p>Initial habitat assessment - surveys using a combination of call detection, call playback and spotlighting</p> <p>A minimum of four nights under ideal conditions</p> <p>Small wetlands (<50 m at greatest length) should be covered in about one hour</p> <p>Large sites should be sampled systematically</p>	<p>All dams within 100-200 m of the project corridor where assessed for their habitat value using criteria identified in the literature. In total 38 farm dams or clusters of connected dams along drainage lines were assessed (refer to Appendix I).</p> <p>Potential habitats identified and each searched for one hour by two ecologists using call detection, call playback and spotlighting. Large series of dams at the Defence site surveyed systematically over four nights. Total survey effort was 6 nights. All surveys were conducted within a week of heavy rainfall which ranged from 30-90 mm.</p> <p>The nocturnal field surveys were undertaken over a period of 6 nights from 2 September 2015 to 4 February 2016 (not inclusive).</p>
Regent Honeyeater	<p>20 minute surveys of two hectare plots per stratification unit</p> <p>Area and targeted searches in woodland concentrating on flowering Eucalypts and where other nectar feeding birds are evident</p> <p>20 hours over 5 days</p>	<p>20 minute dedicated surveys of approx. two hectare plots by one ecologist repeated twice at each of four sites (4 mornings) plus opportunistic surveys during all other site activities (about 25 hours over 10 days). Surveys undertaken at four sites across study area, including opportunistic sightings, targeted both PCTs. The field surveys were undertaken over a period of 6 days from 2 September 2015 to 4 February 2016 (not</p>

Species	Minimum survey requirements	Survey completed
		inclusive).
Cumberland Plain Land Snail	<i>M. corneovirens</i> can be surveyed year round and it is not necessary to wait until after wet weather The minimum time required would depend on the size and amount of potential habitat present within the site being assessed	Habitat assessment undertaken at 50 locations across both PCTs, focused at vegetation plot locations. 10 minute search at each habitat assessment plot and general search around sites identified as moderate to high habitat value.
Australasian Bittern and Black Bittern	Observations targeted foraging habitat within wetland within early morning or evenings for this cryptic species. Detection by observation or solicited calls	Evening and spotlighting surveys and call playback over 6 evenings / nights by two ecologists. Survey times varied between 0.5 to 2.0 hrs at each site. In total 7 sites were surveyed for bitterns.
Eastern Bentwing-bat Large-eared Pied Bat	Harp trapping - Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night) per 100 ha of stratification unit Call detection - Two sound activated recording devices utilised for the entire night (a minimum of four hours), starting at dusk for two nights per 100 ha of stratification unit	Harp traps* – four trap nights over two consecutive nights at four different locations (8 trap nights). Poor flyways in study area so traps placed on tracks where available and on edge of flyway or forest edge. Call detection – Four AnaBat™ II bat detectors used each for two nights and each recording from 1900 hours to 0500 hours.

*Harp traps are a type of trap with a square frame made of aluminium (or steel or wood) mounted on adjustable legs with monofilament fishing line strung vertically in the frame in two or more banks. Below the bottom of the frame is a canvas catch bag lined with plastic. There are many harp trap designs and a range of frame sizes for different uses.

Aquatic surveys

Aquatic habitat assessments were conducted on the 20 to 22 February 2016. Sites were assessed against the Policy and Guidelines for Fish Habitat Conservation and Management (update, 2013) (Department of Primary Industries 2013), Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge, 2003), and Policy and Guidelines for fish Friendly Waterway Crossings (DPI, 2004). These guidelines provide information for waterway classification and ways to minimise impacts to fish and other aquatic wildlife from road projects which may improve the survival rate and protect threatened fish species, populations and their habitat. Due to the low likelihood of threatened fish species present, limited water availability and limited aquatic habitat, fish and macroinvertebrate surveys were deemed unnecessary. Visual inspections allowed the classification of Key Fish Habitat (DPI, 2013).

7.3.2 Existing environment

The following sections outline the existing environmental conditions relevant to terrestrial and aquatic ecology. This is considered to provide a baseline of existing conditions from which potential impacts from the project have been assessed.

Landscape scale biodiversity features

In accordance with Chapter 4 of the FBA, the BAR has identified a number of landscape features such as the IBRA region, IBRA sub-region, Mitchell landscape (landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH, 2014)), rivers and streams, extent of native vegetation in the area assessed for the project.

The landscape scale biodiversity features identified within the biodiversity study area are summarised in Table 7-41 and shown in Figure 7-7.

Table 7-41 Biodiversity landscape features within the biodiversity study area

Landscape feature	Description
Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and sub-region	The study area is located within the Cumberland sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell, 1995.
NSW Landscape Regions (Mitchell Landscapes)	The study area is located wholly on the Cumberland Plain Mitchell Landscape as mapped by the NSW National Parks and Wildlife Service (2002) and described by the NSW Department of Environment and Climate Change (2008).
Rivers and streams	The northern portion of the project lies within the Lower Nepean River Management Zone of the Hawkesbury and Lower Nepean Rivers Water Source, while the while the southern portion lies within the Mid Nepean River Catchment Management Zone and the Upper South Creek Management Zone. The Nepean River is the ultimate downstream receiving environment. The project directly traverses a number of unnamed tributaries and drainage lines (sometimes associated with farm dams), as well as the following named creeks: Cosgroves Creek, a second order intermittent stream which is a tributary of South Creek, and Badgerys Creek, a second order intermittent stream containing permanent residual pools.
Wetlands	Artificial wetlands (i.e. farm dams, detention basins, roadside drains, one effluent treatment system) are scattered throughout the study area. There are no naturally occurring wetlands in the study area.
State of regionally significant biodiversity links	<p>The Biodiversity Investment Opportunities Map (BIO Map) (Office of Environment and Heritage 2015a) identifies areas for biodiversity investment funding within the Cumberland sub-region, termed priority investment areas, including core areas and biodiversity corridors of state and regional significance.</p> <p>The northern portion of the study area on the DEOH is mapped as a core area on the BIO Map (Office of Environment and Heritage 2015a). This core area is also identified as Priority Conservation Land from the Cumberland Plain Recovery Plan (Department of Environment Climate Change and Water 2010) and mapped as a Regional Corridor on the BIO Map. Regional Corridor 17, a corridor that connects the Mulgoa Nature Reserve to the vegetation on the DEOH is also mapped in this area on the BIO Map.</p> <p>The BIO Map (Office of Environment and Heritage 2015a) has not been approved by the Chief Executive of OEH and therefore these</p>

Landscape feature	Description
	<p>biodiversity links have not been included in the FBA calculations.</p> <p>There are seven local area biodiversity links within the study area as defined under the FBA. These seven functional local area connecting links contain woody PCTs assumed to have a percentage foliage cover in over-storey and mid-storey or ground cover condition within benchmark levels. The minor riparian buffers (1st and 2nd order streams) within the study area are not eligible for classification under state or regional biodiversity links according to Appendix 5 of the FBA.</p>
Per cent native vegetation cover	<p>Current per cent native vegetation cover is estimated at 11.8 per cent (score 2.5 as outlined in Table 16 of Appendix 5 of the FBA). After the development, per cent native vegetation cover is estimated at 10 per cent (score 1.25 as outlined in Table 16 of Appendix 5 of the FBA). Clarification of the scores is detailed in the BAR, and relates to a score given for each range.</p>

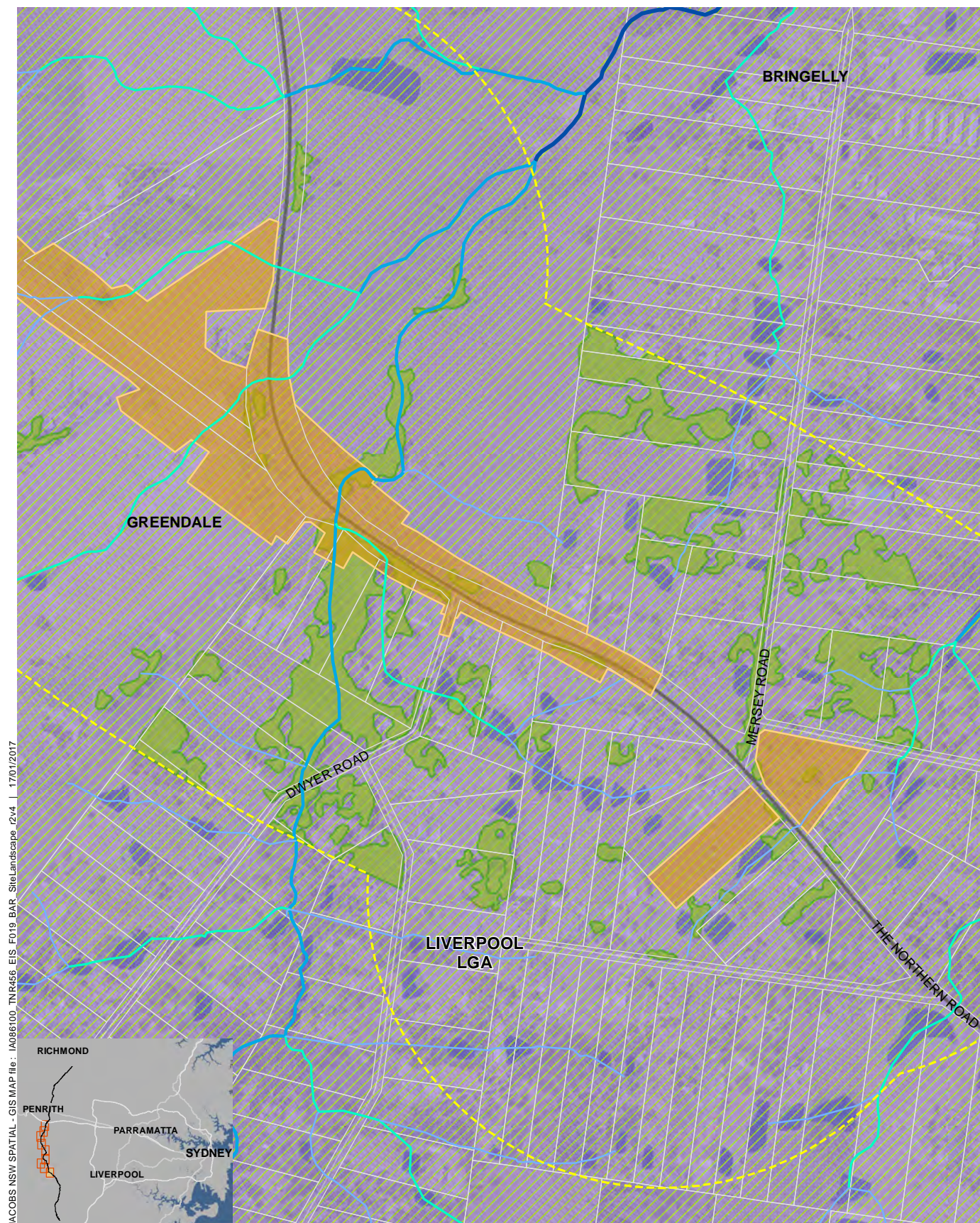
As the project is a linear shaped development, landscape value was also assessed according to Appendix 5 of the FBA (assessing landscape value for linear shaped developments, or multiple fragmentation impacts). To undertake the assessment of landscape values, a 550 m buffer was established either side of the centre line of the proposed alignment. All landscape value calculations were undertaken using ESRI ArcGIS 10.1 software.

The landscape scale biodiversity values identified within the biodiversity study area are summarised in Table 7-42.

Table 7-42 Biodiversity landscape values within the biodiversity study area

Landscape value	Description
Connectivity value	<p>There are no state or regionally significant biodiversity links in the study area. The project would impact on local area biodiversity links and the score for connectivity value class is 2.5. Local links are mapped in the BAR and have been identified as areas of native vegetation in moderate to good condition that are ≥ 250 ha and < 1000 ha in total, or areas greater than 1000 ha in total AND</p> <p>Width of vegetation in moderate to good condition that is connecting the area is > 30 m and < 100 m.</p>
Patch size	<p>The project occurs in the Cumberland Plain Mitchell Landscape with is 89 per cent cleared. The development footprint crosses three distinct vegetation patches. Patch 1 is at least 778 ha in size. Patch 2 is at least 1,820 ha in size. Patch 3 is at least 2,573 ha in size. The final patch size score is 12.5 (the average of the three patch scores).</p>
Area to perimeter ratio	<p>The area to perimeter ratio before the development is 22 and after development is 21. This was calculated as follows:</p> <ul style="list-style-type: none"> The native vegetation within the 550m buffer zone was digitised using GIS to determine the existing percentage vegetation cover across this assessment area Any areas less than or equal to one hectare in size was removed from the digitised GIS layer so that only patches of vegetation greater than one

Landscape value	Description
	<p>hectare were included</p> <ul style="list-style-type: none"> • All other areas not impacted by the development (i.e. intersected, modified or removed) were also removed from the digitised GIS layer. This was then used to calculate the total area and perimeter length of existing vegetation resulting in an area to perimeter ratio before development of 22 <p>The project construction boundary was overlaid onto this GIS layer and any vegetation within the boundary was removed in order to calculate an area to perimeter ratio after development of 21.</p> <p>The proportional change in area to perimeter ratio as calculated by the credit calculator is 4.5 and the score for the proportional change in area to perimeter ratio is therefore 1 based on Table 19 in Appendix 5 of the FBA. This is a relatively small change in area to perimeter ratio and is expected as the vegetation currently has a high area to perimeter ratio (due to many small fragments of vegetation in the landscape) which would not be increased significantly by the project.</p>
Commonwealth land	<p>The project is located on a portion of the DEOH and a portion of Commonwealth land purchased for the Western Sydney Airport. The Orchard Hills Cumberland Plain Woodland is a Listed Place on the Commonwealth Heritage List (CHL 105317) and is located on the DEOH site. The land at Orchard Hills is recognised as the least disturbed and largest remaining remnant of Cumberland Plain Woodland. The tributaries of Blaxland Creek at Orchard Hills are among the least disturbed catchments remaining on the Cumberland Plain and are regarded as possibly the most pristine creek system on Wianamatta Shale left in Western Sydney (Department of the Environment, 2016b).</p>



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F019_BAR_SiteLandscape_v2.v4 | 17/01/2017

0 200 400 m



- The Northern Road (Existing)
- 550m assessment buffer
- Development site boundary
- Hydro areas (dams and waterbodies)
- Native vegetation
- Regional Corridor as identified by OEH BIOMAP

- IBRA sub-region
- Cumberland
- Mitchell landscape
- Cumberland Plain

Rivers and streams (Stahler stream order)

- 1
- 2
- 3
- 4

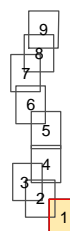


Figure 7-7 | Site location and landscape features

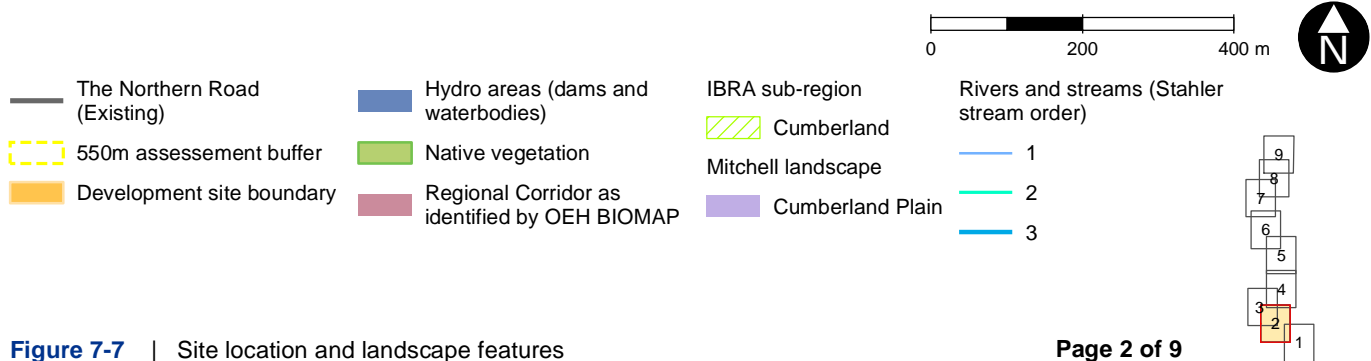
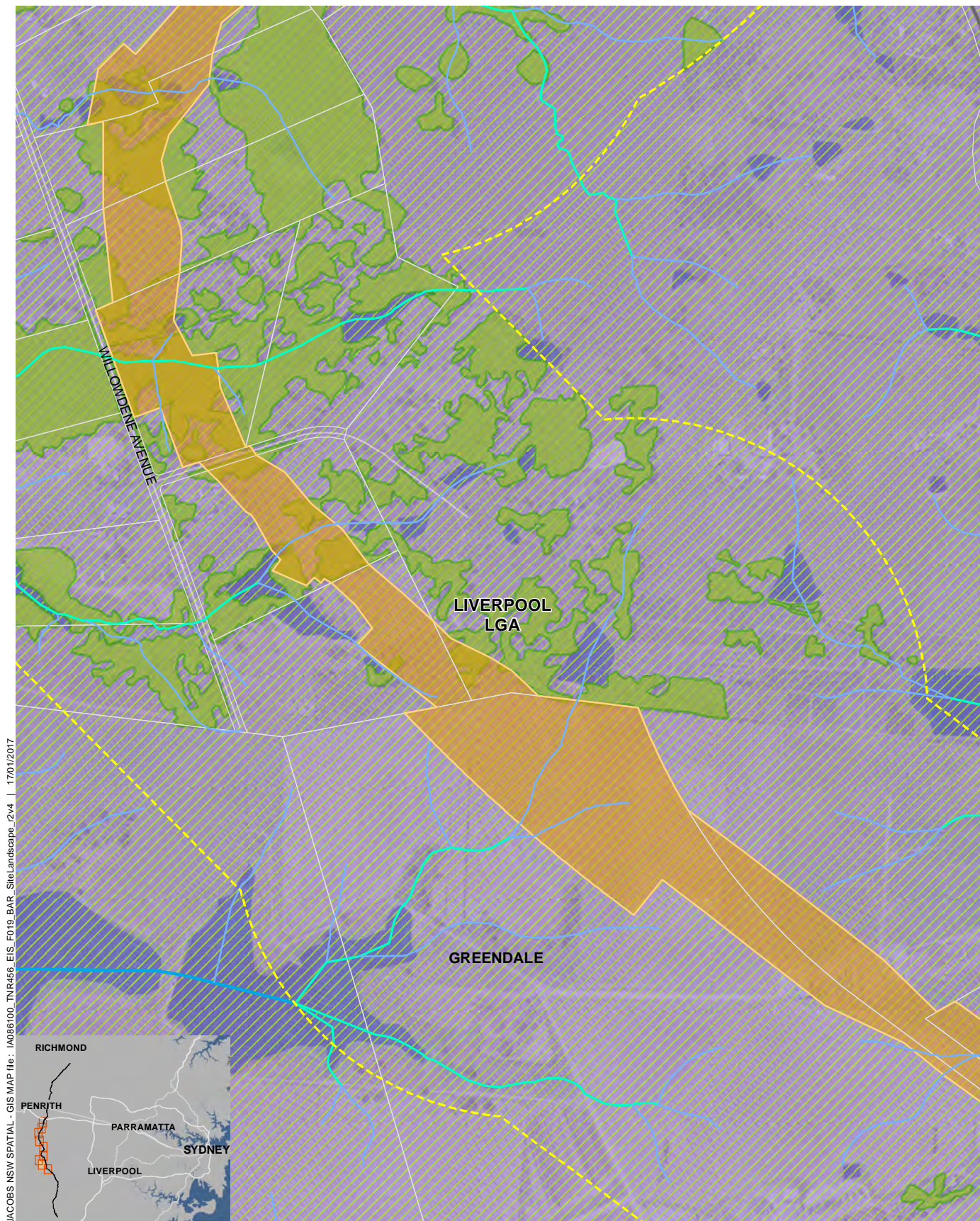
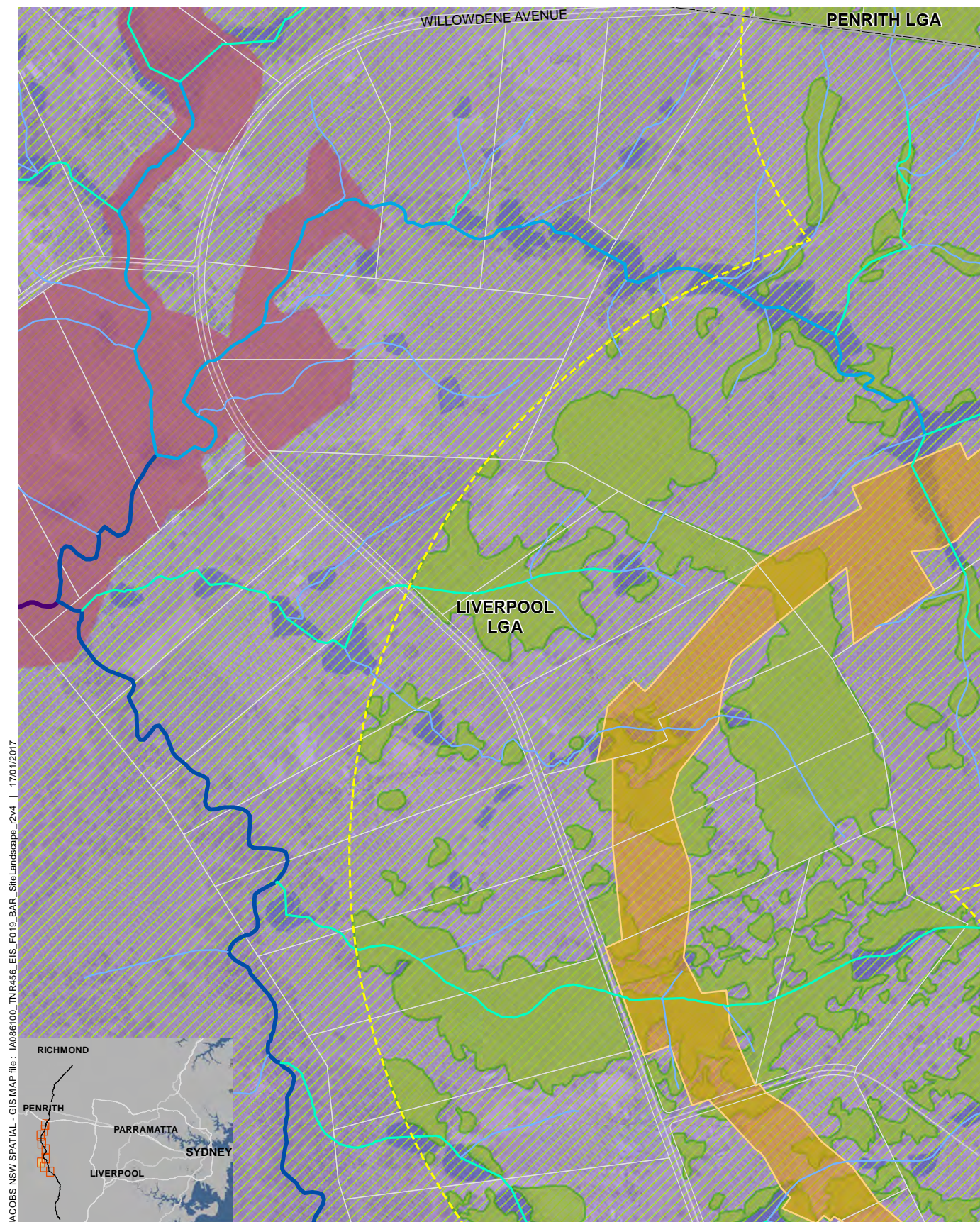


Figure 7-7 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F019_BAR_SiteLandscape_v2v4 | 17/01/2017

0 200 400 m



- The Northern Road (Existing)
- 550m assessment buffer
- Development site boundary
- Hydro areas (dams and waterbodies)
- Native vegetation
- Regional Corridor as identified by OEH BIOMAP

- IBRA sub-region
- Cumberland
- Mitchell landscape
- Cumberland Plain

Rivers and streams (Stahler stream order)

- 1
- 2
- 3
- 4
- 5

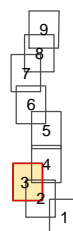
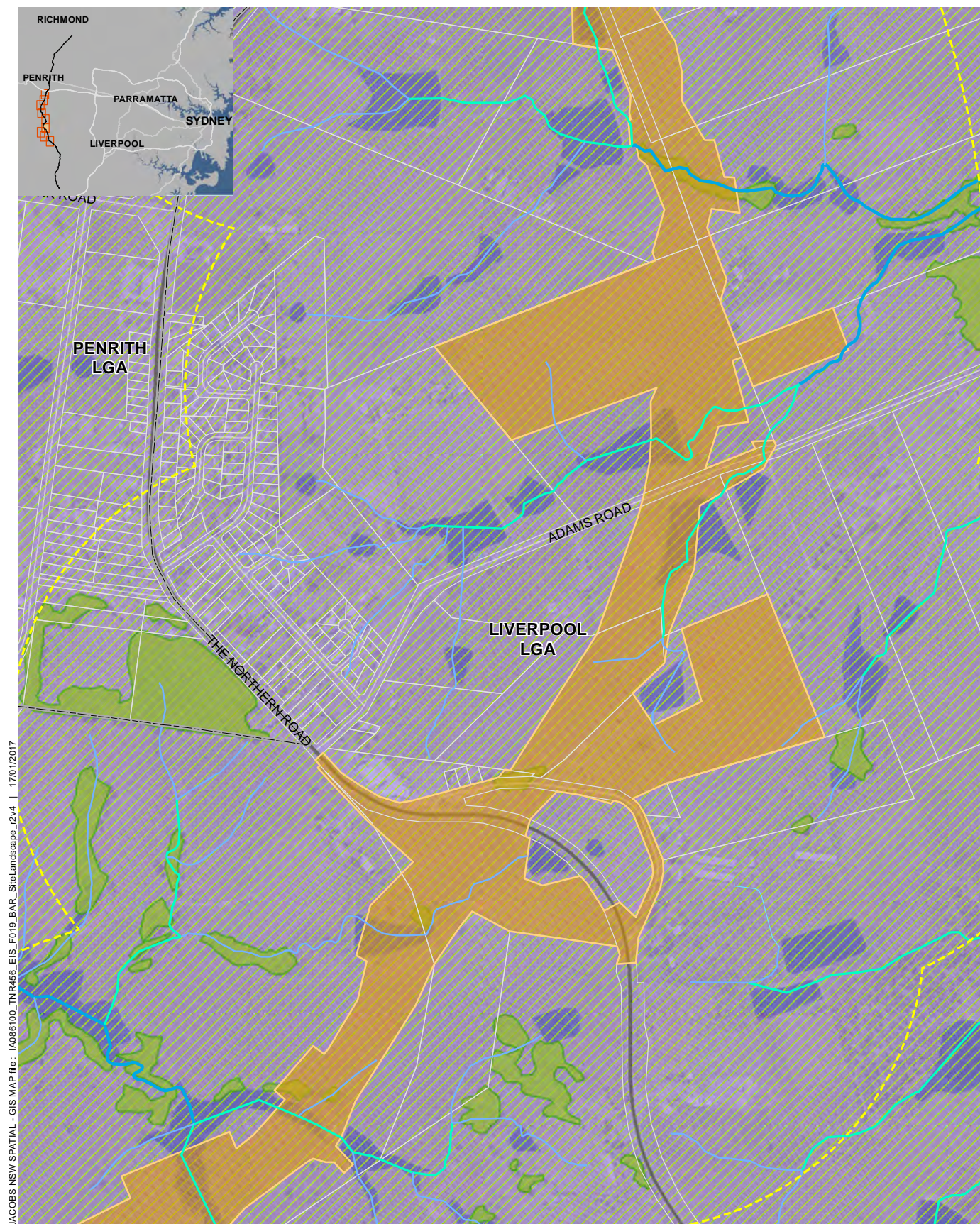


Figure 7-7 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F019_BAR_SiteLandscape_2v4 | 17/01/2017

0 200 400 m



- The Northern Road (Existing)
- 550m assessment buffer
- Development site boundary
- Hydro areas (dams and waterbodies)
- Native vegetation
- Regional Corridor as identified by OEH BIOMAP

- IBRA sub-region
 - Cumberland
 - Mitchell landscape
 - Cumberland Plain

Rivers and streams (Stahler stream order)

- 0
- 1
- 2
- 3

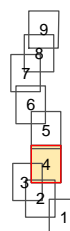


Figure 7-7 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file: JAO86100_TNR456_EIS_F019_BAR_SiteLandscape_v2v4 | 17/01/2017

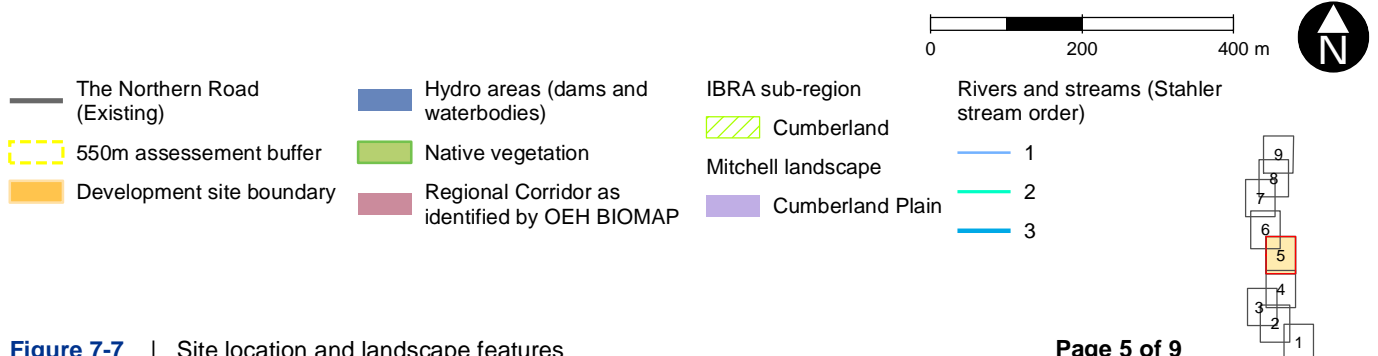
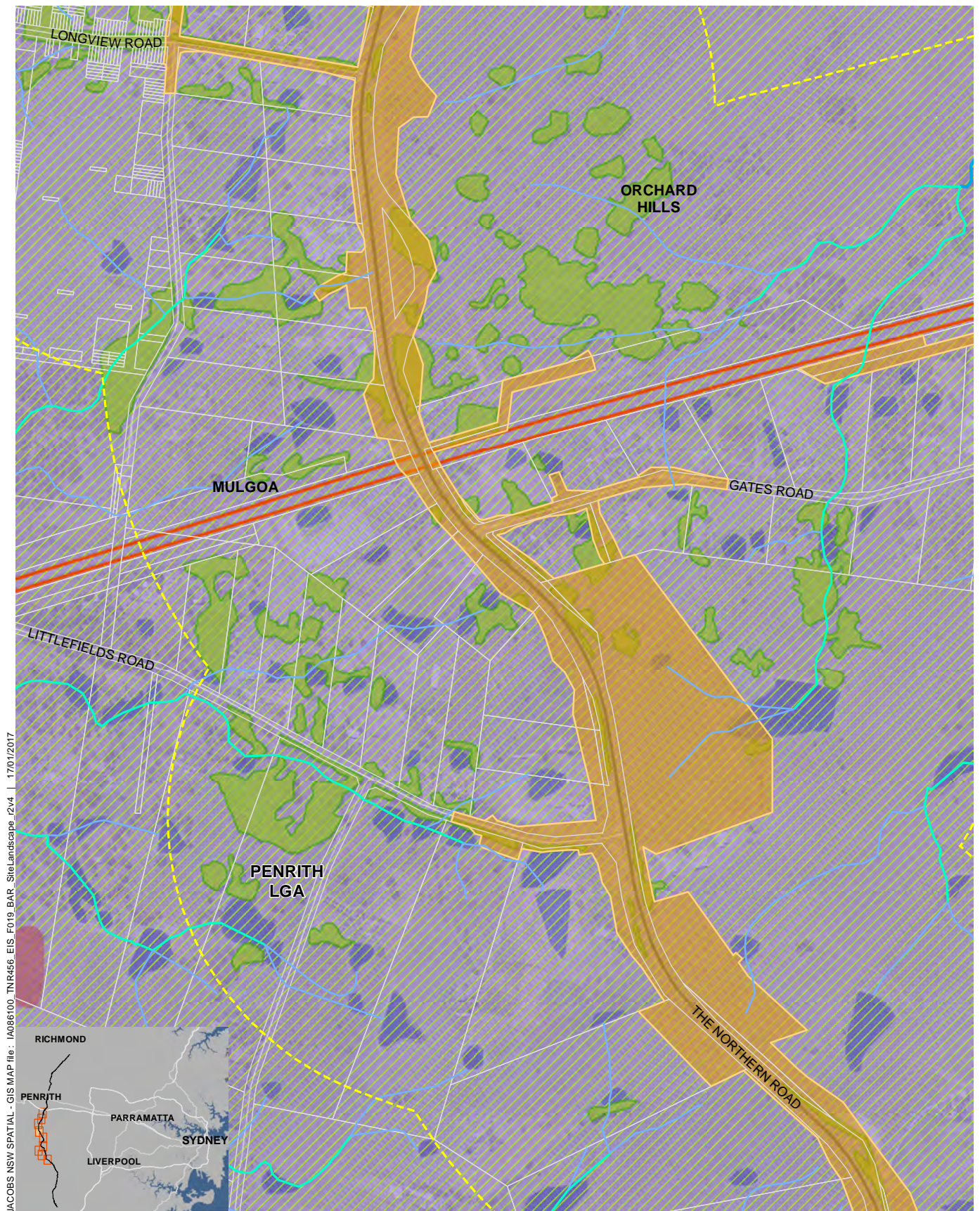


Figure 7-7 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456 EIS F019_BAR_SiteLandscape_v2v4 | 17/01/2017

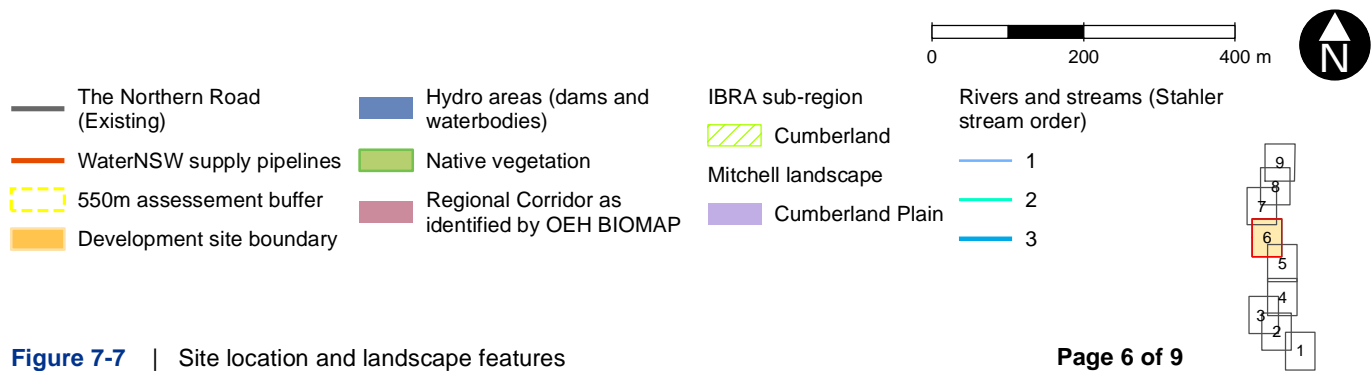
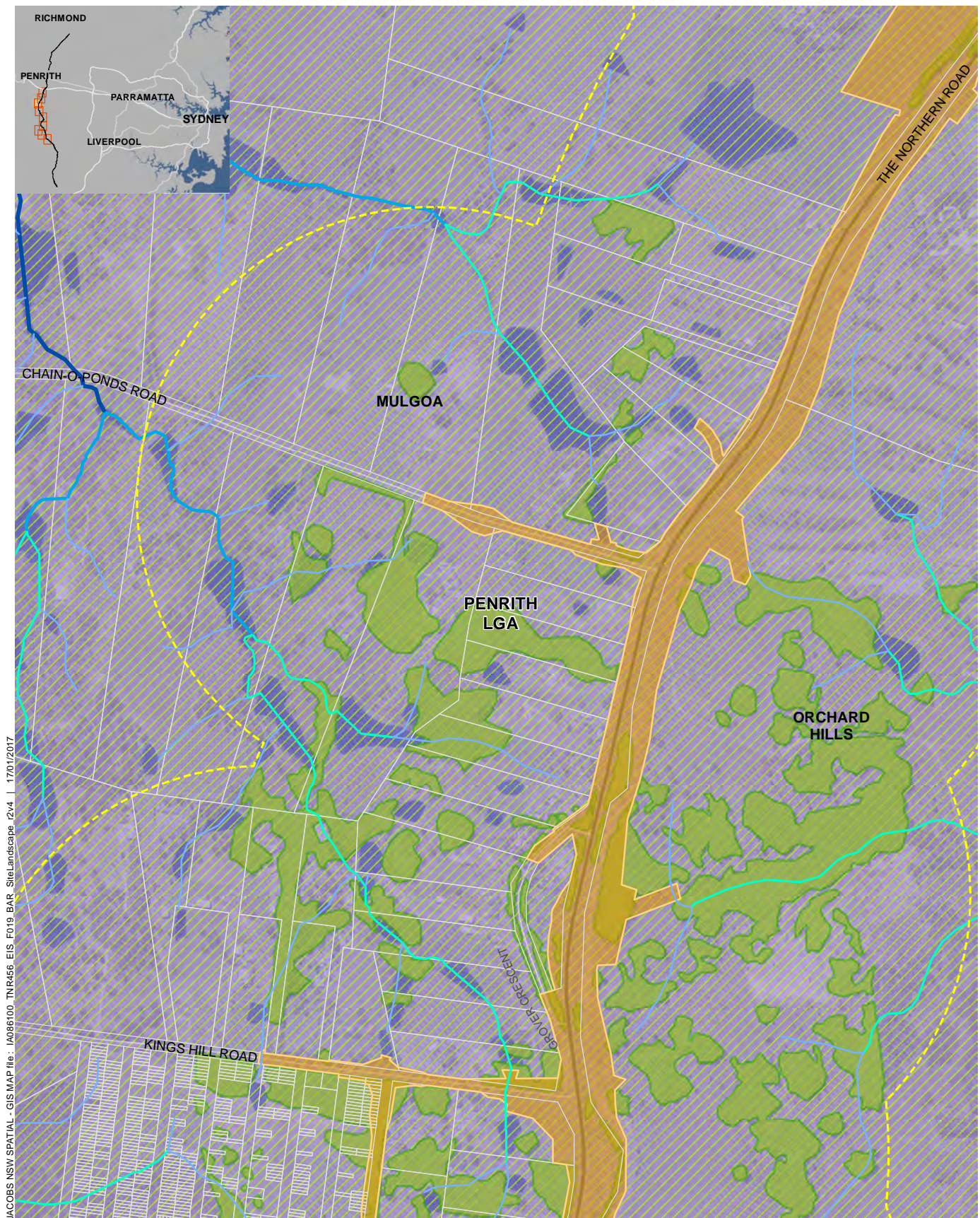


Figure 7-7 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file: J086100_TNR456 EIS F019 BAR SiteLandscape v2v4 | 17/01/2017

- The Northern Road (Existing)
- 550m assessment buffer
- Development site boundary
- Hydro areas (dams and waterbodies)
- Native vegetation
- Regional Corridor as identified by OEH BIOMAP

- IBRA sub-region
- Cumberland
- Mitchell landscape
- Cumberland Plain

- Rivers and streams (Stahler stream order)

- 1
- 2
- 3
- 4

0 200 400 m

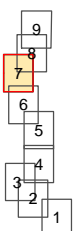
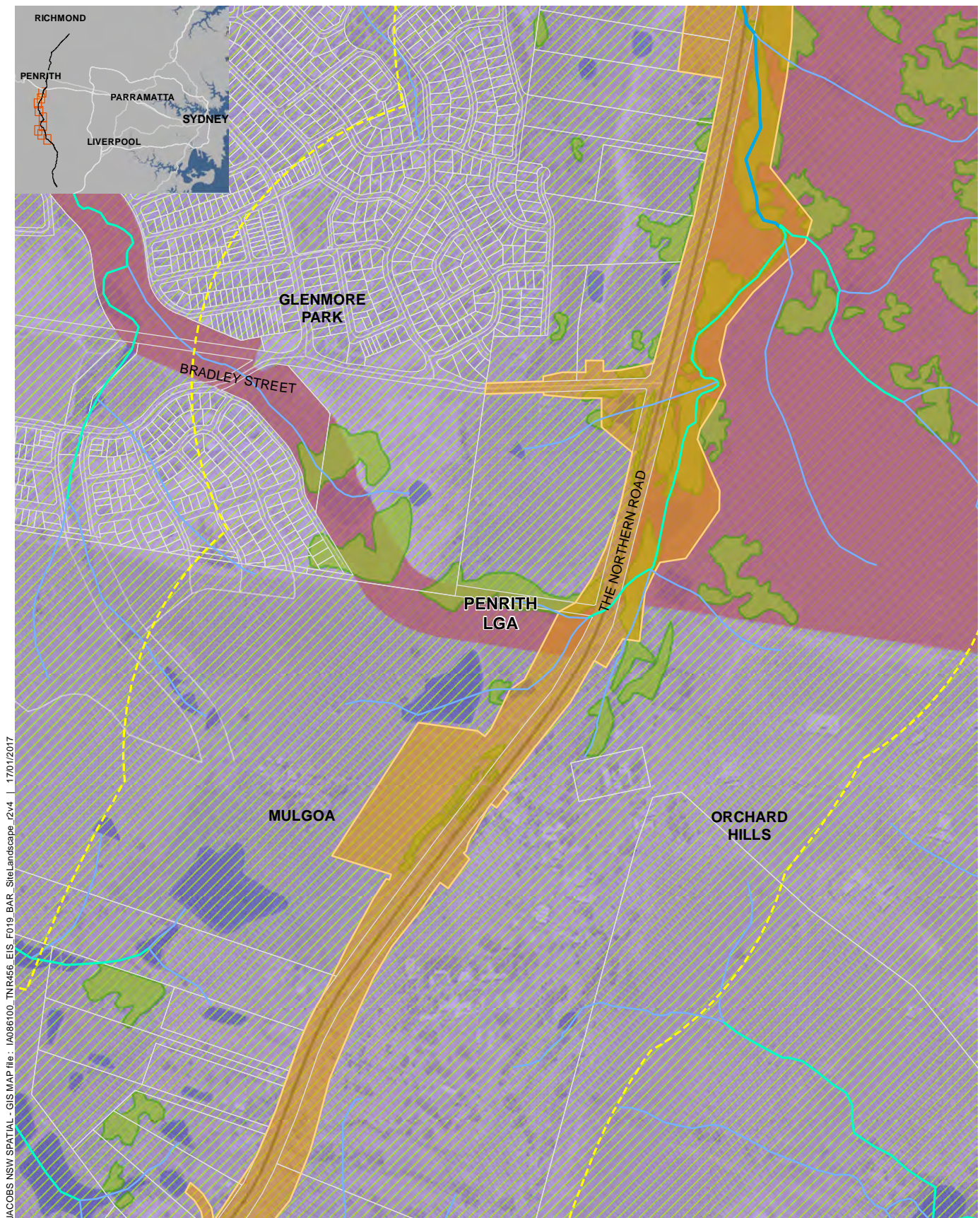
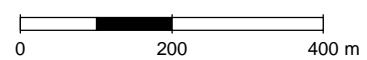


Figure 7-7 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F019_BAR_SiteLandscape_v2v4 | 17/01/2017



- The Northern Road (Existing)
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- Rivers and streams (Stahler stream order)
- 1
- 2
- 3

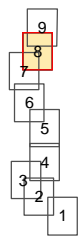
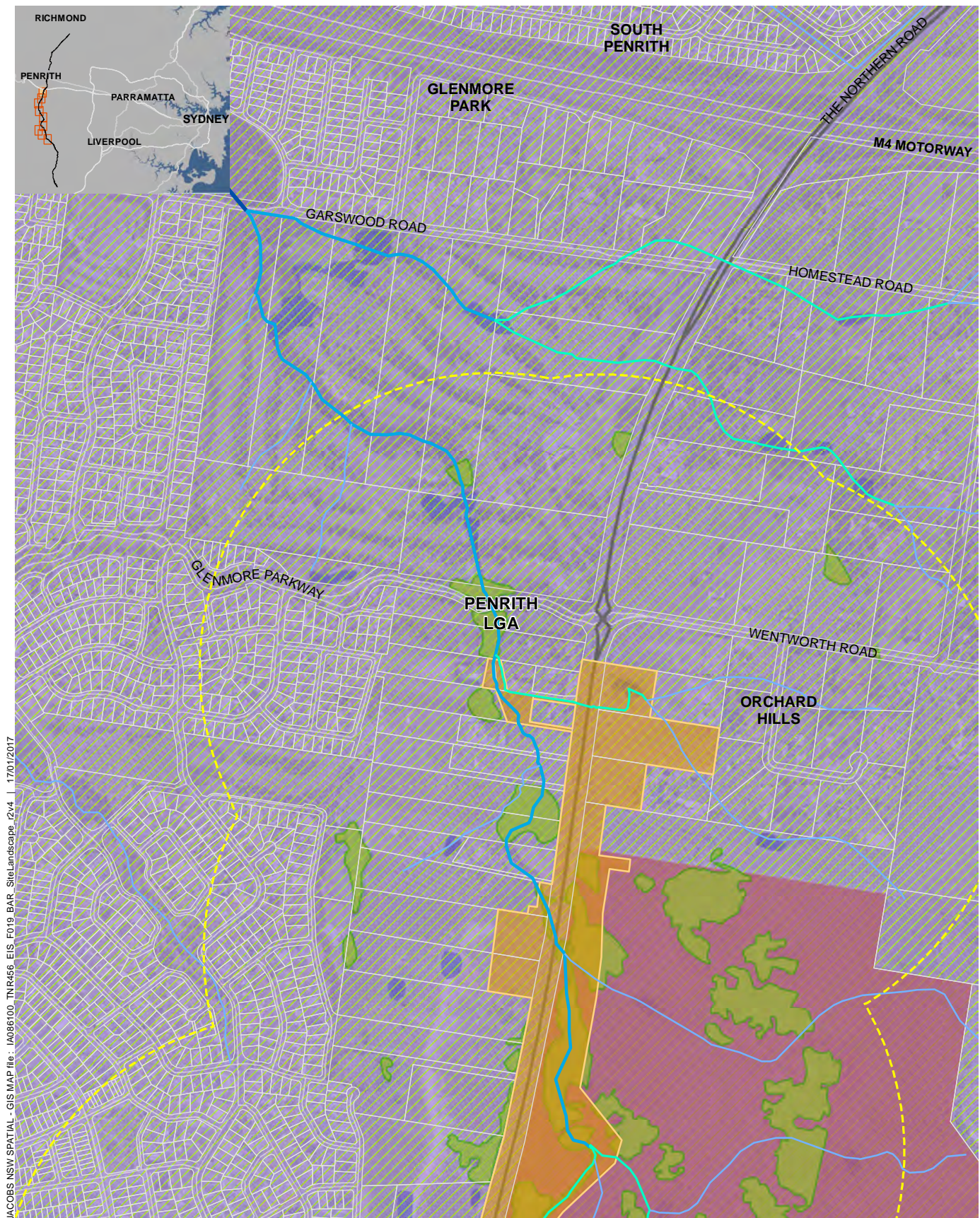


Figure 7-7 | Site location and landscape features



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F019_BAR_SiteLandscape_v2v4 | 17/01/2017

Figure 7-7 | Site location and landscape features

Native vegetation

Plant community types

The extent of native vegetation within the study area was firstly mapped in a GIS using digital aerial photography captured in 2015. This broad scale vegetation mapping of the area was used to inform the initial identification of PCTs for the project. Subsequent to the initial mapping, the PCTs were verified and refined through the detailed floristic assessment collected in the field. This included identification of any noxious weeds.

The field surveys were designed to assess the environmental variation within the study area and any areas with gaps in existing mapping and site information to determine vegetation zones. The condition of PCTs for the study area was assessed in accordance with Chapter 5 of the FBA and vegetation zones assigned by comparing the dominant species, the general description of location, soil type and other attributes as described in the VIS classification database (Office of Environment and Heritage 2015).

Five vegetation types were identified within the study area as described in Table 7-43.

Table 7-43 Plant community types within the study area

PCT code	Plant community type (PCT)	Description
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	As per VIS description: The gentle topography associated with the shale plains of western Sydney carries an open grassy woodland dominated by <i>Eucalyptus moluccana</i> , <i>Eucalyptus tereticornis</i> and <i>Eucalyptus crebra</i> / <i>Eucalyptus fibrosa</i> . Cumberland Shale Plains Woodland is the second of the grassy woodlands that comprise the Cumberland Plain Woodland in the Sydney Basin Bioregion Critically Endangered Ecological Community listed under the NSW TSC Act. Like the related community Cumberland Shale Hills Woodland it is typified by a sparse to moderate cover of shrubs and a high cover of grasses and forbs. Tozer <i>et al.</i> (2010) define the primary habitat for the community as occurring at elevations less than 150 meters above sea level with some sites occurring at higher elevations where the landscape remains gently inclined.
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	As per VIS description: Cumberland Shale Hills Woodland is one of two widespread grassy woodland communities which together are recognised as the Cumberland Plain Woodland in the Sydney Basin Bioregion, a Critically Endangered Ecological Community. It is open woodland of <i>Eucalyptus moluccana</i> and <i>Eucalyptus tereticornis</i> with <i>Eucalyptus crebra</i> also common. <i>Acacia implexa</i> occurs amongst the small tree layer, often amongst regrowth stands. This species is one of the more distinctive floristic attributes that helps distinguish between the two components of the EEC. Other features are similar in that the two woodland units are characterised by an open shrub layer and a grassy ground cover. Fire history can have an important influence on the abundance of shrubs with density of <i>Bursaria spinosa</i> increasing with time since fire. The community occupies higher elevations associated with the hills and rises south from Prospect. It is most extensive in Campbelltown and Liverpool local government areas. It extends west across the

PCT code	Plant community type (PCT)	Description
		Razorback range and once dominated the southern half of the Cumberland Plain. It is restricted to elevations between 50 and 350 m above sea level (Tozer <i>et al.</i> 2010).
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	As per VIS description provided for PCT 835 above. Within the study area the poorer quality examples of this PCT (Moderate/Good/Poor vegetation zone) occur as small fragmented patches of vegetation left in the landscape after clearing for agriculture and the flooding of small valleys and drainage lines during creation of farm dams. Patches of this vegetation zone occur on the Defence Site Orchard Hills on the low lying land which contains the quaternary alluvial soils of the South Creek soil landscape (gravel, silt, sand, clay) which overly the Cranebrook Formation. Small patches of this vegetation zone occur throughout the study area associated with small ephemeral drainage lines including Cosgroves Creek, and fringing the dams on the unnamed tributaries in Luddenham that flow west into Duncans Creek. A small patch of this vegetation zone also occurs in the southern point of the study area along Badgerys Creek where fine grained sand, silt and clay of quaternary alluvium (South Creek soil landscape) occurs. Altitude of the plots varies from 73 to 91 m above sea level.
806	Derived grasslands on shale hills of the Cumberland Plain (50-300 m asl)	Grassland derived from PCT 850 dominated by <i>Themeda triandra</i> .
1071	<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion	A rushland with sub-stratum growth forms of forbs, herbs, grass and aquatics. Dominated by the exotic <i>Juncus acutus</i> * with native wetland species and occasional <i>Casuarina glauca</i> occurs fringing man-made water bodies, drainage lines and depressions across the study area. Also associated with sites of poor drainage where <i>Phragmites australis</i> becomes dominant.

These five PCTs were then classified into ten vegetation zones (labelled 1 to 10) based on areas of native vegetation with the same PCT and of a similar broad condition state (see Figure 7-8). The vegetation zones assigned as Moderate to Good were further classified into a sub-condition class based on observable differences.

Table 7-44 Vegetation zones within the study area

Vegetation zone	Vegetation zone code	Plant community type (PCT)	Threatened ecological community?	Site value score / 100	Extent in study area (ha)
1	849 - Moderate/ Good	Grey Box - Forest Red Gum grassy woodland on flats	Cumberland Plain Woodland in the Sydney Basin	55.56	13.89

Vegetation zone	Vegetation zone code	Plant community type (PCT)	Threatened ecological community?	Site value score / 100	Extent in study area (ha)
		of the Cumberland Plain, Sydney Basin Bioregion	Bioregion		
2	835 - Moderate/ Good	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	53.65	3.24
3	850 – Moderate/Good	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	57.97	25.12
4	849 – Moderate/Good_Poor	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	15.94	10.17
5	850 – Moderate/Good-Poor	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	24.64	13.38
6	835 - Moderate/Good-Poor	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	43.23	10.30

Vegetation zone	Vegetation zone code	Plant community type (PCT)	Threatened ecological community?	Site value score / 100	Extent in study area (ha)
7	850 - Moderate/Good-High	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	74.64	7.33
8	806 – Moderate/Good-Derived grassland	Derived grasslands on shale hills of the Cumberland Plain (50-300 m asl)	Cumberland Plain Woodland in the Sydney Basin Bioregion	19.05	49.78
9	1071 – Moderate/Good-Other	<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion	Not listed as it is man made	34.06	12.92
10	850 – Moderate/Good-Medium	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Cumberland Plain Woodland in the Sydney Basin Bioregion	25.85	2.00
Total					148.13

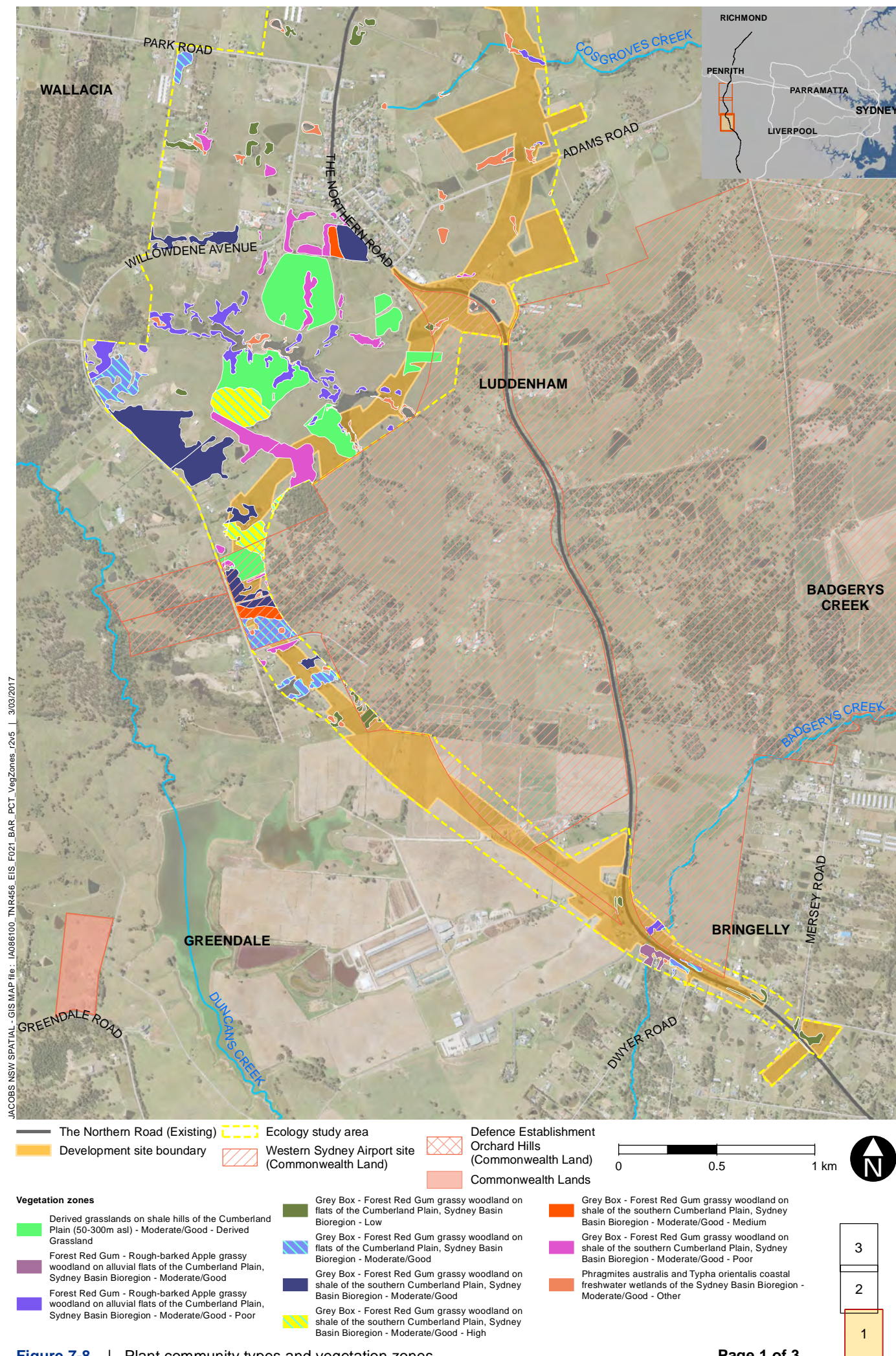
Notes: * = Vegetation in Moderate/Good condition is all native vegetation that is not in low condition. Vegetation in Low condition is defined as:

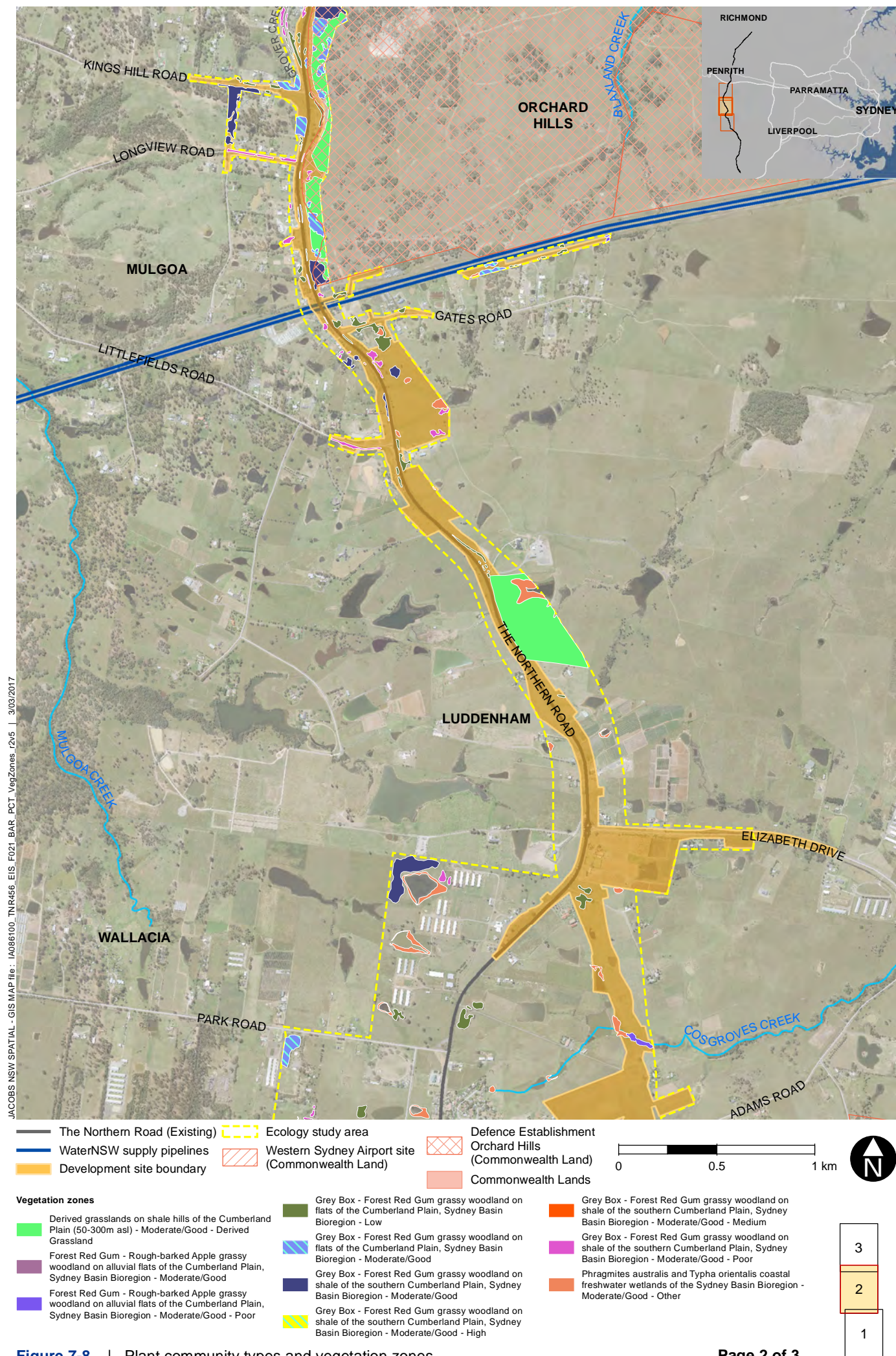
a) woody native vegetation with native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and where either:

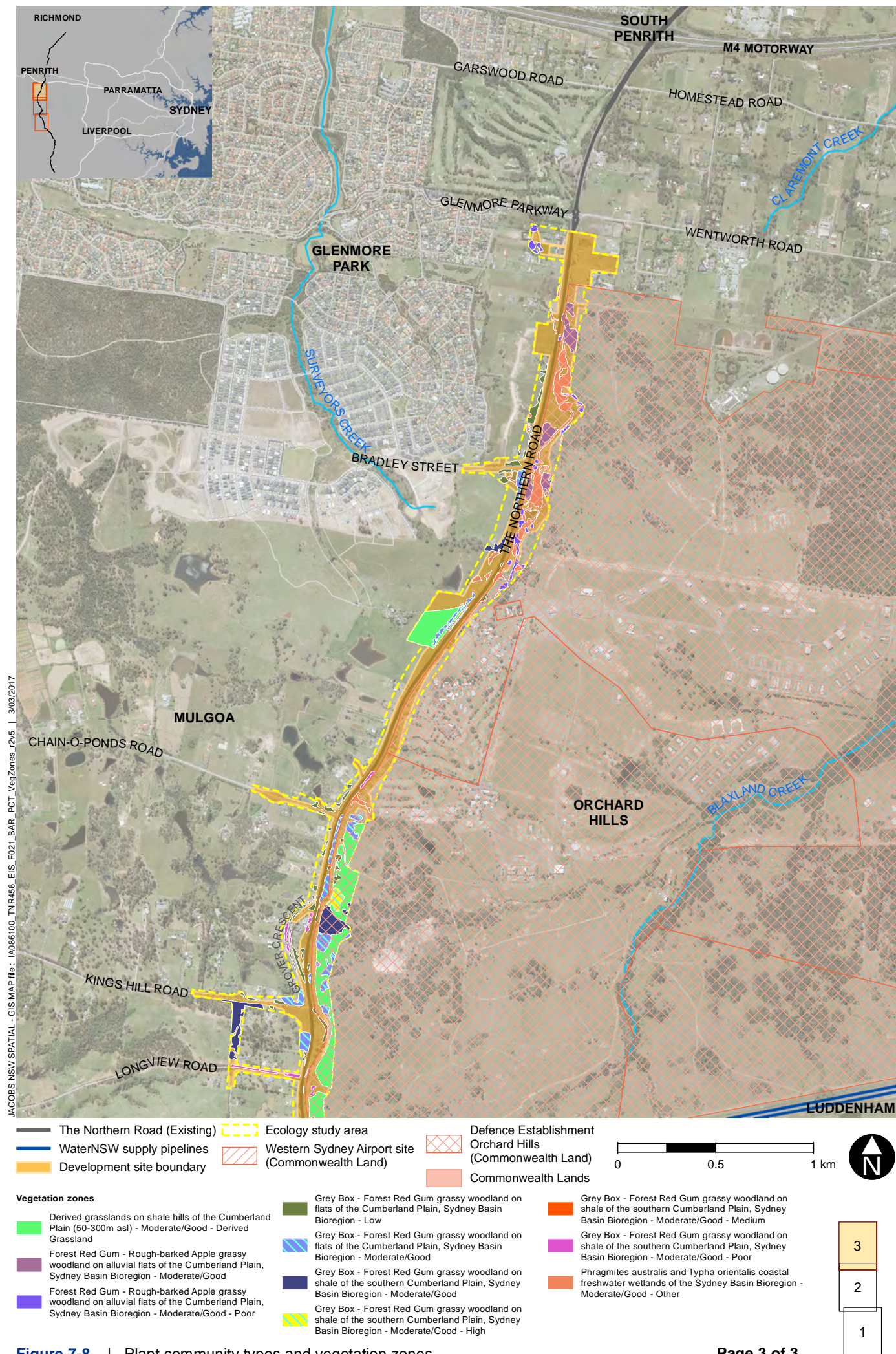
- less than 50% of ground cover vegetation is indigenous species, or
- greater than 90% of ground cover vegetation is cleared OR

b) native grassland, wetland or herbfield where either:

- less than 50% of ground cover vegetation is indigenous species, or
- more than 90% of ground cover vegetation is cleared.







Groundwater dependent ecosystems

No high probability GDEs are mapped within or near the study area by Kuginis et al. (2012). However, PCT 850 and PCT 849 are identified as having a high probability of being a GDE. Additionally, PCT 835 is considered by Kuginis et al. (2012) to be a high probability groundwater dependent wetland community.

Within the study area, Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain (PCT 850), Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain (PCT 849), Derived grasslands on shale hills of the Cumberland Plain (50-300 m asl) (PCT 806), *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071) and Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain (PCT 835) are considered unlikely to be GDEs given their location in the landscape. In the case of PCT 850, 849 and 806, these communities are classed as vadophytic vegetation (that is, they rely on moisture in the soil surface profile) with no apparent groundwater dependency. PCT 835 and PCT 1071 within the study area are not part of a river baseflow system and are situated along losing stream reaches (streams that 'lose' surface water to ground water). The dams in which PCT 1071 are situated are man-made and rely on surface water.

The flow regimes of the streams within the study area are ephemeral (or would have naturally been ephemeral prior to damming). Ephemeral streams flow only in direct response to precipitation, and the stream channel is above the water table at all times. The majority of watercourses within the study area are ephemeral and most flow events occur in direct response to major rainfall. These systems are not considered to support GDEs (Serov et al. 2012). There is no evidence of base-flow feeding any of the streams within the study area. As such, none of the riparian zones within the study area are considered to be GDEs. This conclusion is supported by the findings of the soils, water and contamination study undertaken for this EIS (see Section 8.2 and Appendix L), which states that there are no listed high priority GDEs located in the study area.

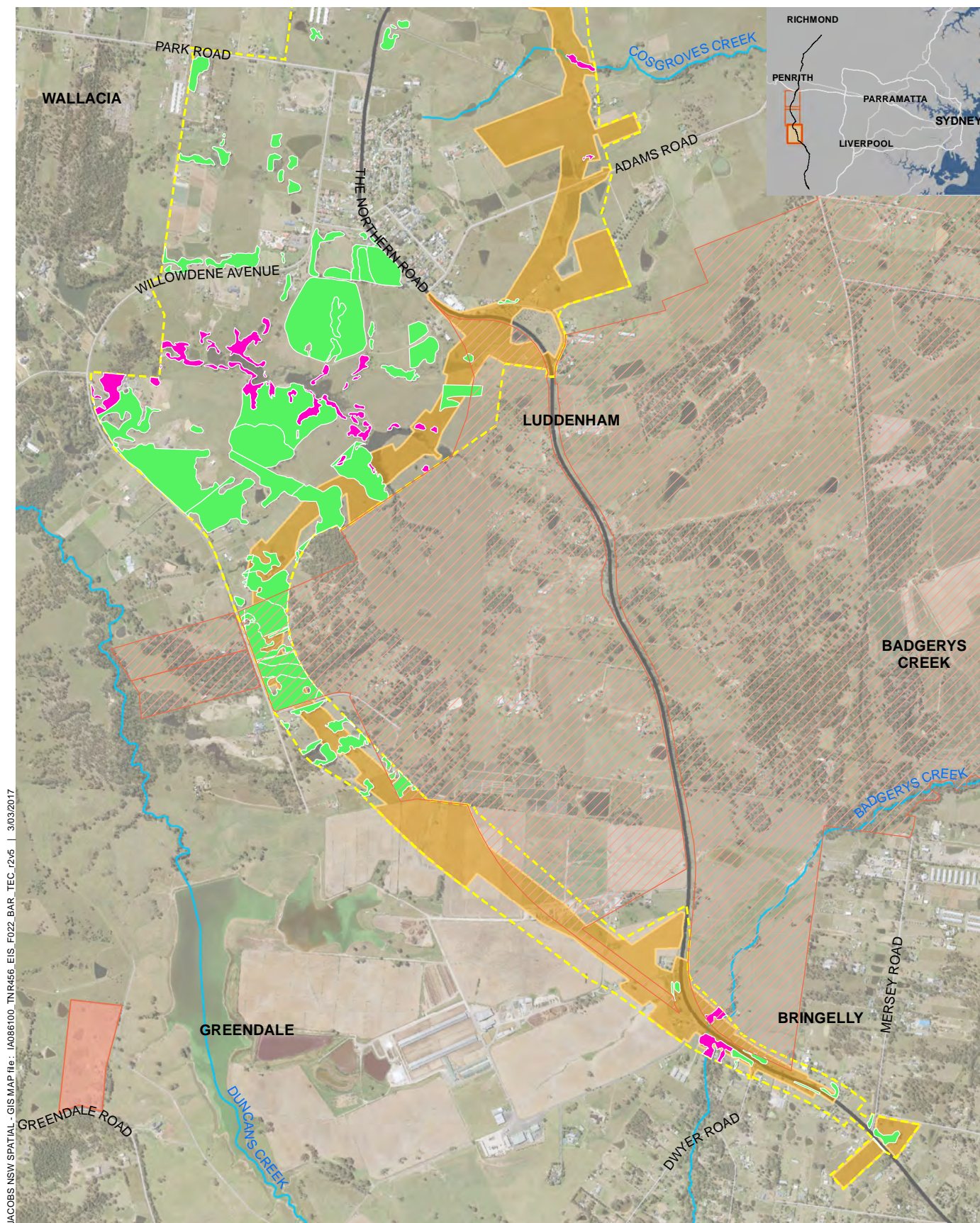
Threatened ecological communities

Threatened Species Conservation Act 1995

The field survey identified two threatened ecological communities (TECs) as listed under the TSC Act within the study area (see Table 7-45). These are shown in Figure 7-9.

Table 7-45 Threatened ecological communities listed under the TSC Act present within the study area

Threatened ecological community	Status TSC Act	Corresponding PCTs	Area (ha)
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically endangered	849, 850, 806	121.7 (includes 49.78 ha of derived native grasslands)
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	835	13.54



JACOBS NSW SPATIAL - GIS MAP file: JA086100_TNR456_EIS_F022_BAR_TEC_2v5 | 3/03/2017

- The Northern Road (Existing) - - - Ecology study area
- Development site boundary ▨ Western Sydney Airport site (Commonwealth Land)
- ▩ Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Lands

0 0.5 1 km



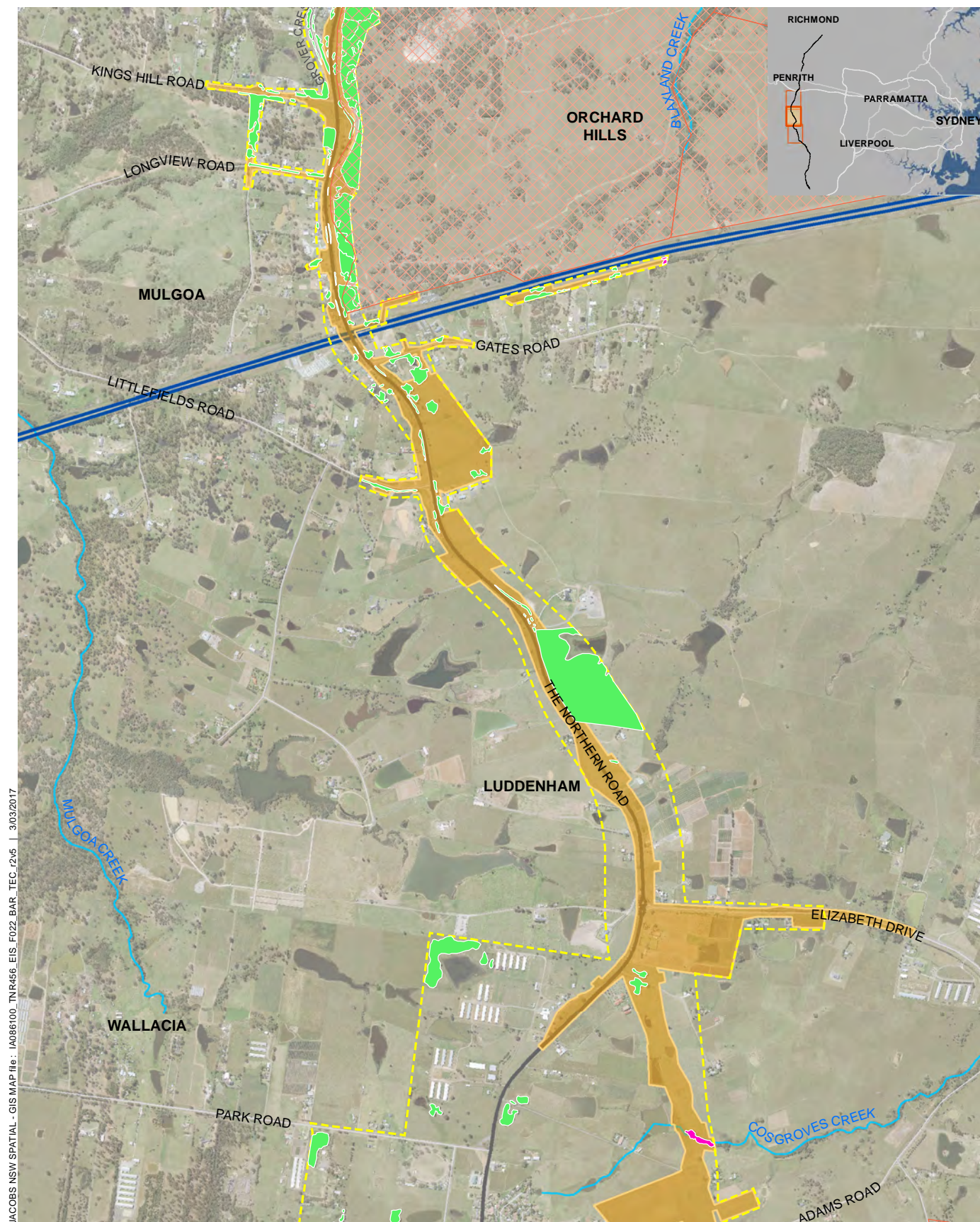
Threatened ecological communities

■ Cumberland Plain Woodland in the Sydney Basin Bioregion

■ River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3
2
1

Figure 7-9 | Threatened ecological communities



JACOBS NSW SPATIAL - GIS MAP file : JA086100_TNR456_EIS_F022_BAR_TEC_2v5 | 3/03/2017

- The Northern Road (Existing)
- WaterNSW supply pipelines
- Development site boundary
- Ecology study area
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Lands

Threatened ecological communities

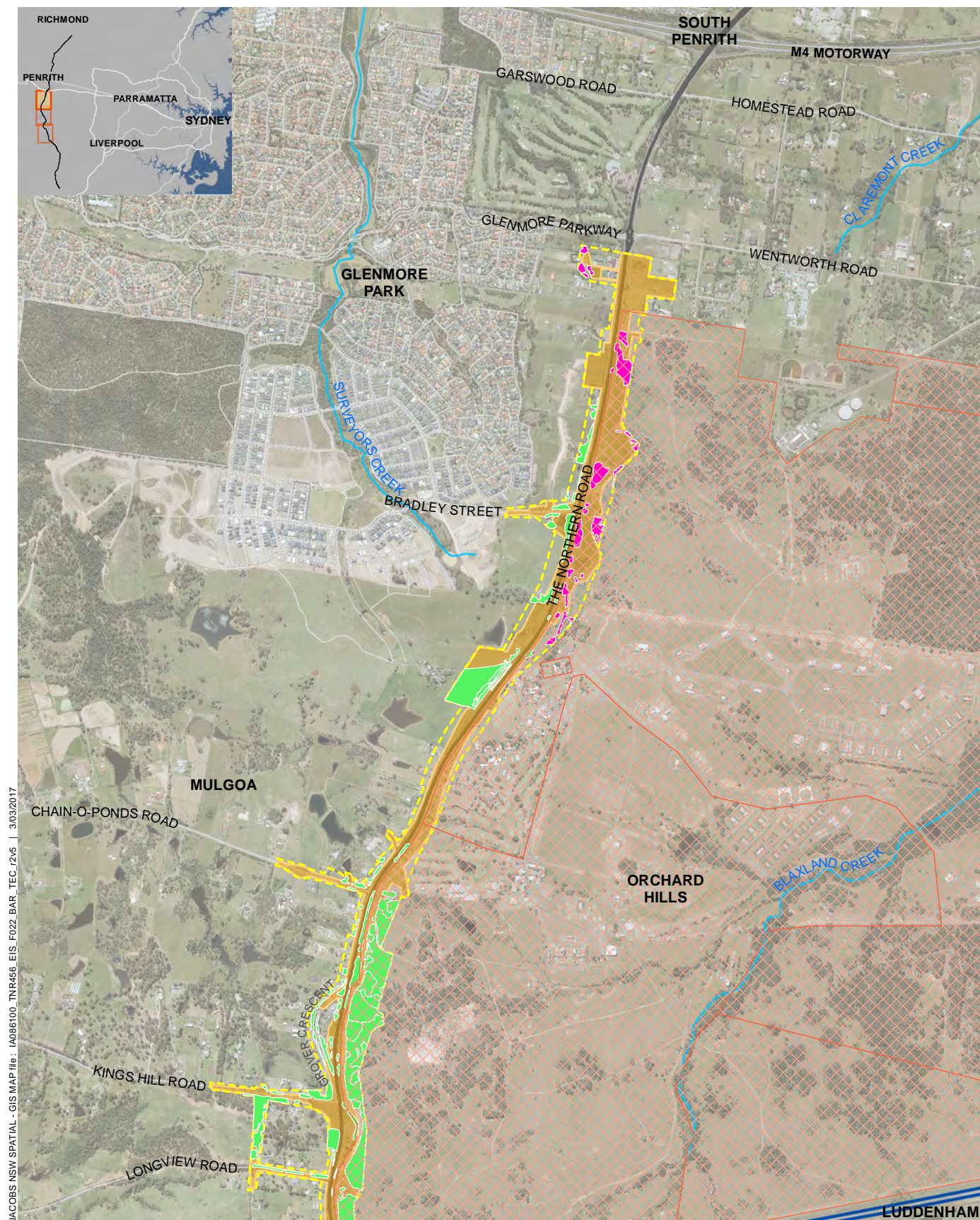
- Cumberland Plain Woodland in the Sydney Basin Bioregion
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

0 0.5 1 km



3
2
1

Figure 7-9 | Threatened ecological communities



JACOBS NSW SPATIAL - GIS MAP file: JA080100_TNR456_EIS_F022_BAR_TEC_2v5 | 3/03/2017

- The Northern Road (Existing)
- Ecology study area
- WaterNSW supply pipelines
- Development site boundary
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Lands

0 0.5 1 km



Threatened ecological communities

Cumberland Plain Woodland in the Sydney Basin Bioregion

River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

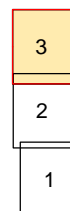


Figure 7-9 | Threatened ecological communities

Environment Protection and Biodiversity Conservation Act 1999

Eight TECs listed under the EPBC Act were identified as potentially occurring during desktop searches. One TEC, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (listed as critically endangered) was identified in the study area during the surveys.

Three PCTs representative of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest are present including:

- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)
- Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)
- Derived grasslands on shale hills of the Cumberland Plain (50-300 m asl) (PCTID 806).

Detailed floristic plots were undertaken within the patches of PCT 849, PCT 850 and PCT 806 within the study area to determine vegetation quality. The condition of patches was assessed according to the criteria provided in the *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (Threatened Species Scientific Committee 2009). Only the highest quality patches of these three PCTs are considered to be consistent with the EPBC Act listing. In accordance with the condition criteria provided in the *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (Threatened Species Scientific Committee 2009), two categories of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest are present within the study area:

- Category A - core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW
- Category C - patches with connectivity to other large native vegetation remnants in the landscape. This category also includes areas of Derived Native Grasslands where the grasslands are contiguous with the TEC.

Within the study area, the patches of Category A Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (patches that meet the core thresholds) are located in two main areas: the southern portion of the DEOH and on private properties along Willowdene Avenue. There is part of one larger patch (>5 ha in size) within the study area which is on private property off Willowdene Avenue (see Figure 7-10). An additional Category A patch is present outside of the study area along Willowdene Avenue but would not be impacted by the proposed action.

The Category C patches are lower condition patches of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest and Derived Native Grasslands that are contiguous with Category A patches. These Category C patches are located on Commonwealth owned and private property off Willowdene Avenue and on the southern portion of the DEOH.

The Orchard Hills Cumberland Plain Woodland is a Listed Place on the Commonwealth Heritage List (CHL 105317). The land at Orchard Hills is recognised as the least disturbed and largest remaining remnant of Cumberland Plain Woodland. The tributaries of Blaxland Creek at Orchard Hills are among the least disturbed catchments remaining on the Cumberland Plain and are regarded as possibly the most pristine creek system on Wianamatta Shale left in Western Sydney (Department of the Environment, 2016b).

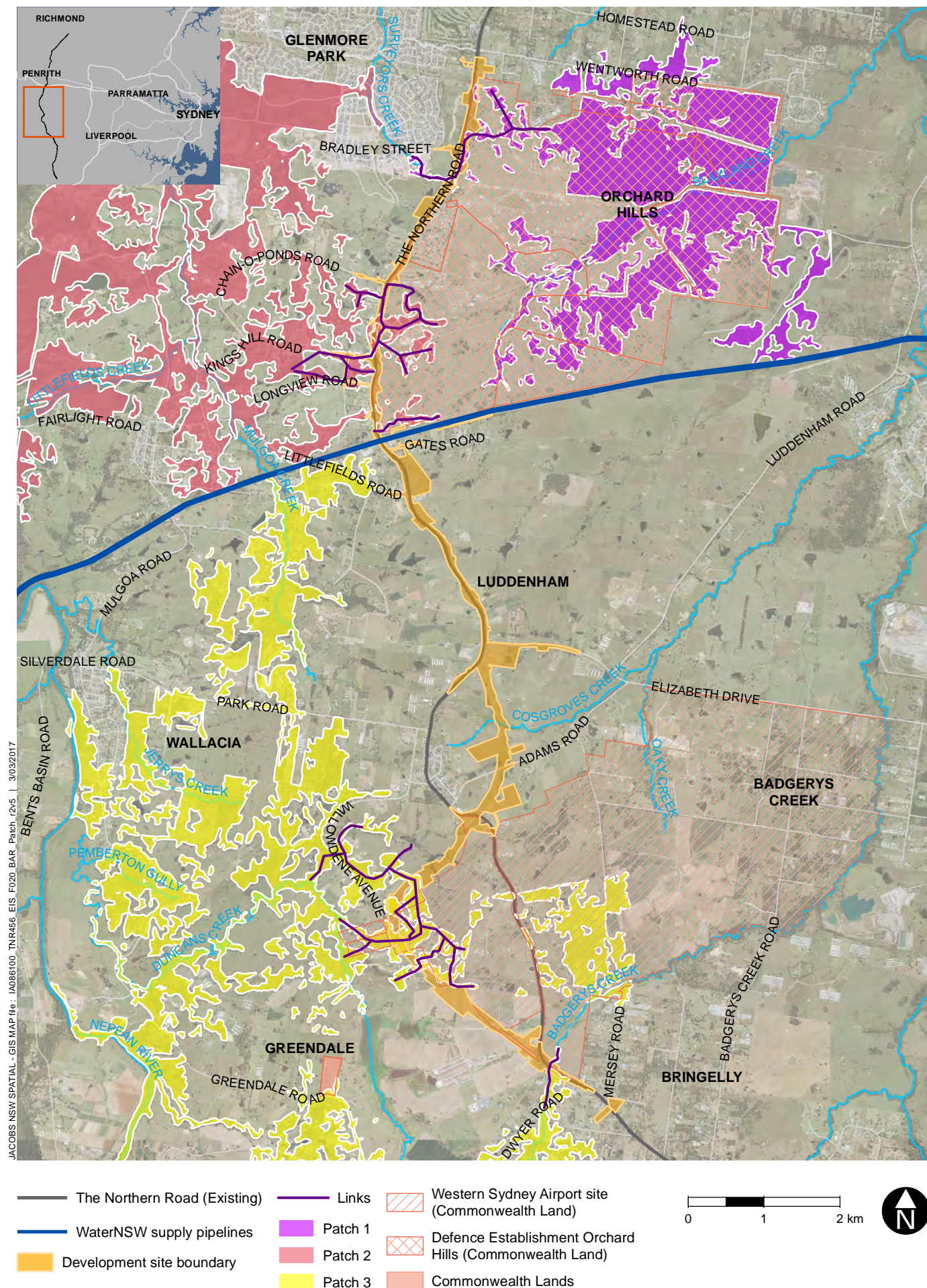


Figure 7-10 | Patch size

Threatened flora species

Database searches and desktop review identified 36 threatened flora species listed under the TSC Act including 26 listed under the EPBC Act within the 10 km search radius around the study area as outlined in the threatened species survey.

Table 7-46. These have been assessed as candidate species and formed the target of the threatened species survey.

Table 7-46 Threatened flora – likelihood of occurrence

Common Name (Scientific Name)	Status ¹		Likelihood of occurrence
	TSC Act	EPBC Act	
Austral Pillwort (<i>Pilularia novae-hollandiae</i>)	E	-	Low
Bargo Geebung (<i>Persoonia bargoensis</i>)	E	V	None
Brown Pomaderris (<i>Pomaderris brunnea</i>)	E	V	None
Bynoes Wattle (<i>Acacia bynoeana</i>)	E	V	Low
Camden White Gum (<i>Eucalyptus benthamii</i>)	V	V	None
<i>Dillwynia tenuifolia</i>	V	-	Low
<i>Dillwynia tenuifolia</i> (a shrub) population, Kemps Creek	EP	-	None
Downy Wattle (<i>Acacia pubescens</i>)	V	V	Low
Dwarf Kerrawang (<i>Commersonia prostrata</i> formerly <i>Rulingia prostrata</i>)	E	E	None
<i>Hibbertia</i> sp. Bankstown (syn. <i>Hibbertia puberula</i> subsp. <i>glabrescens</i>)	CE	CE	None
<i>Hypsela sessiliflora</i> (syn. <i>Isotoma fluviatilis</i>)	E	EX	None
Illawarra Greenhood (<i>Pterostylis gibbosa</i>)	E	E	Low
Juniper-leaved Grevillea (<i>Grevillea juniperina</i> subsp. <i>juniperina</i>)	V	-	Low
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP	-	Recorded
<i>Micromyrtus minutiflora</i>	E	V	Low
<i>Pimelea curviflora</i> subsp. <i>curviflora</i>	V	V	None

Common Name (Scientific Name)	Status ¹		Likelihood of occurrence
	TSC Act	EPBC Act	
Spiked Rice-flower (<i>Pimelea spicata</i>)	E	E	Low
Sydney Plains Greenhood (<i>Pterostylis saxicola</i>)	E	E	None
Tall Knotweed (<i>Persicaria elatior</i>)	V	V	Low
White-flowered Wax Plant (<i>Cynanchum elegans</i>)	E	E	Low
<i>Allocasuarina glareicola</i>	E	E	None
<i>Asterolasia elegans</i>	E	E	None
Leafless Tongue Orchid (<i>Cryptostylis hunteriana</i>)	V	V	None
Bauer's Midge Orchid (<i>Genoplesium baueri</i>)	E	E	None
Small-flower Grevillea (<i>Grevillea parviflora</i> subsp. <i>parviflora</i>)	V	V	None
Square Raspwort (<i>Haloragis exalata</i> subsp. <i>exalata</i>)	V	V	None
Deane's Paperbark (<i>Melaleuca deanei</i>)	V	V	None
Omeo Storksbill (<i>Pelargonium</i> sp. <i>Striatellum</i> (G.W.Carr 10345))	E	E	None
Needle Geebung (<i>Persoonia acerosa</i>)	V	V	None
<i>Persoonia hirsuta</i> (Hairy Geebung)	E	E	Low
Nodding Geebung (<i>Persoonia nutans</i>)	E	E	Low
Smooth Bush-pea (<i>Pultenaea glabra</i>)	V	V	None
<i>Pultenaea parviflora</i>	E	V	Recorded
Eastern Underground Orchid (<i>Rhizanthella slateri</i>)	V	E	Low
Kangaloon Sun Orchid (<i>Thelymitra kangaloonica</i>)	CE	CE	None

Common Name (Scientific Name)	Status ¹		Likelihood of occurrence
	TSC Act	EPBC Act	
Austral Toadflax (<i>Thesium australe</i>)	V	V	Low

1. Status: E = endangered, CE = critically endangered, EP = endangered population, V= vulnerable, EX = extinct

Targeted surveys were completed for all identified candidate flora species with suitable habitat. The field surveys recorded one threatened flora species listed under the TSC Act and EPBC Act: *Pultenaea parviflora* (listed as endangered under the TSC Act and vulnerable under the EPBC Act). Four *Pultenaea parviflora* plants were found in the study area. The plants were located in three areas across two locations within the western road reserve of the Northern Road, and the along Kings Hill Road. Two plants are present in the road reserve at 2465 The Northern Road Mulgoa and one plant is present at the top of the road cutting about 420 m south of the first two plants on the western side of The Northern Road at 2509 The Northern Road Mulgoa. One plant was found in the corner of the property at 34 Kings Hill Road. Based on the data from the OEH Atlas of NSW Wildlife (OEH, 2015b), the *Pultenaea parviflora* plants within the study area would represent an extension of the known south western distribution of this species.

No other threatened flora species were recorded during the field survey. Targeted surveys for other listed threatened flora species was undertaken including detailed survey for *Pimelea spicata*. Three *Pimelea spicata* reference sites were surveyed in January 2016 including the Mt Annan Botanic Gardens, Camden Golf Course bushcare site, and Western Sydney Parklands. *Pimelea spicata* was flowering at all three reference sites during the survey period. *Pimelea spicata* was not recorded during the surveys undertaken for the biodiversity assessment despite targeted survey in habitat using parallel transects.

One endangered population listed under the TSC Act: *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas was recorded during the field surveys. This endangered population was recorded in four locations (all relatively disturbed) adjacent to the current The Northern Road alignment (two locations on the fence of the DEOH, and roadside vegetation adjacent to 2509 The Northern Road, and 2627 The Northern Road). Table 7-47 outlines the results of the threatened flora species surveys.

Table 7-47 Threatened flora species survey results

Species	Record detail	Habitat feature/ component
<i>Pultenaea parviflora</i>	4 plants recorded across three areas in two locations within the western road reserve of The Northern Road and along Kings Hill Road	PCT 806 Also likely to occur in PCT 849 and PCT 850
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Recorded in four locations (all relatively disturbed) adjacent to the current The Northern Road alignment (two locations on the fence of the DEOH, and roadside vegetation adjacent to 2509 The Northern Road, and 2627 The Northern Road)	PCT 849 and PCT 850

Threatened fauna species

Database searches and desktop review identified 51 threatened fauna species listed under the TSC Act including 20 listed under the EPBC Act within the 10 km search radius around the study area as outlined in Table 7-48. Habitat assessment confirmed the presence of potential habitat for 24 of these species.

Table 7-48 Threatened fauna – likelihood of occurrence

Common Name (<i>Scientific Name</i>)	Status		Likelihood of occurrence
	TSC Act	EPBC Act	
Australian Painted Snipe (<i>Rostratula australis</i>)	V	E	Low
Australasian Bittern (<i>Botaurus poiciloptilus</i>)	E	E	Low
Australian Grayling (<i>Prototroctes maraena</i>)	E (FM Act)	V	Low
Barking Owl (<i>Ninox connivens</i>)	V	-	Moderate
Black Bittern (<i>Ixobrychus flavicollis</i>)	V	-	Low
Black-chinned Honeyeater (eastern subspecies) (<i>Melithreptus gularis subsp. gularis</i>)	V	-	Moderate
Black-tailed Godwit (<i>Limosa limosa</i>)	V	M	Low
Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)	V	V	None
Brown Treecreeper (eastern subspecies) (<i>Climacteris picumnus subsp. victoriae</i>)	V	-	Low
Brush-tailed Rock-wallaby (<i>Petrogale penicillata</i>)	E	V	None
Bush Stone-curlew (<i>Burhinus grallarius</i>)	E	-	Low
Comb-crested Jacana (<i>Irediparra gallinacea</i>)	V	-	Low
Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>)	E	-	Recorded
Diamond Firetail (<i>Stagonopleura guttata</i>)	V	-	Moderate
Dural Land Snail (<i>Pommerhelix duralensis</i>)	-	E	None

Common Name (Scientific Name)	Status		Likelihood of occurrence
	TSC Act	EPBC Act	
Eastern Bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>)	V	-	Recorded
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	-	Recorded
Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>)	V	-	Recorded
Eastern Pygmy Possum (<i>Cercartetus nanus</i>)	V	-	Low
Flame Robin (<i>Petroica phoenicea</i>)	V	-	Moderate
Freckled Duck (<i>Stictonetta naevosa</i>)	V	-	Low
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	V	-	Moderate
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	EP	-	None
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	V	V	Low
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	-	Moderate
Green and Golden Bell Frog (<i>Litoria aurea</i>)	E	V	Low
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	Recorded
Hooded Robin (south-eastern form) (<i>Melanodryas cucullata subsp. cucullata</i>)	V	-	Low
Koala (<i>Phascolarctos cinereus</i>)	V	V	Low
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	Moderate
Little Eagle (<i>Hieraaetus morphnoides</i>)	V	-	Moderate
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	-	Moderate

Common Name (Scientific Name)	Status		Likelihood of occurrence
	TSC Act	EPBC Act	
Littlejohn's Tree Frog (<i>Litoria littlejohni</i>)	V	V	Low
Macquarie Perch (<i>Macquaria australasica</i>)	E (FM Act)	E	Low
Masked Owl (<i>Tyto novaehollandiae</i>)	V	-	Moderate
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	-	V	Low
Painted Honeyeater (<i>Grantiella picta</i>)	V	V	Low
Powerful Owl (<i>Ninox strenua</i>)	V	-	Moderate
Regent Honeyeater (<i>Anthochaera phrygia</i>)	E	CE	Moderate
Scarlet Robin (<i>Petroica boodang</i>)	V	-	Moderate
Speckled Warbler (<i>Chthonicola sagittatus</i>)	V	-	Moderate
Spotted Harrier (<i>Circus assimilis</i>)	V	-	Moderate
Spotted-tailed Quoll (<i>Dasyurus maculatus</i>)	V	E	Low
Square-tailed Kite (<i>Lophoictinia isura</i>)	V	-	Moderate
Squirrel Glider (<i>Petaurus norfolcensis</i>)	V	-	Low
Stuttering Frog (<i>Mixophyes balbus</i>)	V	E	Low
Swift Parrot (<i>Lathamus discolor</i>)	E	CE	Moderate
Turquoise Parrot (<i>Neophema pulchella</i>)	V	-	Low
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	V	-	Moderate
White-fronted Chat (<i>Epthianura albifrons</i>)	V	-	Low

Common Name (<i>Scientific Name</i>)	Status		Likelihood of occurrence
	TSC Act	EPBC Act	
Yellow-bellied Sheath-tail-bat (<i>Saccolaimus flaviventris</i>)	V	-	Moderate

1. Status: E = endangered, CE = critically endangered, EP = endangered population, V = vulnerable, M = migratory

Cumberland Plain Land Snail

The Cumberland Plain Land Snail was recorded in the study area. Live snails and shells were found in a variety of habitats from high quality woodland, to woodland with a heavily grazed understorey. Shells (often heavily bleached) were also found in dense swards of the exotic grass *Eragrostis curvula* on roadsides particularly along Willowdene Avenue.

Microchiropteran bats

Three threatened insectivorous bats were recorded via Anabat: Eastern Bentwing-bat, Eastern False Pipistrelle, and Eastern Freetail-bat. Foraging habitat for these species is widespread throughout the study area. These species are likely to fly across cleared land to move between habitat patches. Large trees in the study area (e.g. the large old *Eucalyptus tereticornis* tree to the north of the wetlands on the DEOH) may provide potential roosting habitat for the Eastern False Pipistrelle, and Eastern Freetail-bat.

The Grey-headed Flying-fox was recorded in one location on private property off Willowdene Avenue during spotlight surveys.

No other threatened fauna species were recorded during the surveys. However, the following species are considered moderately likely to occur:

- The Regent Honeyeater is considered moderately likely to occur in the study area based on the presence of suitable foraging habitat (about 84.97 ha)
- The Swift Parrot is considered moderately likely to occur in the study area during winter based on the presence of suitable foraging habitat and recent records near to the study area (about 84.97 ha)
- A population of the Large-eared Pied Bat is considered moderately likely to utilise the study area due to the proximity of the foraging habitat (about 84.97 ha) to the lower Blue Mountains and recent records of the species from the locality (i.e. from Mulgoa Nature Reserve)
- Green and Golden Bell Frog. This species was not recorded in the study area and there are no reported existing populations of the Green and Golden Bell Frog in the study area
- Australasian Bittern and Black Bittern There is one record of the cryptic Australasian Bittern in the study area, in 2003 to the south of Badgerys Creek, this species and the Black Bittern are considered to have a low to moderate chance of occurring.

Table 7-49 outlines the results of the threatened fauna species surveys. Recorded threatened species identified during the surveys are shown on Figure 7-11.

Table 7-49 Threatened fauna species survey results

Species	Identification method (assumed, recorded, expert report)	Vegetation zone code / TEC
Cumberland Plain Land Snail	Recorded	PCT 835 (River-Flat Eucalypt Forest TEC) PCT 849, PCT 850, PCT 806

Species	Identification method (assumed, recorded, expert report)	Vegetation zone code / TEC
		(Cumberland Plain Woodland TEC)
Eastern Bentwing-bat	Recorded (probable call recording)	PCT 835 (River-Flat Eucalypt Forest on Coastal Floodplains TEC) PCT 849, PCT 850 (Cumberland Plain Woodland TEC)
Eastern False Pipistrelle	Recorded (possible call identification)	PCT 835 (River-Flat Eucalypt Forest TEC) PCT 849, PCT 850 (Cumberland Plain TEC)
Eastern Freetail-bat	Recorded (possible call identification)	PCT 835 (River-Flat Eucalypt Forest TEC) PCT 849, PCT 850 (Cumberland Plain Woodland TEC)
Grey-headed Flying-fox	Recorded	PCT 835 (River-Flat Eucalypt Forest TEC) PCT 849, PCT 850 (Cumberland Plain Woodland TEC)

Aquatic biodiversity

The relevant water source is the Hawkesbury and Lower Nepean Rivers Water Source and the relevant management zone for the northern portion of the project is the Lower Nepean River Management Zone, and the Mid Nepean River Catchment Management Zone and the Upper South Creek Management Zone for the southern portion of the project. The catchment is relatively flat with gently undulating hills. The project directly traverses Badgerys Creek and Cosgrove Creek. There are a number of other unnamed tributaries/drainage lines and farm dams traversed by the project. The predominant catchment land uses are residential, rural residential and various forms of agriculture. The rural areas are predominantly agriculture including cattle grazing.



The Nepean River is the downstream receiving environment to the project area; however, the project itself is located close to the catchment divide, just west of the eastern boundary. The Nepean River is significant both environmentally and economically and provides for a range of domestic and irrigation uses. Several threatened species including Macquarie Perch (*Macquaria australasica*), Australian Grayling (*Prototroctes marena*), Silver Perch (*Bidyanus bidyanus*), Murray Cod (*Maccullochella peelii peelii*) and Trout Cod (*Maccullochella macquariensis*) have been recorded within the Hawkesbury-Nepean Catchment based on database searches; however, habitat for these species is not present within the study area and there are no records in the study area.



No protected or threatened fish species are considered likely to occur within the study area due to the limited water and aquatic habitat present.



Fish habitat classification criteria for watercourses in the project area and recommended crossings types are provided in Table 7-50.



No watercourse crossings have been mapped as Key Fish Habitat by DPI Water (2007), however five waterway crossings in the study area have been identified as Type 1 – Key Fish Habitats (DPI, 2013), as they contain a combination of native aquatic plants and/or woody snags. These watercourses are impacted, intermittently flowing waterways which are also identified as Class 2 – Moderate Key Fish Habitat (Fairfull & Witheridge, 2003) due to the presence of limited in stream aquatic vegetation. These are shown as key waterways in Figure 8-6.



Table 7-50 Fish habitat classification criteria for watercourses and recommended crossings types

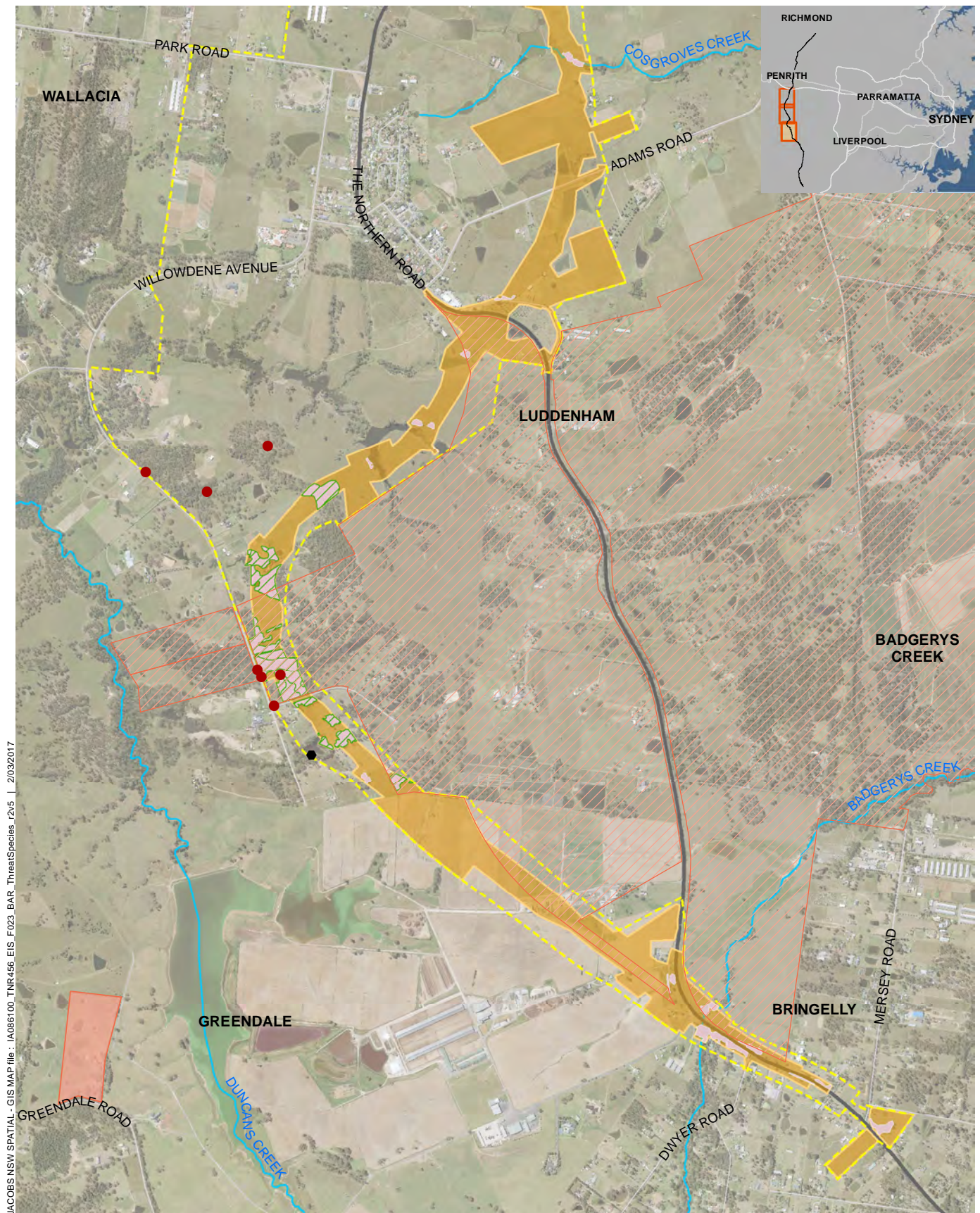
Site	Description	Key Fish Habitat Classification, and Fish Passage Classification
<p>Site 17 – Badgerys Creek</p> 	<p>Site 17 is an intermittent stream, Badgerys Creek which is crossed by the Project. It contains permanent residual pools which provide refuge habitat for fish. The substrate consists of sand, gravel and clay. A variety of instream macrophytes are present including Cumbungi (<i>Typha</i> sp.), <i>Eleocharis</i>, <i>Vallisneria</i>, Duckweed (<i>Lemna</i>), and Water Primrose (<i>Ludwigia peploides</i>). The presence of macrophytes and instream woody snags provides fish habitat, however no threatened or protected fish species are expected to occur within the Creek. Visual inspection sighted the invasive pest species, Gambusia (<i>Gambusia holbrooki</i>) within the Creek.</p> <p>Surrounding landuse is agriculture, primarily cattle grazing which has led to some bank degradation. Riparian vegetation is sparse, consisting of both natural and exotic vegetation.</p> <p>Water quality appears moderate, tannin stained with some frothing and instream rubbish. Runoff from surrounding agriculture is likely to impact upon water quality.</p>	<p>Class: Class 2 – Key Fish habitat</p> <p>Key Fish Habitat – Type 1 Highly sensitive key fish habitat</p>
<p>Site 20 – Unnamed Gully upstream of Duncan’s Creek</p> 	<p>Site 20 is an unmapped, unnamed gully associated with Leppington Dam and Duncans Creek. It has minimal channel definition, and no water was present at the time of inspection, despite heavy rainfall in the past 24 hours. No instream aquatic habitat is present. The surrounding land use is agriculture including cattle grazing and various crops.</p> <p>Downstream is a large dam ‘Leppington Dam’ which forms part of Duncans Creek. Duncans Creek is a perennial stream; however the Leppington Dam is an artificial barrier to fish migration and would affect the natural flow regimes within Duncans Creek. Water quality within the Dam appears poor, with frothing and an extensive green algae bloom (pictured), suggesting high nutrient concentrations are likely to be present and are likely to result in deoxygenation events within the dam. No fish were sighted during visual inspections.</p>	<p>Class: Class 4 – Unlikely Key Fish Habitat</p> <p>Key Fish Habitat: Type 3 Minimally sensitive key fish habitat.</p>

Site	Description	Key Fish Habitat Classification, and Fish Passage Classification
<p>Site 23 – Farm Dam</p> 	<p>Site 23 is a farm dam situated immediately downstream of alignment. The dam is part of a series of disconnected ponds situated within an undefined gully. The dam is used for cattle, and has poor water quality, with high turbidity and frothing upon the water surface. Limited aquatic habitat is present and consists of a small density of the aquatic macrophyte Water Primrose (<i>Ludwigia peploides</i>).</p> <p>The substrate consists of a relatively even distribution of silt, clay, sand, gravel and pebble. A lot of rubbish such as tiles, bricks and broken glass is also present.</p> <p>No fish were sighted during visual inspections, and no threatened or protected fish species are expected to occur within the dam.</p>	<p>Class: Class 3 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: n/a (farm dam)</p>
<p>Site 27 – Farm Dam</p> 	<p>Site 27 is a farm dam, situated immediately downstream of site 23, downstream of the alignment. The dam is part of a series of disconnected ponds situated within an undefined gully. The dam is used for cattle and has poor, stagnant water quality with high turbidity and a thick algal bloom suggesting elevated nutrient concentrations. Substrate is predominantly silt, clay and detritus.</p> <p>Variety of aquatic habitat is present including submerged woody logs, and a variety of aquatic macrophytes including Water Primrose (<i>Ludwigia peploides</i>), Nardoo (<i>Marsilea mutica</i>), <i>Eleocharis</i> sp., Floating Pondweed (<i>Potamogeton sulcatus</i>) and several sedge species (<i>Cyperus</i> sp.).</p> <p><i>Gambusia</i> (<i>Gambusia holbrooki</i>) were sighted during visual inspections, however no threatened or protected fish species are expected to occur within the dam.</p>	<p>Class: Class 3 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: n/a (farm dam)</p>

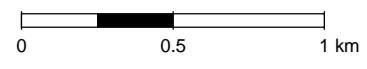
Site	Description	Key Fish Habitat Classification, and Fish Passage Classification
<p>Site 29a – Unnamed watercourse</p> 	<p>Site 29a is an intermittent stream which is crossed by the Project. It has low to no flow, despite rainfall occurring within the past 24 hours. Creek will only flow when the dams upstream (including site 29a) overflows. Variety of substrates present including boulder, pebble, gravel, clay, sand and silt. Large quantities of detritus are present within the residual pools. Some instream woody snags are present. Macrophytes present include Water Primrose (<i>Ludwigia peploides</i>), Sedge (<i>Cyperus</i> sp.) and Watermilfoil (<i>Myriophyllum</i> sp.).</p> <p>Water quality appears moderate, with anoxic odour within residual pools, tannin staining and filamentous algae present. Some rubbish such as tyres are present within the site.</p> <p>No fish were sighted during visual inspections, and no threatened or protected fish species are expected to occur within the stream.</p>	<p>Class: Class 2 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: Type 1</p>
<p>Site 29b – Farm Dam</p> 	<p>Site 29b is a farm dam immediately upstream of the alignment. Dam acts as a barrier to fish passage, and disrupts the natural hydrology of the creek downstream (site 29a). Water quality appears poor, with an anoxic odour and thick algae present.</p> <p>Substrate consists of an even distribution of silt, clay, sand, gravel and pebble. A thick layer of detritus is present throughout the dam.</p> <p>Macrophytes present include Water Primrose (<i>Ludwigia peploides</i>) and Watermilfoil (<i>Myriophyllum</i> sp.).</p> <p>No fish were sighted during visual inspections, and no threatened or protected fish species are expected to occur within the dam.</p>	<p>Class: Class 3 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: n/a (farm dam)</p>

Site	Description	Key Fish Habitat Classification, and Fish Passage Classification
<p>Site 212 - Cosgrove Creek</p> 	<p>Site 212 is an intermittent stream, Cosgrove Creek which is crossed by the project. At the time of inspection it consisted of a series of shallow disconnected pools. The bed and banks of the channel are degraded by cattle access. The substrate consists of silt and clay.</p> <p>Water quality appears poor, with thick algae bloom, oily film and frothing present in some of the stagnant pools.</p> <p>Aquatic macrophytes present include Azolla, Duckweed (<i>Lemna</i>) and Floating Pondweed (<i>Potamogeton sulcatus</i>). Typha Sedges are present further downstream.</p> <p>A large density of Gambusia (<i>Gambusia holbrooki</i>) were sighted during visual inspections, however no threatened or protected fish species are expected to occur within the dam.</p>	<p>Class: Class 2 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: Type 1</p>
<p>Site 215 – Farm Dam</p> 	<p>Site 215 is a series of farm dams which are crossed by the project. It is fed by an undefined gully which only flows when the upstream dams overflow.</p> <p>The bed and banks of the channel are degraded by cattle access. The substrate consists of silt and clay. Aquatic macrophytes present within the site include Cumbungi (<i>Typha</i> sp.).</p> <p>No fish were sighted during visual inspections, and no threatened or protected fish species are expected to occur within the dam.</p>	<p>Class: Class 3 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: n/a (farm dam)</p>

Site	Description	Key Fish Habitat Classification, and Fish Passage Classification
<p>Site 39 – Unnamed Dam and Watercourse</p> 	<p>Site 39 is a large farm dam, fed by several minor 1st and 2nd order streams. These streams are ephemeral with minimal channel definition, only flowing when the upstream dams overflow.</p> <p>A variety of aquatic habitat is present including submerged woody logs, and a variety of aquatic macrophytes including Water Primrose (<i>Ludwigia peploides</i>), Nardoo (<i>Marsilea mutica</i>), Eleocharis sp., Cumbungi (<i>Typha</i> sp.), Floating Pondweed (<i>Potamogeton sulcatus</i>) and several sedge species (<i>Cyperus</i> sp.).</p> <p>No fish were sighted during visual inspections, however Gambusia (<i>Gambusia holbrooki</i>) are likely to be present. No threatened or protected fish species are expected to occur within the dam.</p>	<p>Class: Class 2 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: Type 1</p>
<p>Unnamed tributary of Surveyors Creek Location: 286887.04 E, 6257728.9 N</p> 	<p>The unnamed tributary of Surveyors Creek is an ephemeral stream which is crossed by the project. At the time of inspection no water was present and the channel was densely populated by Typha Sedges. No fish were sighted during visual inspections, however Gambusia (<i>Gambusia holbrooki</i>) are likely to be present. No threatened or protected fish species are expected to occur within the dam.</p>	<p>Class: Class 2 – Moderate Key Fish habitat</p> <p>Key Fish Habitat: Type 1</p>



JACOBS NSW SPATIAL - GIS MAP file : IAC6100_TNR456_EIS_F023_BAR_ThreatSpecies_r2v5 | 2/03/2017



- The Northern Road (Existing)
- Development site boundary
- - - Ecology study area

Threatened flora

- *Marsdenia viridiflora* subsp. *viridiflora*
- *Pultenaea parviflora*

Threatened fauna

- Cumberland Plain Land Snail
- Eastern Bentwing-bat, Eastern Freetail-bat, Eastern False Pipistrelle
- ▲ Latham's Snipe

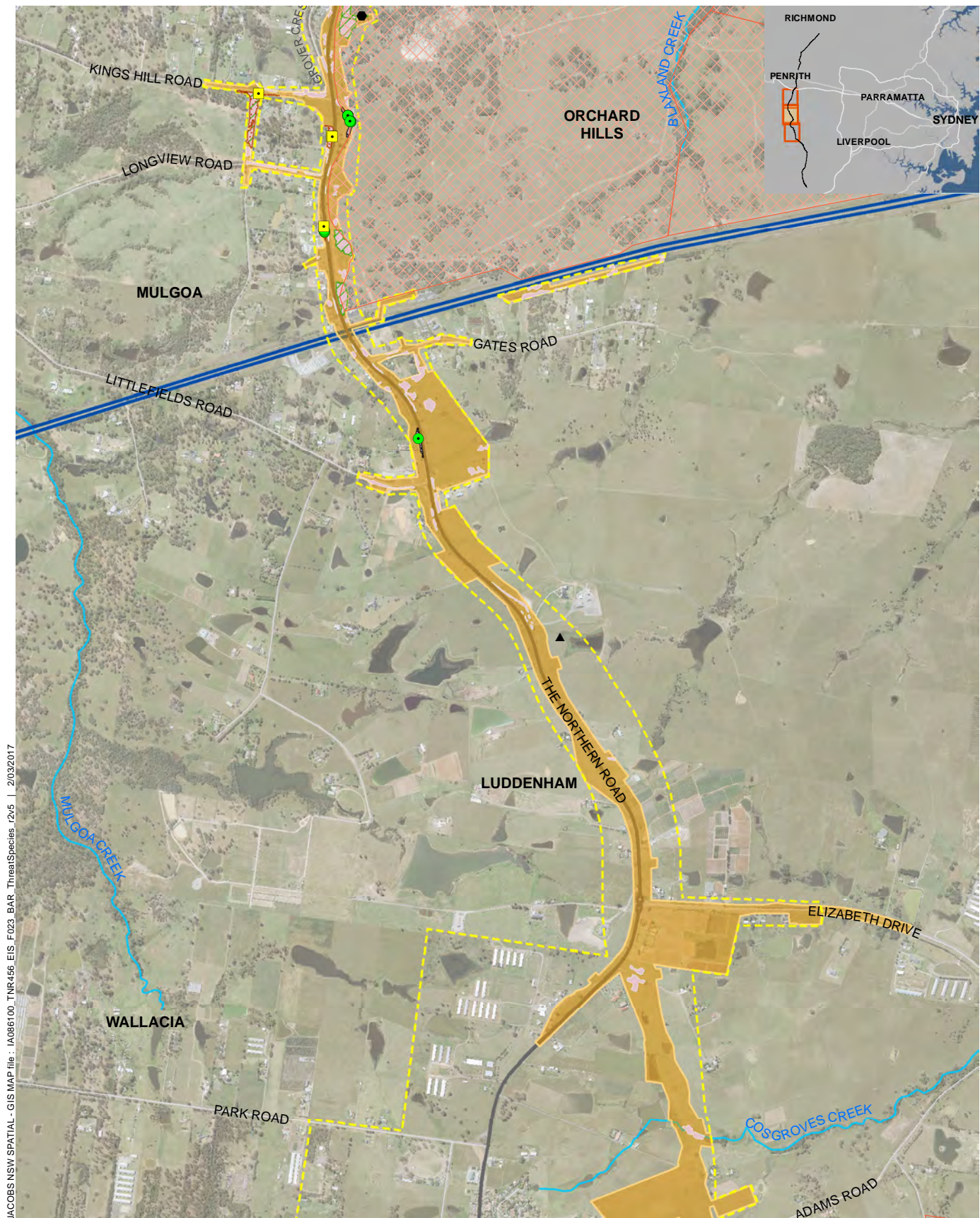
Threatened species habitat polygons

- *Pultenaea parviflora*
- Cumberland Plain Land Snail habitat
- *Marsdenia viridiflora* subsp. *viridiflora* - endangered population
- Regent Honeyeater habitat

- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Lands

3
2
1

Figure 7-11 | Recorded threatened species



JACOBS NSW SPATIAL - GIS MAP file : IAC06100_TNR456_EIS_F023_BAR_ThreatSpecies_r2v5 | 2/03/2017

- The Northern Road (Existing)
- WaterNSW supply pipelines
- Development site boundary
- - - Ecology study area
- Threatened flora**
- *Marsdenia viridiflora* subsp. *viridiflora*

- *Pultenaea parviflora*
- Threatened fauna**
- Cumberland Plain Land Snail
- Eastern Bentwing-bat, Eastern Freetail-bat, Eastern False Pipistrelle
- ▲ Latham's Snipe

- Threatened species habitat polygons**
- *Pultenaea parviflora*
- Cumberland Plain Land Snail habitat
- *Marsdenia viridiflora* subsp. *viridiflora* - endangered population
- Regent Honeyeater habitat

- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)
- Commonwealth Lands

0 0.5 1 km



3
2
1

Figure 7-11 | Recorded threatened species



JACOBS NSW SPATIAL - GIS MAP file : IAC66100_TNR456_EIS_F023_BAR_ThreatSpecies_r2v5 | 2/03/2017

— The Northern Road (Existing)

— WaterNSW supply pipelines

— Development site boundary

- - - Ecology study area

Threatened flora

● *Marsdenia viridiflora* subsp. *viridiflora*

■ *Pultenaea parviflora*

Threatened fauna

● Cumberland Plain Land Snail

● Eastern Bentwing-bat, Eastern Freetail-bat, Eastern False Pipistrelle

▲ Latham's Snipe

Threatened species habitat polygons

■ *Pultenaea parviflora*

■ Cumberland Plain Land Snail habitat

■ *Marsdenia viridiflora* subsp. *viridiflora* - endangered population

■ Regent Honeyeater habitat

■ Western Sydney Airport site (Commonwealth Land)

■ Defence Establishment Orchard Hills (Commonwealth Land)

■ Commonwealth Lands

0 0.5 1 km



3
2
1

Figure 7-11 | Recorded threatened species

Listed migratory species

No migratory species listed under the EPBC Act were recorded during the targeted bird surveys; however, the Latham's Snipe was recorded opportunistically in the study area on three occasions. It was recorded in the same location in an area of flooded grassland on DEOH. The Latham's Snipe is considered likely to utilise the extensive network of farm dams, however this habitat is not considered to comprise important habitat.

The Cattle Egret was observed repeatedly in paddocks throughout the study area and broader locality. The Great Egret is also considered moderately likely to occur in the wetlands throughout the study area. The White-throated Needletail and Fork-tailed Swift are considered likely to fly over the study area during migration.

7.3.3 Avoidance and minimisation

Chapter 4 of the EIS describes the alternatives that were considered as part of the project development process and explains how and why the project was selected as the preferred option. Chapter 4 of the EIS also outlines how particular elements of the project have been refined. During the short listing process for Segment 2, options 6 and 7 were not progressed further due to impacts to critical endangered and threatened ecological communities. A route selection process was initiated and during the short listing options process, key areas were identified where additional field based investigations would assist in assessing the route options. Early biodiversity field investigations were carried out between July and September 2015 which involved rapid biodiversity assessments with the data used to inform final route selection.

An analysis of the biodiversity data was undertaken with reference to the route options proposed. The analysis was undertaken within a GIS by overlaying the eastern and western route options onto the vegetation mapping layer that showed TECs and known or potential habitat for threatened species. Potential worst case impacts were quantified based on a 100 m wide corridor and considered impacts to TECs, further fragmentation of woodland, and the direct loss of vegetation / habitat.

A comparison of the impacts of the eastern and western short-listed route options to threatened ecological communities determined that impacts to TSC Act listed TECs were estimated to be marginally greater for the eastern option. However, impacts to EPBC Act listed TECs were estimated to potentially be marginally greater for the western option (refer to Appendix I). Both options were identified to impact on PCTs; however, the total loss of vegetation and habitat would be greatest with the eastern option.

The data collected for each option indicated that fragmentation would be comparable for each option although the western option around Duncans Creek would likely result in greater vegetation loss and fragmentation due to the traverse of the creek in two locations.

7.3.4 Assessment of potential impacts

Nine of the ten vegetation zones identified within the development footprint require impacts to be assessed under the FBA. One vegetation zone within the development footprint (Vegetation zone 4, Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion – Moderate/Good_Poor condition) was identified as having a site value score of less than 17 (this vegetation zone had a site score of 15.94). As such, impacts to this vegetation zone do not require assessment under the FBA and offsets for this vegetation zone do not need to be calculated.

Impacts to biodiversity requiring assessment under the FBA include:

- Removal of native vegetation including threatened ecological communities
- Removal of threatened fauna species habitat and habitat features
- Removal of threatened plants.

Impacts to biodiversity that are not covered by the FBA would also occur including:

- Impacts to the Orchard Hills Cumberland Plain Woodland
- Impacts to habitat for listed migratory species
- Impacts to aquatic biodiversity
- Fragmentation of biodiversity links and habitat corridors
- Edge effects on adjacent native vegetation and habitat
- Injury and mortality of fauna (including vehicle strike)
- Invasion and spread of weeds and pests
- Invasion and spread of pathogens and disease
- Noise, vibration, dust, light and contaminants
- Cumulative impacts.

In addition to the FBA, the BAR has also addressed the biodiversity assessment requirements under the EPBC Act which include impacts to the environment of Commonwealth land.

An assessment of the potential impacts of the project during construction and operation are detailed below and environmental management measures to avoid, minimise, mitigate and offset these impacts are discussed in Section 7.

Approved threat abatement plans

Threat abatement plans establish a national framework to guide and coordinate Australia's response to key threatening processes registered under the EPBC Act. The plans identify research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by key threatening processes. A list of approved threat abatement plans is included in Appendix I. It is noted that not all of the approved threat abatement plans are applicable to the project.

The threat abatement plans that relate to the project involve invasion and spread of pests (i.e. goats, rabbits, red fox, feral cats, and pigs) and pathogens (i.e. beak and feather disease, *Phytophthora cinnamomi*, and chytrid fungus). Pest species and pathogens would be managed within the project site according to the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (NSW Roads and Traffic Authority, 2011). This would ensure to the greatest extent possible that invasion and spread of pests and pathogens are managed throughout the project lifecycle. The potential impacts from pests and pathogens are discussed further in the relevant section below.

In summary, the project does not include any activities that would interfere with any of the relevant threat abatement plans.

Recovery plans

Two relevant recovery plans have been considered below in relation to the project as follows:

- Regent Honeyeater the National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (Commonwealth of Australia, 2016)
- The National Recovery Plan for the Swift Parrot (Saunders & Tzaros, 2011) (Swift Parrot Recovery Team, 2001).

These are discussed in more detail in the relevant sections below and in Appendix I. In summary, the project is not expected to interfere with the strategies, objectives or associated actions outlined in any of these plans.

Potential construction impacts

Removal of native vegetation

The potential loss of vegetation and habitat associated with the project is summarised in Table 7-51. The construction footprint would remove up to 39.61 ha of remnant native vegetation. These impacts have been quantified based on the development footprint and take into consideration potential disturbance during construction including compound sites and access tracks. Impacts associated with native vegetation removal would be long-term.

Removal of TSC Act listed threatened ecological communities

The removal of native vegetation includes removal of about 29.14 ha of the TSC Act listed critically endangered Cumberland Plain Woodland in the Sydney Basin Bioregion ecological community. The vegetation removal also involves removal of about 4.29 ha of the TSC Act listed River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions endangered ecological community. These impacts would be long-term.

Table 7-51 Impacts to native vegetation to be assessed under the FBA

Vegetation zone	PCT	Condition	Status (TSC Act)	Percent cleared in CMA	Area to be impacted (ha)
1	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)	Moderate/ Good	CEEC	95%	6.67
2	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 835)	Moderate/ Good	EEC	95%	2.53
3	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)	Moderate/ Good	CEEC	90%	4.91
5	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)	Moderate/ Good-Poor	CEEC	90%	3.21
6	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 835)	Moderate/ Good-Poor	EEC	95%	1.76

Vegetation zone	PCT	Condition	Status /TSC	Percent cleared in	Area to be
7	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 849)	Moderate/ Good-High	CEEC	90%	1.25
8	Derived grasslands on shale hills of the Cumberland Plain (50-300 m asl) (PCT 806)	Moderate/ Good-Derived grassland	CEEC	-	12.01
9	<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)	Moderate/ Good-Other	-	70%	6.17
10	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)	Moderate/ Good-Medium	CEEC	90%	1.09
Total vegetation removal to be assessed					39.6

Removal of EPBC Act listed threatened ecological communities

Based on the estimated construction footprint, the project would result in the direct clearing of about 16.37 ha of the critically endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community listed under the EPBC Act. This clearing includes:

- 10.69 ha of core Category A vegetation
- 1.47 ha of Category C vegetation
- 4.21 ha of Category C Derived Native Grassland.

An assessment of significance pursuant to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment, 2013) was completed for the critically endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CPSWSGTF) ecological community (refer to Appendix I). An overall conclusion has been made that the action is likely to result in a significant impact to the critically endangered CPSWSGTF as it would:

- Reduce the extent of the CEEC by about 16.37 ha
- Adversely affect habitat critical to the survival of the CEEC
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the CEECs survival
- Cause a substantial change in the species composition of an occurrence of the CEEC, including causing a decline or loss of functionally important species
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, particularly form potential weed invasion
- Interfere with the recovery of an ecological community.

These impacts would be long-term.

Removal of threatened plants

There would be an impact to the following threatened plant and endangered population:

- *Pultenaea parviflora* (Endangered – TSC Act, Vulnerable EPBC Act). The proposed action would result in the direct clearing of four *Pultenaea parviflora* plants for the construction of batters. The area of surrounding habitat likely to possess a soil seedbank for this species is about 0.98 ha.
- *Marsdenia viridiflora* subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas (Endangered population – TSC Act).

The predicted impact to *Pultenaea parviflora* and the *Marsdenia viridiflora* subsp. *viridiflora* endangered population are outlined in Table 7-52.

The construction footprint contains (and therefore would remove) all known individuals and habitat for the *Marsdenia viridiflora* subsp. *viridiflora* endangered population in the study area. The construction footprint would also remove all known *Pultenaea parviflora* plants in the study area.

An assessment of significance pursuant to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment 2013) was completed for *Pultenaea parviflora* (refer to Appendix I). Given the conservation status of this species (vulnerable) and the low magnitude of the impact, an overall conclusion has been made that the action is unlikely to result in a significant impact to *Pultenaea parviflora*. A significant impact to *Pultenaea parviflora* is not predicted for the following reasons:

- The larger core population, to which the impacted sub-population belongs, would still exist about three kilometres to the east within the DEOH. There is also potential for additional *Pultenaea parviflora* plants from the sub-population to be present on private property further to the west of the study area (e.g. Lot 23 and Lot 85 Longview Road Mulgoa, 99 Vineyard Road Mulgoa). Overall, the removal of three plants from this apparent outlying sub-population would not lead to a long-term decrease in the size of the important population
- The project would not result in the breaking apart of large blocks of high quality habitat for *Pultenaea parviflora* and would not fragment a continuous population of *Pultenaea parviflora*
- The area of habitat to be impacted by the project is directly adjacent to The Northern Road in the road reserve. In the context of existing larger populations and areas of habitat that are clearly more critical to the survival of this species, the habitat to be affected is not considered critical
- While the project would disrupt the breeding cycle of the *Pultenaea parviflora* sub-population, the breeding cycle of the overall core population would continue

- The project would result in a small decrease in the availability of habitat for *Pultenaea parviflora* of about 0.98 ha. This habitat represents about 0.7 per cent of the 126 ha of suitable habitat for the core population on the DEOH. Removal of 0.98 ha of habitat is unlikely to be so detrimental as to cause this species to decline.

The identified impacts to threatened plant species would be long-term.

Table 7-52 Summary of threatened plant species impacts

Threatened species	Status		Habitat or individuals to be impacted
	TSC Act	EPBC Act	
<i>Pultenaea parviflora</i>	Endangered	Vulnerable	4 individuals
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> – endangered population	Endangered population	-	35 individuals

Removal of threatened fauna species habitat and habitat features

There are about 49.58 ha of suitable habitat (in good condition and where live snails or shells were found during the field survey) for the Cumberland Plain Land Snail (Endangered - TSC Act) in the study area. Of this, about 13 ha would be impacted by construction.

The Grey-headed Flying-fox (Vulnerable TSC Act and EPBC Act) was recorded in one location on private property off Willowdene Avenue during spotlight surveys. Three additional threatened fauna species were identified as having a moderate to high likelihood of occurring within the study area (these species were not recorded during the survey). These included:

- Regent Honeyeater (Critically Endangered – TSC Act and EPBC Act)
- Swift Parrot (Endangered TSC Act, Critically Endangered EPBC Act)
- Large-eared Pied Bat (Vulnerable TSC Act and EPBC Act).

The predicted impact to threatened fauna species is outlined below in Table 7-53. These impacts would be long-term. An assessment of significance pursuant to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment, 2013) was completed for these the Grey-headed Flying-fox, Regent Honeyeater, Swift Parrot and Large-eared Pied Bat (refer to Appendix I). The project is considered unlikely to result in a significant impact to any of the EPBC Act listed threatened fauna species.

The Regent Honeyeater and Swift Parrot would suffer a reduction in extent of marginal foraging habitat of about 26.25 ha. Within the study area, this potential loss represents about 31 percent of the available habitat for these species. Within the Cumberland sub-region, this potential habitat removal represents less than 0.1 percent of the currently available habitat for these species. The state and national extent of habitat for these species is not known but the proportional impacts from the project to habitat at these scales would be less than 0.1 per cent. The impacts are predicted to be minimal as these species are unlikely to use the study area consistently. The project is unlikely to reduce the population size of the Regent Honeyeater or Swift Parrot or decrease the reproductive success of these species as no breeding habitat would be affected. The action would not interfere with and key breeding sites or foraging areas and would not interfere with the recovery of these species.

The National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (Commonwealth of Australia 2016) contains four overarching strategies for recovery of the Regent Honeyeater (refer to Appendix I). One of the actions associated with these strategies is to protect intact (high quality) areas of Regent Honeyeater breeding and foraging habitat. The study area is not recognised as a high quality area of Regent Honeyeater breeding or foraging habitat therefore the project would not interfere with this action. The remaining research and on ground actions associated with the strategies are not applicable to the project.

The National Recovery Plan for the Swift Parrot (Saunders & Tzaros, 2011) (Swift Parrot Recovery Team, 2001) outlines objectives and associated recovery actions for this species (refer to Appendix I). The objectives are not applicable to the biodiversity assessment study area or project. The identified recovery actions mostly relate to identifying the extent and quality of habitat, monitoring, raising community awareness, and coordinating and reviewing the recovery process. There is an action relating to management and protection of Swift Parrot habitat at the landscape scale. However, this action applies to fencing off habitat on private land to encourage regeneration of habitat, revising forestry practices, developing a strategic management plan for Swift Parrot breeding habitat in Tasmania, and providing Swift Parrot conservation information for consideration during the New South Wales Local Government Local Environmental Planning review process. Therefore these recovery actions will not be interfered with by the project.

The Grey-headed Flying-fox would suffer a small reduction in extent of suitable local foraging habitat of about 26.25 ha. Within the Cumberland sub-region, this potential habitat removal represents less than 0.1 percent of the currently available habitat in the region. The state and national extent of habitat for these species is not known but the proportional impacts from the project to habitat at these scales would be less than 0.1 per cent. No breeding camps or other important habitat would be impacted. As such, the project is considered unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. The project would not interfere with the recovery of the Grey-headed Flying-fox and would not contribute to the key threats to this species. An overall conclusion has been made that the action is unlikely to result in a significant impact to the Grey-headed Flying-fox.

The Large-eared Pied Bat would suffer a small reduction in extent of foraging habitat of about 26.25 ha. Within the Cumberland sub-region, this potential habitat removal represents less than 0.1 percent of the currently available habitat in the region. The state and national extent of habitat for these species is not known but the proportional impacts from the project to habitat at these scales would be less than 0.1 per cent. No breeding habitat (i.e. caves) would be impacted. As such, the project is unlikely to reduce the population size of this species or decrease its reproductive success. The project is considered unlikely to result in a significant impact to the Large-eared Pied Bat.

Table 7-53 Summary of threatened fauna species impacts

Threatened species	Status		Habitat or individuals to be impacted	Habitat or individuals in the study area
	TSC Act	EPBC Act		
Cumberland Plain Land Snail	Endangered	-	13 ha of habitat	74.95 ha of habitat
Grey-headed Flying-fox	Vulnerable	Vulnerable	26.25ha of habitat	84.97 ha of habitat
Regent Honeyeater	Critically endangered	Critically endangered	26.25 ha of habitat	84.97 ha of habitat
Swift Parrot	Endangered	Critically endangered	26.25 ha of habitat	84.97 ha of habitat
Large-eared Pied Bat	Vulnerable	Vulnerable	26.25 ha of habitat	84.97 ha of habitat

Impacts to habitat for EPBC listed migratory species

An assessment of significance pursuant to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment, 2013) was completed for recorded migratory species and those with a moderate or high likelihood of occurrence (refer to Appendix I). In accordance with the guideline, 'Important habitat' for a migratory species is defined as (Department of the Environment, 2013):

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

Habitat in the study area is not considered to comprise important habitat for the Latham's Snipe or other potentially occurring migratory species. The assessment concluded that although the proposed action is expected to result in the loss of occasional habitat for migratory species, but not important habitat, the proposed action is unlikely to result in a significant impact on migratory species listed under the EPBC Act.

The remaining discussion on potential biodiversity impacts is not covered by the FBA although are considered relevant to the project.

Seasonal and temporal variation in impacts to threatened fauna species

The threatened species that were recorded within the study area and those that are considered likely to occur utilise the habitats in different ways during differing seasons or in some cases will only utilise the habitat during specific times of the year. In some cases, the habitat may not be used every year and may only be visited when environmental conditions are favourable. As such, the potential impacts of the project on threatened fauna species will vary temporally.

The Grey-headed Flying-fox (Vulnerable TSC Act and EPBC Act) was recorded in one location on private property off Willowdene Avenue during spotlight surveys. This species is considered likely to occur throughout the study area based on the presence of suitable foraging habitat. There are no roost camps in the study area and the project will not impact on any known permanent roosting, breeding / maternity sites. As such, the direct impacts of the project during the Grey-headed Flying-fox breeding season is likely to be negligible. The foraging habitat to be impacted may be productive from winter to spring (based on the widely ranging flowering period of *Eucalyptus tereticornis* and *Eucalyptus molluccana*) so the ability of the Grey-headed Flying-fox to forage in the area of impact would be impacted at this time. During some years conditions may not be suitable for foraging as the trees may not flower but it is not possible to predict when or whether this may occur. As such, there are no specific management measures outlined regarding seasonal impacts of key species, however, pre clearing surveys would be conducted to identify the presence of any species.

The Regent Honeyeater may utilise habitat within the study area on occasion outside of the breeding season when birds disperse from core habitats (ie during winter). Likewise, the Swift Parrot would only be present on occasion in the habitat during winter (outside of the breeding season) when it migrates to mainland Australia from Tasmania. No direct impacts to these species would occur during the breeding season. Impacts are limited to the loss of some potential foraging habitat that may be productive in winter during some years when environmental conditions are favourable. The study area will only be used on occasion by these two species when more favourable inland foraging habitats (ie box gum woodlands, box ironbark woodlands) or coastal habitats (ie spotted gum and swamp mahogany forests) fail to produce sufficient resources. The impact of the project to the habitat would only be realised by these two species during winter in years when other more preferred foraging habitat fail to produce sufficient resources.

Any Large-eared Pied Bats that would forage in the study area are likely to roost in the sandstone escarpments of the lower Blue Mountains. There are no maternity roosts in the study area. This species has been observed to establish nursery colonies in September with adult males dispersing after the young are born in early summer. Juvenile bats and females leave the roost before the

winter months. This suggests the main foraging period for males and females in the study area may be during autumn and winter (April to September) and the impact to this species would likely be most pronounced during this time.

Impacts to aquatic biodiversity

The construction of the project has the potential to impact aquatic ecosystems due to changes in water quality, habitat loss and instream barriers.

Construction activity around watercourses in the project area has potential to result in temporary changes to flow and loss of aquatic habitat associated with the removal of woody snags, changes to instream substrate and loss of aquatic plants (macrophytes).

The construction of the project has the potential to impact on water quality. The main impact to water quality during construction comes from vegetation clearing and earthworks, and including cut and fill activities.

Stockpiling of earthworks could potentially reduce downstream water quality during wet weather if not managed appropriately. Whilst there are numerous locations for stockpile sites (as documented in the Working Paper – Soils, Water and Contamination), they have been located such that no stock piles or compound sites are within 50 m of a Type 1 Fish Habitat.

The removal of large woody debris or snags is listed under Schedule 6 of the FM Act as a key threatening process. All woody debris and snags encountered during construction would be relocated instream to ensure impacts to the presence and availability of woody debris is prevented.

Many of the watercourses in the study area are artificial dams, situated in minor gullies which are either first or second order streams, and as such are not considered key fish habitat. Threatened species are unlikely to be present within these dams. However, there is a possibility that native and invasive fish species have colonised these dams. Should dams or creeks be dewatered during the construction of the project, then native fish species would need to be relocated in to a similar aquatic environment to which it was found by trained aquatic ecologists under a Fisheries Permit issued by the NSW DPI.

Aquatic impacts during construction of the project would be short-term and managed through the implementation of appropriate management measures.

Fragmentation of biodiversity links and habitat corridors

Habitat fragmentation *per se* relates to the physical dividing up of once continuous habitats into separate smaller 'fragments' (Fahrig 2002). The historic human activities including clearing for agriculture have resulted in the Cumberland Plain becoming a highly fragmented landscape. Most vegetation now occurs as small fragments in an agricultural setting of improved pasture and cropping.

The existing The Northern Road and the perimeter fence (about two metres high) around the DEOH currently create a physical barrier to movements of fauna. The project is considered unlikely to result in a large increase to landscape scale fragmentation. The project is however likely to result in localised fragmentation of local wildlife corridors between The Northern Road and Willowdene Avenue where some intact habitat patches would be broken apart and the hard barrier introduced by the project would restrict fauna movement. The widening of the existing The Northern Road in the north of the study area would further the barrier effects of this roadway where it bisects Regional Corridor 17 as identified in the OEH BIOMAP.

The predicted level of fragmentation from the project is not expected to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. Functional connectivity for many species would remain in the study area. However, local division of some wildlife populations, isolation of key habitat resources, loss of genetic interchange, and loss of population viability may result from the local fragmentation caused by the project which would result in long-term impacts to some local wildlife.

Edge effects on adjacent native vegetation and habitat

The development of linear infrastructure is known to cause disturbance in terms of reducing habitat quality and patch size. This is due to the greater potential for edge effects and habitat fragmentation and barrier effects associated with these forms of development due to their impact footprint and perimeter.

Within the study area, and construction footprint, many patches of vegetation are small, irregularly shaped, and fragmented. As such, many areas of vegetation within and directly adjacent to the construction footprint are already subject to considerable edge effects. However, there is potential for a high magnitude residual impact to occur to some of the more intact habitats within the study area from edge effects (such as those off Willowdene Avenue). These impacts would be long-term.

Overall, new edge effects from the project are predicted to result in the modification of about 1.94 ha of vegetation that would remain at the edge of the project once construction is complete (based off a 50 metre edge effect buffer).

Injury and mortality of fauna (including vehicle strike)

Fauna injury or death has the greatest potential to occur during vegetation clearing and the extent of this impact would be proportionate to the extent of vegetation that is cleared. Some mobile species, such as birds, may be able to move away from the path of clearing and may not be greatly affected unless they are nesting. However, other species that are less mobile (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to move rapidly when disturbed. Common fauna species such as possums, reptiles and frogs are the most likely to be affected.

Entrapment of wildlife in any trenches that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in machinery that is stored in the study area overnight that may result in injury or death.

Invasion and spread of weeds and pests

Proliferation of weed and pest species due to the project may be a key impact to biodiversity in the study area. Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of project activities) that may have cumulative effects as each project activity may act together to increase the chances of weed and pest proliferation throughout the study area. Proliferation of weed and pest species is likely to occur during construction and the impacts would be greatest as a result of vegetation clearing during the construction phase. This impact has potential to have the greatest impact to the quality and integrity of TECs and threatened species habitat.

Without appropriate management strategies, project activities have the potential to disperse weeds into areas of remnant vegetation where weed species are currently limited or in low density. Project activities also have the potential to import new weed species into the study area. The most likely causes of weed dispersal and importation associated with the project include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. Large expanses of the study area have significant weed growth. Therefore, the potential for habitat modification from weed invasion resulting from the project is highest where activities take place in relatively intact areas such as the higher condition areas of Cumberland Plain Woodland along Willowdene Avenue that exhibit low weed diversity and abundance.

The study area is currently habitat for a range of pest species including rabbits. Project activities have the potential to disperse pest species out of the project footprint across the surrounding landscape and increase the ability of pest species to utilise habitats due to habitat removal, noise, and human presence during construction and operation. In the context of the project this impact is predicted to be minimal as all vegetation in the study area is likely to be impacted by foxes and cats. The magnitude of this impact would be low.

The forests of southwest Sydney are currently experiencing 'Bell miner associated dieback' (also known as BMAD). This form of tree canopy dieback is caused by over-abundant psyllids (sap-sucking insects that create a sugary excretion called lerp) in conjunction with Bell Miners that feed on the psyllids and the lerp. Bell miners are aggressive and exclude other bird species (that would

feed on psyllids) from their territories. This can lead to psyllid populations increasing to the extent that they cause substantial canopy damage. In western Sydney, *Eucalyptus moluccana* (Grey Box) trees appear to be the most affected, as is the case with the vegetation in the study area. Substantial landscape scale defoliation of Grey Box trees is occurring in these areas and given this species is a key component of the critically endangered Cumberland Plain Woodland ecological community, this phenomena is of concern. As such, 'Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners' is listed as a key threatening process under the TSC Act.

The project would involve vegetation removal and some localised fragmentation of local wildlife corridors between The Northern Road and Willowdene Avenue where some intact habitat patches would be broken apart. This could increase the prevalence and severity of BMAD in the locality due to increased fragmentation and removal of trees used as habitat by psyllids and Bell Miners. The magnitude of this impact is unknown and the potential extent and severity of any increased effects of BMAD cannot be quantified. The influence of the project on BMAD is however likely to be insignificant when compared to the broad scale clearing that has occurred in the past for agriculture and urban development. Additionally the project would not interfere with the objectives or proposed actions as identified by the BMAD working group and outlined in the BMAD strategy, and would not interfere with any of the 10 priority actions identified to help recover species affected by BMAD (refer to Appendix I for further details).

Invasion and spread of pathogens and disease

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

- Dieback caused by Phytophthora (Root Rot; EPBC Act and TSC Act)
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and TSC Act)
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (TSC Act).

While these pathogens were not observed or tested for in the study area the potential for pathogens to occur should be managed during construction. The most likely causes of pathogen dispersal and importation associated with the project include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during all project phases (construction and operation).

Noise, vibration, dust, light and contaminants

Some night works would be required. The noise and vibration from construction activities associated with the project will potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours. The impacts from noise emissions are likely to be localised to the construction areas and are not considered likely to have a significant, long-term, impact on wildlife populations outside the area of impact. Within the area of impact, some sensitive species (e.g. woodland birds) may avoid the noise and some more tolerant species, including small mammals, will habituate over the longer-term.

Dust pollution is likely to be greatest during periods of substantial earthworks, vegetation clearing, vehicle movements for construction and decommissioning activities and during adverse weather (such as high wind) conditions. However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary (particularly during the wet season) and is therefore not considered likely to be a major impact of the project.

Some night works would be required during construction and lighting will be installed on the roadside. As such, the immediate area surrounding the project activities will be subject to artificial lighting, essentially creating 'daylight' conditions. Ecological light pollution may potentially affect nocturnal fauna by interrupting their life cycle.

During the construction phase localised release of contaminants (i.e. hydraulic fluids, oils, fluids, etc.) into the surrounding environment (including drainage lines) may accidentally occur. The most likely result of contaminant discharge will be the localised contamination of soil and potential direct physical trauma to flora and fauna that are exposed to contaminants. Accidental release of contaminants is likely to be localised.

Potential operational impacts

Fragmentation of biodiversity links and habitat corridors

Barrier effects occur where particular species are either unable or are unwilling to move between suitable areas of habitat due to the imposition of a 'barrier' (e.g. a newly created inhospitable habitat type or physical barrier such as the project). The operation of the project would create barrier effects that restrict fauna movement and this impact is likely to be most obvious for fauna groups including mammals, frogs, and reptiles. Mobile species such as birds and bats may not be affected to the same extent.

In terms of potential operational impacts on aquatic fauna, inappropriate design or type of water crossing can impede or prevent fish from travelling within their natural range. Detailed design of culverts would ensure that barriers to fish are not created. Construction of permanent and temporary waterway crossings such as bridges, causeways, fords and culverts are known to have significant impacts upon passage of fish. The project would require the traversing of minor waterways and farm dams. Water crossing structures have been designed to minimise the impacts of altering the natural flow regimes of the rivers and streams within the region. Detailed design of bridges and culverts would be undertaken in accordance with Fairfull & Witheridge (2003) and DPI (2004) should ensure that barriers to fish are not created and associated long-term impacts to the existing hydrology are minimised.

Additionally, there is potential for hydrology and flooding to be altered during operation which may result in increased rate, velocity and concentration of flow from the widened carriageway and new drainage system and structures. The changes to hydrology and flooding may affect biodiversity values by altering the frequency, magnitude and distribution of inundation of land adjacent to creeklines during floods and by altering the geomorphology and channel structure of waterways. Changes may include a shift in the distribution and identity of riparian species, resuspension and resettlement of instream sediments and scouring of the stream bed which may result in loss or gain of aquatic macrophytes and a shift in aquatic fauna community structure.

To mitigate impacts, Roads and Maritime would consult with property owners regarding upgrades to farm dam spillways to manage areas where increased flows are predicted. Energy dissipation and scour protection measures such as rock riprap or rock gabion mattresses would be utilised along transverse drainage structures to reduce erosion. Stormwater detention ponds will control discharge to the downstream environment.

Injury and mortality of fauna (including vehicle strike)

There is of the potential for fauna mortality during the operational phase the project through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local population numbers and is a common occurrence in Australia (Coffin 2007; Rowden et al. 2008). Mammals, reptiles, amphibians and birds would potentially be impacted by vehicle strike, particularly those common species (e.g. macropods) that are tolerant of disturbance and/or those species that can utilise roadways for movement pathways or as foraging habitat.

As there are no definitive data on current rates of roadkill or fauna population densities in the study area, the consequences of vehicle strike on local populations is unknown. With the creation of a new road the potential for vehicle strike is introduced but the significance of such an impact cannot be predicted. The impact on threatened species however is expected to be minimal and, based on evidence from other arterial roads in the locality, most vehicle strike impacts can be expected to occur to common mammals such as possums and macropods and exotic animals including foxes.

Invasion and spread of weeds and pests

Proliferation of weed and pest species is likely to occur during operation. The effects of proliferation of weed and pest species may not be experienced immediately or even in the short-term, however, would likely commence a few months after the construction phase commences and gradually increase over months and seasons as the project is operational resulting in potential long-term impacts.

Noise, vibration, dust, light and contaminants

There would be increased noise and vibration levels in the study area and immediate surrounds during operation as vehicles use the roadway. The noise and vibration from vehicles would potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours. Within the area of impact, some sensitive species (e.g. woodland birds) may avoid the noise and some more tolerant species, including small mammals, would habituate over the longer-term.

Dust is likely to be generated throughout the lifecycle of the project through vehicle movements and the greatest impacts during operation would be to vegetation directly adjacent to the road. The deposition of dust on foliage is likely to be highly localised, intermittent, and temporary (particularly during the wetter seasons) and is therefore considered unlikely to be a major impact of the project.

During operation the roadside would be subject to artificial lighting, essentially creating permanent 'daylight' conditions. Ecological light pollution may potentially affect nocturnal fauna by interrupting their life cycle but some species may benefit from the lighting due to increased food availability (insects attracted to lights) around these areas. Due to the frequency and sustained nature of the lighting, it is unlikely that animals would habituate to the light disturbance and a long-term impact in the area of lighting is likely.

During operation the accidental release of contaminants is likely, which would potentially result in localised contamination of soil and potential direct physical trauma to flora and fauna that come into contact with contaminants. Similarly pollutant runoff during operation of the road would have the potential to impact on water quality, however this would be managed through the implementation of water quality vegetated swales and rock check dams (refer to Section 8.2) which have been assessed to sufficiently reduce and manage water quality impacts to sensitive receiving waters (ie Key Fish Habitat) during operation. Therefore impacts to aquatic habitat identified for the project are expected to be minimal.

7.3.5 Summary of impacts to the environment of Commonwealth land

A summary of potential impacts to the environment of Commonwealth land as a result of construction and operation of the project is provided in this section as it relates to biodiversity. This includes an assessment of ecosystems and their constituent parts and water resources as it relates to the portions of Commonwealth land associated with the project. This includes the DEOH land, and land that has been acquired by the Commonwealth for the purposes of developing the Western Sydney Airport at Badgerys Creek.

The portion of the project within Commonwealth land is estimated at about 43.32 ha. Within this footprint, the following impacts to biodiversity are expected:

- Up to 13.34 ha of remnant native vegetation including about:
 - 10.51 ha of the Threatened Species Conservation Act (TSC Act) listed, critically endangered Cumberland Plain Woodland in the Sydney Basin Bioregion ecological community
 - 2.84 ha of the TSC Act listed River-Flat Eucalypt Forest on Coastal Floodplains
- About 10.07 ha of the critically endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community

- Potential impact to aquatic ecosystems due to changes in water quality, habitat loss and instream barriers associated with works in and around waterways identified as Key Fish Habitat located within or immediately adjacent to Commonwealth land, most notably Badgerys Creek and the unnamed tributary of Surveyors Creek
- Potential impacts to aquatic and riparian habitats due to changes to flooding and hydrology during operation of the project would be restricted to direct scouring of waterways, drainage lines and shallow-rooted riparian groundcover on Commonwealth lands. There would be an increase in scour potential for a short distance from the project corridor in drainage lines flowing through DEOH site which may deepen the water way and cause some bank erosion. Increases to the 100 year ARI peak flows are not expected to impact waterways or vegetation communities due to the infrequent and short term nature of the impact
- Localised fragmentation of local wildlife corridors between The Northern Road and Willowdene Avenue where some intact habitat patches would be broken apart and the hard barrier introduced by the project would restrict fauna movement. The widening of the existing The Northern Road in the north of the study area would further the barrier effects of this roadway where it bisects Regional Corridor 17 as identified in the OEH BIOMAP
- Potential high magnitude residual impact to occur as a result of edge effects to some of the more intact habitats such as those off Willowdene Avenue
- Potential injury or death of fauna on Commonwealth land, for example during vegetation clearing
- Potential for the invasion and spread of weeds, pests, pathogens and disease which would potentially impact on the environment of Commonwealth land
- General construction and operational related impacts associated with noise, vibration, dust, light and contaminants as outlined above where they impact the environment of Commonwealth land.

Potential impacts would be restricted to direct scouring of waterways, drainage lines and shallow-rooted riparian groundcover on Commonwealth lands.

The Orchard Hills Cumberland Plain Woodland is listed on the Commonwealth Heritage List (CHL) and Register of the National Estate (RNE) for its natural heritage values.

About 9.15 ha of native vegetation from the western edges of the Orchard Hills Cumberland Plain Woodland Listed Place would be removed by the project. This is considered to be medium scale native vegetation clearance which would permanently destroy some of the structural elements upon which the Orchard Hills Cumberland Plain Woodland Listed Place is based. However, the core vegetation areas in the centre and east of the Orchard Hills Cumberland Plain Woodland would not be affected. Further details of the impact of the project on remnant vegetation are described above. An assessment of impacts to the heritage values of the site is provided in Section 8.4.

Given the extent of clearing of EPBC listed critically endangered Cumberland Plain Woodland on Commonwealth land, the impact is assessed as significant. Biodiversity offsets would be required to compensate for the loss of the vegetation community in accordance with the FBA. Refer to Section 7.3.5 for a discussion on matters for further consideration under the FBA and Section 7.3.8 for details on biodiversity offset requirements.

7.3.6 Matters for further consideration

Matters for further consideration can those for which impacts are considered to be complicated or severe. The assessment is based on thresholds detailed in Section 9 of the FBA. Matters for further consideration can also be included as part of the SEARs. It is noted that there are no matters for further consideration nominated in the SEARs for the project.

While there would be an impact to a Critically Endangered Ecological Community (Cumberland Plain Woodland), the project is considered unlikely to cause the extinction of this CEEC from the

IBRA sub-region. The project is however, considered likely to significantly reduce the viability of the Cumberland Plain Woodland. In accordance with the FBA, impacts on this CEEC are a matter for further consideration. Detailed discussion on the potential impacts on the CEEC are discussed in the BAR.

The area and condition of the Cumberland Plain Woodland to be impacted directly by the project includes about 29.14 ha of this CEEC. Of this, about 1.25 ha is considered to be in high condition and about 11.58 ha in moderate/good condition.

The extent of Cumberland Plain Woodland within an area of 1,000 ha and 10,000 ha surrounding the proposed development footprint has been estimated using a GIS and available regional mapping (Tozer 2003) as follows:

- There are about 136 ha of Cumberland Plain Woodland mapped within 1,000 ha of the project
- There are about 2,053 ha of Cumberland Plain Woodland mapped within 10,000 ha of the project.

The extent of Cumberland Plain Woodland remaining within the Cumberland sub-region has been estimated using a GIS and available regional mapping (Tozer 2003). There are about 24,422 ha of Cumberland Plain Woodland mapped within the Cumberland sub-region.

Where Cumberland Plain Woodland would be removed by the action, all abiotic factors (i.e. water, nutrients and soil) would be permanently modified and/or destroyed through vegetation removal and construction of infrastructure.

The composition of Cumberland Plain Woodland is likely to be modified as a result of the action through weed invasion and removal of vegetation. The patches of Cumberland Plain Woodland are in poor to high condition and a reduction in ecological function can be expected from the action in the form of:

- altered community structure
- altered species composition
- disruption of ecological processes (e.g. altered drainage)
- invasion and establishment of exotic species
- degradation of habitat
- fragmentation of habitat.

Machinery associated with vegetation clearance and subsequent construction for the project has the potential to introduce and transmit weed propagules and Phytophthora to remaining native vegetation remnants. This is a potential indirect impact through the spread and transmission of weeds and pathogens into retained habitat near the road.

This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene but an impact, particularly from weeds, is likely.

7.3.7 Environmental management measures

Expected environmental outcomes

Potential impacts to biodiversity were considered during options and design development (as described in Section 4) with the aim of avoiding or minimising impacts as far as possible. Despite this, unavoidable impacts would occur, including impacts to threatened ecological communities and threatened species.

All practicable steps to avoid or minimise impacts to biodiversity would be implemented during the detailed design phase to reduce the scope of the overall impact. This would include the application of measures such as road design refinements to reduce the project footprint and incorporating design features to minimise impacts, where practical.

Specific outcomes that would be achieved through the implementation of environmental management measures include:

- Ensure controls and procedures are implemented during construction and operational activities to avoid, minimise or manage potential adverse impacts to biodiversity values within and adjacent to the project
- Minimising the removal of vegetation, in particular native vegetation
- Ensuring the appropriate re-establishment of native vegetation following construction of the project
- Minimising the removal of habitat and protection of surrounding habitat
- Reinstatement of habitat following construction of the project
- Development and implementation of appropriate offsets for the project
- Ensure measures are implemented to comply with the relevant legislative requirements and project conditions of approval.

Expected effectiveness

Roads and Maritime have experience in managing potential biodiversity impacts as a result of road developments of similar scale and scope to this project.

These measures are based on the following documents, as well as best management practice and specialist experience:

- Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects (NSW Roads and Traffic Authority 2011)
- Policy and Guidelines for fish habitat conservation and management (Department of Primary Industries 2013).

Roads and Maritimes' Biodiversity Guidelines were developed in consultation with the NSW office of Environment and Heritage (OEH), NSW department of Primary Industries, biodiversity specialists and Roads and Maritime staff including project managers, construction personnel and designers.

Waterway crossings throughout the project have been designed in accordance with Policy and Guidelines for Fish Habitat Conservation and Management (update 2013) (Department of Primary Industries 2013), *Fish Passage Requirements for Waterway Crossings* (Fairfull & Witheridge 2003), and *Policy and Guidelines for fish Friendly Waterway Crossings* (DPI 2004). These guidelines provide an effective mitigation, built into design, to minimise impacts to fish and other aquatic wildlife from road projects which may improve the survival rate and protect threatened fish species.

A construction Flora and Fauna Management Plan (FFMP) would be prepared as part of the CEMP prior to construction. The plan would be prepared to address the requirements of the project approvals, the environmental management measures outlined in this EIS and all applicable legislation. The key components of the FFMP are based on Roads and Maritime biodiversity guidelines. The individual guides are for managing specific aspects of biodiversity. These guidelines were developed in consultation with the NSW office of Environment and Heritage (OEH), NSW department of Primary Industries (Fisheries), biodiversity specialists and Roads and Maritime staff including project managers, construction personnel and designers. The guidelines also outline specific and tailored requirements for monitoring and reporting to record the success of the biodiversity management measures.

As such, the measures outlined in the FFMP are considered to be proven effective in managing potential impacts to biodiversity.

Through the implementation of the construction FFMP, it is expected that residual impacts from construction on biodiversity values would be minimised as far as reasonably practicable. This would include minimising disturbance to vegetation communities during construction and

implementation of site management procedures to minimise the potential for harming native fauna. Further discussion on the residual impacts the project would have on biodiversity and proposed offset strategies are discussed in Section 7.3.9.

Audits and reporting of the effectiveness of environmental management measures is generally carried out to show compliance with management plans and other relevant approvals and would be outlined in detail in the CEMP and FFMP prepared for the project.

Further information regarding proposed offsetting measures and their effectiveness is provided in Section 7.3.9.

Table 7-54 outlines environmental management measures that have been developed to specifically manage potential impacts which have been predicted as a result of the proposed works.

Table 7-54 Biodiversity environmental management measures

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
General construction impacts	B-1	<p>A Flora and Fauna Management Plan (FFMP) would be developed for the project. The plan would include procedures for pre-clearance surveys that are consistent with the Roads and Maritime Biodiversity Guidelines (RTA 2011). The FFMP would outline:</p> <ul style="list-style-type: none"> • Details of pre-construction surveys to verify the construction boundaries/ footprint of the project and to confirm the vegetation to be cleared as part of the project, identify habitat trees to be felled in a staged approach and identification of fauna release areas should fauna be encountered during vegetation removal • Updated sensitive aerial vegetation maps based on clearance surveys and previous survey work • Exclusion zones and fencing or other means to demarcate vegetation to be retained (endangered ecological communities) in close proximity to the works • Clearing of vegetation and removal of bush rock (Guide 7) including implementation of the pre-clearing process (Guide 1) and the associated staged habitat removal process where hollow-bearing trees, habitat trees or bush rock is to be removed • Weed management (see Guide 6) through the use of mechanical weed control methods 	Contractor	Pre- construction	<p>Proven to be effective.</p> <p>Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.</p>

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>such as slashing or mowing, as well as a range of herbicides</p> <ul style="list-style-type: none"> • Pathogen management (see Guide 7) through the implementation of hygiene protocols such as the provision of vehicle and boot wash down facilities and ensuring vehicles and footwear are free of soil before entering or exiting the site, as well as the establishment of exclusion zones and designated access tracks • Mechanism for the monitoring, review and amendment of this sub-plan. 			
Removal of native vegetation, threatened species and threatened species habitat	B-2	Native vegetation removal would be minimised through detailed design.	Roads and Maritime	Detailed design	<p>Expected effective.</p> <p>The design has been optimised throughout design options to minimise impacts to vegetation</p>
	B-3	<p>Pre-clearing surveys would be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> • Identify and locate habitat features on site, 	Contractor	Pre- construction	<p>Proven to be effective if done in accordance with the Biodiversity Guidelines.</p> <p>Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.</p>

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>and mark those to be protected during clearing</p> <ul style="list-style-type: none"> Identify suitable habitat areas for fauna relocation (if encountered during clearing works) 24 hours prior to clearing, licensed wildlife carers and/or ecologists should capture and/or remove fauna that have the potential to be disturbed as a result of clearing activities and relocate to the pre-determined location (as above) Carry out staged habitat removal (Guide 4) where fauna habitat features have been identified and marked. 			
	B-4	<p>Vegetation removal would be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bush rock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> Carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation Retain stumps in riparian zones and aquatic 	Contractor	Construction	<p>Proven to be effective if done in accordance with the Biodiversity Guidelines.</p> <p>Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.</p>

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		habitats to reduce the potential for bank erosion <ul style="list-style-type: none"> • Separate woody vegetation into millable timber, secondary re-use (Guide 5) or exotic (non-native) vegetation • Non-woody vegetation should be incorporated into the stripping of topsoil to retain any organic materials and nutrients • The staged habitat removal process is to be used when identified habitat is to be removed, with a licensed wildlife carer or ecologist on site • Undertake bush rock removal in a way that minimises damage to the bush rock, avoids excessive soil disturbance and avoids climatic seasons when species are utilising this resource • The Australian Standard AS 4373 Pruning of amenity trees should be followed for all pruning works. 			
	B-5	The unexpected species find procedure is to be followed under Biodiversity Guidelines: <ul style="list-style-type: none"> • Protecting and managing biodiversity on RTA projects (NSW Roads and Traffic Authority 2011) if threatened ecological communities, flora or fauna not assessed in the biodiversity assessment, are identified in the project site. The procedure is as follows: 	Contractor	Construction	Proven to be effective. Reporting requirements of the FFMP to be adhered to.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<ul style="list-style-type: none"> Threatened flora or fauna species unexpectedly encountered stop work, Notify the environment manager, Environmental manager would arrange for an ecologist to conduct an assessment of significance of the likely impact, develop management options and notify OEH, DPI and DoEE as appropriate, If a significant impact is not likely to occur, recommence work and maintain regular inspections, If a significant impact is likely to occur: Consult with OEH, DPI and DoEE as appropriate, Obtain approvals, licenses or permits as required, Recommence works once advice is sought and necessary approvals, licences and permits are obtained, Include species in subsequent inductions, toolbox talks and update the CEMP. 			
	B-6	Native vegetation would be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the	Contractor	Post construction	<p>Proven to be effective if done in accordance with the Biodiversity Guidelines.</p> <p>Monitoring and reporting requirements of the FFMP</p>

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> • Use experienced and licensed seed collectors to carry out seed collection in accordance with <i>RTA Seed Collection QA Specification R176</i> and the Florabank Guidelines and Model Code of Practice • Planting operations should be in accordance with <i>RTA Landscape Planting QA Specification R179</i> • Collect local native topsoils and leaf litter and store for use in revegetation works • Ensure areas to be revegetated have an appropriate level of natural drainage, avoid compaction of soils in those areas and ensure suitable moisture requirements are maintained • Implement planting as per the planting plan for the project, including planting during suitable conditions, spacing and diversity of plants, etc. • Inspection, monitoring and maintenance of revegetated areas should be conducted in accordance with the Landscape Management Plan. 			to confirm effectiveness of measures.
	B-7	Habitat removal would be minimised through	Roads and	Detailed design	Expected effective.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		detailed design.	Maritime		The design has been optimised throughout design options to minimise impacts to vegetation
	B-8	<p>Habitat removal would be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> • Carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation • Retain stumps in riparian zones and aquatic habitats to reduce the potential for bank erosion • Separate woody vegetation into millable timber, secondary re-use (Guide 5) or exotic (non-native) vegetation • Non-woody vegetation should be incorporated into the stripping of topsoil to retain any organic materials and nutrients • The staged habitat removal process is to be 	Contractor	Construction	<p>Proven to be effective if done in accordance with the Biodiversity Guidelines</p> <p>Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.</p>

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>used when identified habitat is to be removed, with a licensed wildlife carer or ecologist on site</p> <ul style="list-style-type: none"> Undertake bush rock removal in a way that minimises damage to the bush rock, avoids excessive soil disturbance and avoids climatic seasons when species are utilising this resource <p>The Australian Standard AS 4373 Pruning of amenity trees should be followed for all pruning works.</p>			
	B-9	<p>Habitat would be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> Separate weeds from native vegetation Carry out removal, stockpiling, transportation and relocation of woody debris and/or bush rock in a manner that minimises disturbance to native vegetation or bush rock Engage an ecologist to provide advice on positioning woody debris and bush rock in 	Contractor	Construction	Proven to be effective if done in accordance with the Biodiversity Guidelines. Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>designated relocation areas</p> <ul style="list-style-type: none"> Keep topsoil disturbance to a minimum. 			
Aquatic impacts	B-10	<p>Aquatic habitat would be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011) and Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and guidelines for fish habitat conservation and management Update 2013</i> (Department of Primary Industries 2013). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> Avoid activities in aquatic habitats and riparian zones as much as practicable Establish exclusion zones and set up exclusion fencing around sensitive areas Keep vehicles and machinery away from the banks of a waterway where possible Refuelling of vehicles and plant, and chemical storage and decanting should not take place within 50 metres of aquatic habitats Avoid clearing within the riparian zone during 	Contractor	Construction	Proven to be effective if done in accordance with the Biodiversity Guidelines. Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>periods when flooding is likely to occur</p> <ul style="list-style-type: none"> • Retain the roots of trees on the bank of a waterway in order to maintain bank stability • During rehabilitation, stabilise the banks of the waterway through revegetation and/or armouring according to available landscape plans • Remove all temporary works, flow diversion barriers and sediment control barriers within aquatic habitats as soon as practicable and in a manner that does not promote future channel erosion. 			
Removal of woody debris	B-11	All large woody debris or snags would be relocated instream (Guide 10).	Contractor	Construction	Expected to be effective.
Changes to hydrology	B-12	Changes to existing surface water flows would be minimised through detailed design.	Roads and Maritime	Detailed design	Expected to be effective. Drainage upgrades for the project have been designed and optimised to minimise changes to existing flows as much as possible.
	B-13	Measures to mitigate potential water quality impacts during construction are outlined in Section 8.1 and Section 8.2 of the EIS.	Contractor	Construction	N/A
Fragmentation of identified biodiversity links and habitat	B-14	Connectivity measures have been considered during design in accordance with the <i>Wildlife Connectivity Guidelines for Road Projects</i> (RMS in prep). In particular, design where connectivity	Roads and Maritime and Contractor	Detailed design, during construction and post construction	Expected to be effective if done in accordance with the Wildlife Connectivity Guidelines.

Chapter 7 – Assessment of key Issues

The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park
Environmental impact statement / draft Environmental Impact Statement

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
corridors		has been considered included culvert design, lighting and fencing.			Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.
Edge effects on adjacent native vegetation and habitat	B-15	<p>Exclusion zones would be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> • Identify exclusion zones on a suitable plan as required to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease • Mark out exclusion zones on site with temporary markings such as pegs or paint and where possible use a qualified surveyor • Erect signs to inform personnel of the purpose of exclusion zone fencing • Ensure all exclusion zones are regularly inspected and repairs to fencing are made where required • Maintain exclusion fencing until the potential for disturbance within the excluded zone has been eliminated through other means. 	Contractor	Construction	Proven to be effective if done in accordance with the Biodiversity Guidelines. Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>Removal of fencing should be undertaken in consultation with environmental staff.</p> <ul style="list-style-type: none"> Communicate the importance of exclusion zones, and any changes to the zones, to all site staff and visitors (eg in toolbox talks and inductions). 			
Injury and mortality of fauna	B-16	<p>Fauna would be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> Allow fauna to leave an area without intervention as much as possible Use a licensed fauna ecologist or wildlife carer with specific animal handling experience to carry out any fauna handling Include the procedures to follow if fauna is found or injured on site in project inductions Release fauna into pre-determined habitat identified for fauna release Release fauna into similar habitats, as near as possible to their capture location. Release nocturnal fauna at dusk 	Contractor	Construction	Proven to be effective if done in accordance with the Biodiversity Guidelines. Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<ul style="list-style-type: none"> Temporary fauna fencing may be required on projects to reduce the chances of road kill/injury from public traffic or construction machinery. 			
Invasion and spread of weeds	B-17	<p>Weed species would be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> Use an ecologist or person trained in weed management and identification to undertake a site weed assessment to identify and describe or map weed infested areas within the site and adjacent areas. Develop a Weed Management Plan for the site Map and mark areas that are infested with weeds as an exclusion zone with fencing and signage to limit access by personnel and vehicles Minimise soil disturbance within weed infested areas Use mechanical weed control methods such as slashing or mowing, as well as a range of 	Contractor	Construction	Proven to be effective if done in accordance with the Biodiversity Guidelines. Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		<p>herbicides to avoid the development of herbicide resistance</p> <ul style="list-style-type: none"> • Mow/slash areas infested with weeds before they seed. This may reduce the propagation of new plants • Clean machinery, vehicles and footwear before moving to a new location • Securely cover loads of weed-contaminated material to prevent weed plant material falling or blowing off vehicles • Dispose of weed-contaminated soil at an appropriate waste management facility. 			
Invasion and spread of pathogens and disease	B-18	<p>Pathogens would be managed in accordance with <i>Guide 7 – Pathogen Management: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011). These measures would be outlined in the FFMP and would include monitoring and review procedures to be implemented to ensure the effective implementation of these measures, including but not limited to the following:</p> <ul style="list-style-type: none"> • Ensure vehicles and footwear are free of soil before entering or exiting the site (ie directed to wash down area before entering or exiting the site) • Provide vehicle and boot wash down facilities • Set up exclusion zones with fencing and 	Contractor	Construction	Proven to be effective if done in accordance with the Biodiversity Guidelines. Monitoring and reporting requirements of the FFMP to confirm effectiveness of measures.

Impact	Ref #	Environmental Management Measures	Responsibility	Timing	Effectiveness of measures
		signage to restrict access into contaminated areas. <ul style="list-style-type: none"> Restrict vehicles to designated tracks, trails and parking areas. 			
Noise, light and vibration	B-19	Shading and artificial light impacts would be minimised through detailed design. Measures to mitigate potential noise and vibration impacts are provided in Section 7.2 of the EIS.	Roads and Maritime	Detailed design	Expected to be effective.

7.3.8 Residual impacts to listed threatened species and ecological communities

Residual impacts are those that remain after the implementation of avoidance and minimisation measures and after mitigation measures have been implemented for the project. Due to the design and nature of the project (i.e. a road widening and construction of new road sections), total avoidance and mitigation of biodiversity impacts cannot be reasonably achieved. The predicted residual impacts of the project on listed threatened species and ecological communities some of which are located on or adjacent to Commonwealth land. Despite avoidance and minimisation, significant residual impacts from the clearing of native vegetation would occur.

Vegetation removal would occur during construction of the project which would result in residual impacts associated with the loss of vegetation and associated habitat across the project. The most significant of these would be the impact on up to 39.6 ha of remnant native vegetation, including about 16.37 ha of the critically endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community listed under the EPBC Act. The project would adversely affect habitat critical to the survival of the CEEC, as well as other indirect impacts to its survival. These impacts would be long-term and significant, even after the implementation of mitigation measures. The predicted impacts to the critically endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community on Commonwealth land is considered likely to contribute to the significant residual impacts of the project.

Impacts on threatened plant, fauna species habitat and habitat features have not been assessed as significant, therefore residual impacts although likely to occur, are not expected to be significant. The same can be said for impacts to migratory species and aquatic species, impacts to which would be reduced though the implementation of mitigation measures.

The predicted level of localised habitat fragmentation that would occur as a result of the project is not expected to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. As such residual impacts as a result of habitat fragmentation are not expected to be significant.

In terms of edge effects, there is potential for a significant high magnitude residual impact to occur to some of the more intact habitats within the study area from edge effects (such as those off Willowdene Avenue).

These construction related impacts would be long-term and would carry over into the operational stage of the project. Other operational residual impacts that may occur would be fauna injury or mortality as a result of the introduction of a new or extended road corridor into the environment; however this is not expected to have a significant impact.

The BOS includes details of offsets to be implemented to compensate for residual significant impacts associated with the project in accordance with the BOPMP and FBA which have been endorsed by the Commonwealth.

7.3.9 Biodiversity offsets

Despite avoidance and mitigation measures to minimise impacts to biodiversity, residual impacts from the clearing of threatened ecological communities and threatened species as a result of the construction and operation of the project are significant and require offsetting.

In accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014), the required offsets for the project have been calculated using the FBA methodology and the BBCC. A summary of the biodiversity offset credits required for the project is presented in Table 7-55 and further detail is provided in the Biodiversity Offset Strategy (Appendix I). Note that the Commonwealth EIS guidelines make an allowance for offsets to be assessed in accordance with State policy. The FBA has been endorsed by the Commonwealth.

Table 7-55 Summary of biodiversity offset credits required

Threatened ecological communities		
Plant community type	Area impacted (ha)	Ecosystem credits required
Derived grasslands on shale hills of the Cumberland Plain (50-300 m asl) (PCT 806)	12.01	223
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 835)	4.29	178
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)	11.44	307
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)	10.47	409
<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)	6.17	142
Total	44.38	1,259
Threatened species		
Species	Impact (ha or individuals)	Species credits required
<i>Pultenaea parviflora</i>	4.00	60
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	35.00	1,400
Cumberland Plain Land Snail	13 ha	169
Regent Honeyeater	26.25 ha	2,021

Biodiversity offset investigations

The FBA outlines two options to fulfil the offset requirement for the project, which can be used alone or in combination, these include:

- Retiring biodiversity credits – like for like offsets are secured and credits retired (or the variation criteria are applied)
- Contributing to supplementary measures.

Investigations for sourcing the required credits to meet the offset obligations are underway, with a range of offset options already identified. Initial investigations included a desktop assessment of available offsets undertaken by Eco Logical Australia in March 2016. Potential sources of credits (ecosystem and species) were identified through:

- A search of the BioBanking Public Registers on the OEH BioBanking webpage

- Communication with credit owners, accredited BioBanking assessors and other sources closely involved with the biodiversity credit market
- Communication with local Councils who are currently pursuing options to establish Biobank sites on their own Council land, or who were known to be interested
- Investigation of potential properties.

An updated review of the available credits on the BioBanking Credits Register was undertaken in July 2016 and indicates that appropriate offsets are generally available (in the form of ecosystem credits) and the approach for securing the offset requirements is the purchase of credits available on the BioBanking Credit Register.

Biodiversity offset options

Biodiversity offset options are detailed in the BOS prepared for the project (Appendix I). The BOS indicates that a direct like-for-like offset is available for most ecosystem credits required for the project including critically endangered ecological communities listed under the TSC Act and the EPBC Act. Ecosystem credits measure the loss in biodiversity values of a project and the gain in biodiversity values at an offset site (OEH 2014). They are assigned to a threatened species that can be predicted by habitat surrogates. However, there is a current shortfall in credits available on the BioBanking Credit Register for:

- *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (HN 630)
- *Pultenaea parviflora*
- *Marsdenia viridiflora* subsp. *viridiflora* - endangered population
- Cumberland Plain Land Snail
- Regent Honeyeater.

Properties that may have potential to provide species credits for *Pultenaea parviflora* and Cumberland Plain Land Snail have been identified. A search of the BioBanking Public Register indicates that an expression of interest may contain species credits for the *Marsdenia viridiflora* subsp. *viridiflora* - endangered population and Regent Honeyeater, subject to further investigation. The BioBanking public register has been checked for available credits and a credits wanted request was placed on the BioBanking credits wanted register on 21 July 2016.

Where like-for-like offsets are unable to be identified after taking reasonable steps, in accordance with the NSW Biodiversity Offset Policy for Major Projects (OEH, 2014), variation rules may apply for non-EPBC Act listed matters. The variation rules allow vegetation to be offset with a broader suite of similar vegetation types in the locality that have similar percentage of historical clearing. They also allow species to be offset with similar species in the locality that use the same habitat and are under a similar or greater level of threat.

In the case of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (HN 630), variation rules may need to be applied due to the current shortfall of credits available for this PCT on the BioBanking Public Register. However, before variation rules can be used, Roads and Maritime would:

- Continue to check the BioBanking public register and
- Liaise with the OEH offices and relevant local councils to obtain a list of potential sites that meet the requirements for offsetting

If appropriate offset sites cannot be found, Roads and Maritime would then provide funds for supplementary measures.

This BOS addresses the requirements of the Commonwealth EIS Guidelines regarding offsets. The approach taken to offsets for the project is a direct offset that aims to provide 'like for like' offset for all biodiversity values, with this being the minimum requirement for those matters listed under the EPBC Act. The offset package itself will be finalised after the offset investigations have

been completed. As such, the BOS cannot outline specific details of a proposed offset package (ie location and size of any offset sites, maps for an offset site, ownership and tenure, etc.).

7.4 Socio-economic and land use

This chapter describes the socio-economic values of the study area and identifies the potential impacts to these values as a result of the construction and operation of the project. This chapter also recommends environmental management measures to reduce the socio-economic impacts of the project.

The technical working paper, Socio-economic Assessment (Appendix J) has been used to inform this chapter.

Table 7-56 sets out the Secretary's Environmental Assessment Requirements (SEARs) and requirements of the Commonwealth EIS Guideline as they relate to socio-economic impacts and states where in this EIS these have been addressed.

Table 7-56 Environmental assessment requirements – Socio-economic

Requirement	Where addressed in the EIS
Secretary's Environmental Assessment Requirements	
Social and Economic — including: impacts on directly affected properties and land uses, including impacts related to access and severance, existing and proposed land uses, property acquisition and amenity related changes;	Refer to Section 7.4.3 for property and land use impacts
social and economic impacts to the community and businesses in the vicinity of the proposal (including agricultural businesses), associated with traffic, access, property, public domain and amenity related changes; and	Refer to Section 7.4.3 for community and business impacts
draft Community Involvement Plan for the works, identifying relevant stakeholders, procedures for distributing information and receiving/ responding to feedback and procedures for resolving community complaints during construction. Key issues that should be addressed in the draft Plan should include (but not necessarily be limited to): <ul style="list-style-type: none"> • traffic management (including property access and pedestrian access), and • noise and vibration mitigation and management, including work outside standard construction hours. 	A Draft Community Involvement Plan for the project is referenced in Chapter 6 and attached in Appendix R
Commonwealth EIS Guidelines	
The EIS must include a description of the environment of the proposal site and the surrounding areas that may be affected by the action. It is recommended that this include the following information: <ul style="list-style-type: none"> • A description of the environment in all areas of potential impact, including all components of the environment as defined in Section 528 of the EPBC Act: <ul style="list-style-type: none"> – Ecosystems and their constituent parts, including plants and animals, people and communities, landscapes and soils – Natural and physical resources, including water resources 	Refer to Section 7.4.2 for description of the environment Refer Section 7.3, 8.2, 8.5 Refer Sections 8.1, 8.2,

Requirement	Where addressed in the EIS
<p>and air</p> <ul style="list-style-type: none"> – The qualities and characteristics of locations, places and areas – Heritage values of places <p>The social, economic and cultural aspects of a thing mentioned in preceding dot points.</p>	<p>8.6</p> <p>Refer Section 8.5</p> <p>Refer Sections 8.3, 8.4</p> <p>Refer to Section 7.4.3</p>
<p>Impacts to the environment (as defined in Section 528) should include but not be limited to the following:</p> <p>Changes in recreational use and amenity of natural areas</p>	<p>Refer to Section 7.4.3</p>
<p>The economic and social impacts of the action, both positive and negative, must be analysed. Matters of interest may include:</p> <ul style="list-style-type: none"> • Details of any public consultation activities undertaken, and their outcomes • Employment opportunities expected to be generated by the project (including construction and operational phases). <p>Economic and social impacts should be consisted at the local, regional and national levels.</p>	<p>Refer to Sections 7.4.3, 7.4.4</p> <p>Refer to Chapter 6 Consultation</p> <p>Refer to Sections 7.4.3, 7.4.4</p>

7.4.1 Assessment methodology

The socio-economic impact assessment involved a process of analysing, monitoring and managing the intended and unintended social and economic impacts, both positive and negative, of the project. It involved identifying, assessing and evaluating changes to or impacts on, communities, business and industry that are likely to occur as a result of the project, in order to mitigate or manage impacts and maximise benefits. This assessment has been developed in accordance with the Roads and Maritime *Environmental Impact Assessment Practice Note N05 – Socio-economic assessment* and to address socio-economic matters outlined in the SEARs and the economic and social matters identified in the Commonwealth EIS Guidelines.

The information sources used in carrying out the assessment are identified below, where applicable, and comprise ABS Census Data and previous assessments. A complete list of information sources used in the assessment is provided in the working paper. The assessment methodologies described below identify where those sources of information have been verified or considered to be the latest available data. Additional surveys have also been used to gather further information to assist the assessment.

Where information regarding specific socio-economic parameters are unknown (such as financial information associated with private businesses), or unpredictable (such as the extent of impact on individual businesses from the project), the assessment has identified these uncertainties.

The approach to this assessment involved five main stages:

1. Scope socio-economic issues. This stage involved scoping the range of potential socio-economic impacts for local and regional communities, business and industry that could result from the project
2. Establishing a socio-economic baseline. This stage involved an investigation of the key socio-economic characteristics and conditions. It included consideration of:
 - Government policy and strategy
 - Population, demographic and housing indicators
 - Industry, employment and income data

- Existing and future land use, including land use zoning
 - Economic information, including data on employment and income, agricultural uses, and local business and industry in the study area
 - Existing social infrastructure, including education facilities, health and emergency services, recreation uses and transport facilities
 - Community values relating to factors such as amenity and sense of place, access and connectivity, and community health and safety.
3. Describing the existing land use, planning and socio-economic conditions principally from information in the ABS Census of Population and Housing 2011 (ABS, 2012b) which is the most comprehensive dataset currently available on population and housing in the study area, supplemented with more recent information and data where available, including the information collected during stakeholder consultations (as documented in Chapter 6), and the surveys of local businesses (see below and in Section 7.4.2)
 4. Assessing potential impacts. This stage involved evaluating impacts on and changes to socio-economic conditions and values in the study area from the project's construction and operation
 5. Development of measures to avoid, manage, or mitigate impacts. This stage involved the development of measures to address socio-economic impacts. Opportunities to maximise the benefits of the project were also explored.

The outcomes of consultation and key stakeholders including local communities, business representatives, local government officers and community service providers informed all of the assessment stages.

The study area for this socio-economic assessment has been based on those communities that have potential to experience impacts on or changes to socio-economic conditions due to the location of the project, construction activities and changes in movement patterns for residents, workers and visitors. It includes the Australian Bureau of Statistics (ABS) Statistical Areas Level 2 (SA2) geographies of:

- Glenmore Park-Regentville SA2 (referred to as Glenmore Park-Regentville)
- Mulgoa-Luddenham-Orchard Hills SA2 (referred to as Mulgoa-Luddenham-Orchard Hills)
- Badgerys Creek-Greendale SA (referred to as Badgerys Creek-Greendale).

It also considers at a broader level, regional impacts on communities and businesses in the Local Government Area's (LGA) of Penrith City and Liverpool City as well as the wider Sydney region.

Two separate surveys were conducted to gather information on local businesses in the study area. These included:

- Car park (number plate) survey to gather information on the origin of 'shoppers' within Luddenham
- Survey of local business owners/ managers to gather information on local businesses within the study area about the type and nature of businesses, business operations, and business owners' perceptions of potential benefits and impacts for local businesses of the projects construction and operation.
- Written surveys were conducted with owners/ managers of retail and service businesses (eg doctors, hairdressers, etc) businesses within Luddenham and other areas near the project. Surveys were hand delivered to local businesses on Wednesday, 9 March 2016. These were either completed face-to-face with business owners/ managers or left for the business owners/ managers to complete separately. Some surveys were also completed over the telephone. A copy of the business survey is provided in Appendix J.

Economic appraisal of individual business impacts has not been carried out as part of the socio-economic assessment in this EIS. Due to the sensitivities of the bypassing of Luddenham, Roads and Maritime deemed that approaching business owners to attain business operations records would be inappropriate.

Further detail regarding these surveys is provided in Appendix J – Socio-economic Assessment.

7.4.2 Existing environment

This section describes existing socio-economic characteristics and features of the study area to provide a baseline against which the project's socio-economic impacts can be assessed. As outlined above, the existing environment (or baseline) has been derived from ABS Census 2011 data which is the most comprehensive dataset currently available. The data has been supplemented with more recent information from surveys or from previous assessments.

The existing environment includes information on land use and land use zoning, population and housing, the economy, community values, social infrastructure and transport and access.

Property and land use

Regional land use

The project extends from the Liverpool LGA in the south to Penrith LGA in the north and west.

Penrith comprises predominantly rural land uses, including a wide range of agricultural activities such as dairying, poultry farming, hobby farming, orcharding, market gardening and horse breeding. Major commercial centres in the LGA are located at Penrith, west of the project and St Marys, east of the project. The LGA also accommodates the DEOH adjacent to The Northern Road. In addition to buildings and structures, land within the DEOH includes areas used for recreation, conservation, water storage (dams) and open space.

Land uses in the Liverpool LGA include a mix of rural and urban uses, including residential, commercial, agricultural and industrial uses. The LGA also accommodates Defence uses including the Holsworthy Barracks. The Liverpool CBD is the key commercial centre for the region, offering a range of retail, business and commercial uses. The LGA accommodates a number of major community services and facilities, including education facilities, major health care services and recreational facilities.

Agricultural uses in the study area vary in their scale and intensity, from small-scale market gardens and hobby farms to capital-intensive agribusiness developments such as the Leppington Pastoral Company, occupying about 600 ha on The Northern Road at Bringelly which is used for intensive dairying, grazing and feedlots. While its use (for now) remains rural and agricultural, the site of the Western Sydney Airport at Badgerys Creek, which is of socio-economic significance at the local, regional and national levels, lies on land within the Liverpool LGA. For the purposes of this assessment, it has been assumed that as the airport site begins to be developed for aviation purposes, its regional and national socio-economic importance would begin to grow in regard to its impacts on land use, employment, industry and business in the western Sydney region.

The NSW Government has mapped land at a regional scale to identify areas of Biophysical Strategic Agricultural Land (BSAL), which is land with high quality soil and water resources capable of sustaining high levels of productivity. No land within the study area has been identified at a regional level as BSAL (www.planning.nsw.gov.au/Policy-and-Legislation/Mining-and-Resources/Safeguarding-our-Agricultural-Land).

A number of regional and state level community services and facilities are located within the Penrith and Liverpool LGAs that cater for communities in the study area as well as in the broader western Sydney region. These include:

- Major hospitals such as Nepean public and private hospitals at Penrith, and Liverpool Hospital at Liverpool
- Tertiary education facilities, including University of Western Sydney campuses at Kingswood and Werrington, TAFE Western Sydney Institute – Nepean College campuses at Kingswood and Penrith; TAFE South Western Sydney Institute – Liverpool College

- Regional, state and national sport and recreation facilities, such as Penrith Lakes Regional Park, including Sydney International Regatta Centre and Penrith Whitewater Stadium; Nepean Aquatic Centre; Penrith Park, including Penrith (Pepper) Stadium and Howell Oval; and Western Sydney Parklands, including Sydney International Shooting Centre, Eastern Creek International Raceway and Sydney International Equestrian Centre
- Major retail, commercial uses, cultural and community support facilities located in the Penrith and Liverpool CBDs.

Land use in the study area

Land use zones within the study area are shown in Figure 7-12. Current and future land uses in the study area are listed below.

Rural use zones (RU) generally cover the southern part of the study area, mainly south of the WaterNSW Supply Pipelines. They include:

- Primary production areas, located south of Elizabeth Drive and generally west of The Northern Road at Luddenham, Greendale and Bringelly (including agricultural land used for cropping, grazing, dairying, horticulture and intensive animal production, as well as a quarry)
- Small lot primary production around Willowdene Avenue at Luddenham and at Bringelly
- Rural landscape areas, located on either side of The Northern Road between the WaterNSW Supply Pipelines and Elizabeth Drive, and at Mulgoa opposite the DEOH
- Rural village at Luddenham, west of The Northern Road.

Residential zones (R) are mainly located at Bringelly, Luddenham and Glenmore Park. They include:

- Large lot residential areas at Luddenham, east of The Northern Road and Luddenham town centre and at Bringelly, south of The Northern Road
- Low density residential areas at Luddenham town centre, and Glenmore Park
- Environmental living and general residential areas at Glenmore Park.

Land in the study area zoned for special purposes (SP) comprises:

- Special Activities zone, including:
 - DEOH, located in the northern part of the study area, east of The Northern Road (this includes the land occupied by the Orchard Hills Golf Club)
 - The site of the Western Sydney Airport, located in the southern part of the study area, east of the proposed The Northern Road corridor.
- Infrastructure zone, including:
 - The existing The Northern Road Corridor
 - The WaterNSW Supply Pipelines, which crosses The Northern Road corridor at Orchard Hills and Mulgoa.

Land zoned for environment protection (E) is mainly located in the northern part of the study area and includes:

- Environmental conservation areas (E2), surrounding the DEOH and along Cosgroves Creek north of Elizabeth Drive (including conservation areas, river systems, farm dams, and tree coverage)
- Environmental management areas (E3) west of The Northern Road at Mulgoa.

The environmental conservation zone (E2) seeks to prevent development that could destroy, damage or otherwise have an adverse effect on areas of high ecological, scientific, cultural or aesthetic value. The zone allows for low impact, passive recreational uses and ancillary land uses that are consistent with the retention of the natural ecological significance.

The Environmental Management zone (E3) provides for limited development that does not have an adverse effect on special ecological, scientific, cultural or aesthetic values. The zone also seeks to ensure development is compatible with the environmental capabilities of the land and preserve and improve natural resources through appropriate land management.

Other land use zones in the study area include:

- Business zones (B), including neighbourhood centres within Luddenham town centre and local centres at Glenmore Park
- Recreation zones (RE), including public recreation areas at Glenmore Park and Luddenham, and land zoned for private recreation at Glenmore Park (Penrith Golf and Recreation Club) north of the project
- Commonwealth Defence land within the DEOH, used for recreation, conservation, dams, or open space buffers
- Commonwealth land that has been acquired for the development of the Western Sydney Airport at Badgerys Creek
- Town centre of Luddenham (refer below).

The objectives of each land use zone are further outlined in Appendix J.

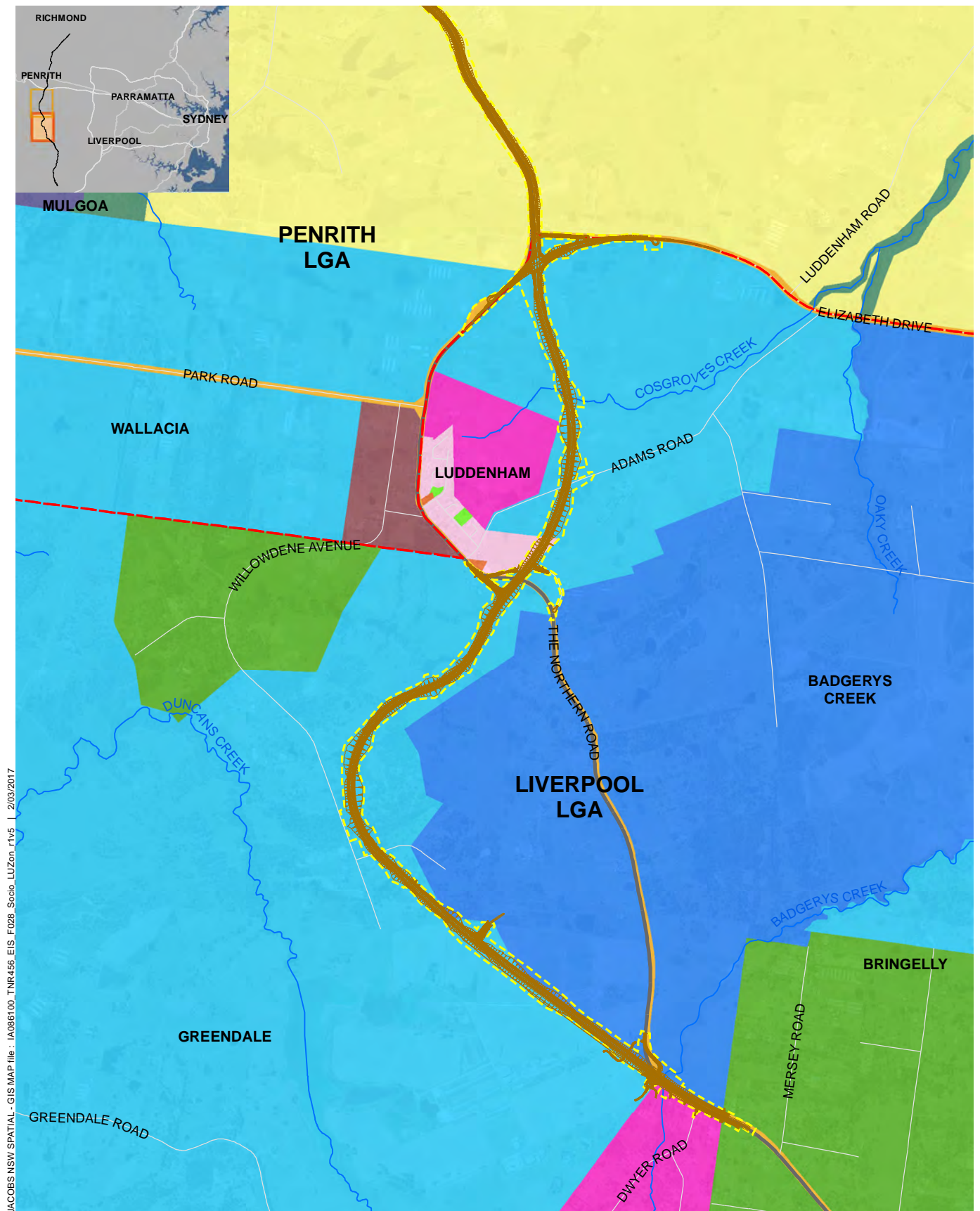
Additionally, it is noted that an existing Mineral Exploration Licence (EL 8429) held by The Austral Brick Co Pty Ltd exists over the study area, as granted on 20 April 2016. An exploration licence gives the holder the exclusive right to explore for the specified mineral group(s) within the exploration licence area, during the term of the licence. The purpose of exploration is to locate areas where mineral resources may be present, to establish the quality and quantity of those resources and to investigate the viability of extracting the resource. The granted licence EL 8429 is for Group 5 Clay minerals, and is due to expire on 20 April 2018.

Commonwealth land

As referred to above, extensive areas of Commonwealth land exist within and adjacent to the study area, which have a major bearing on the project. The lands required for the Western Sydney Airport at Badgerys Creek have been acquired and set aside by the Commonwealth, with the airport's development being a key driver for the project in socio-economic terms. The DEOH is also on land owned by the Commonwealth, and occupies an extensive site fronting The Northern Road on its eastern side, north of the WaterNSW Supply Pipelines. The site for the Western Sydney Airport largely remains in rural and agricultural use pending commencement of the airport's development, while the DEOH land is primarily used for a range of Defence-related purposes although remains largely undeveloped. There is a section within the DEOH site that also contains the Orchard Hills Golf Course. The golf course is currently leased from the Commonwealth Government for private use.

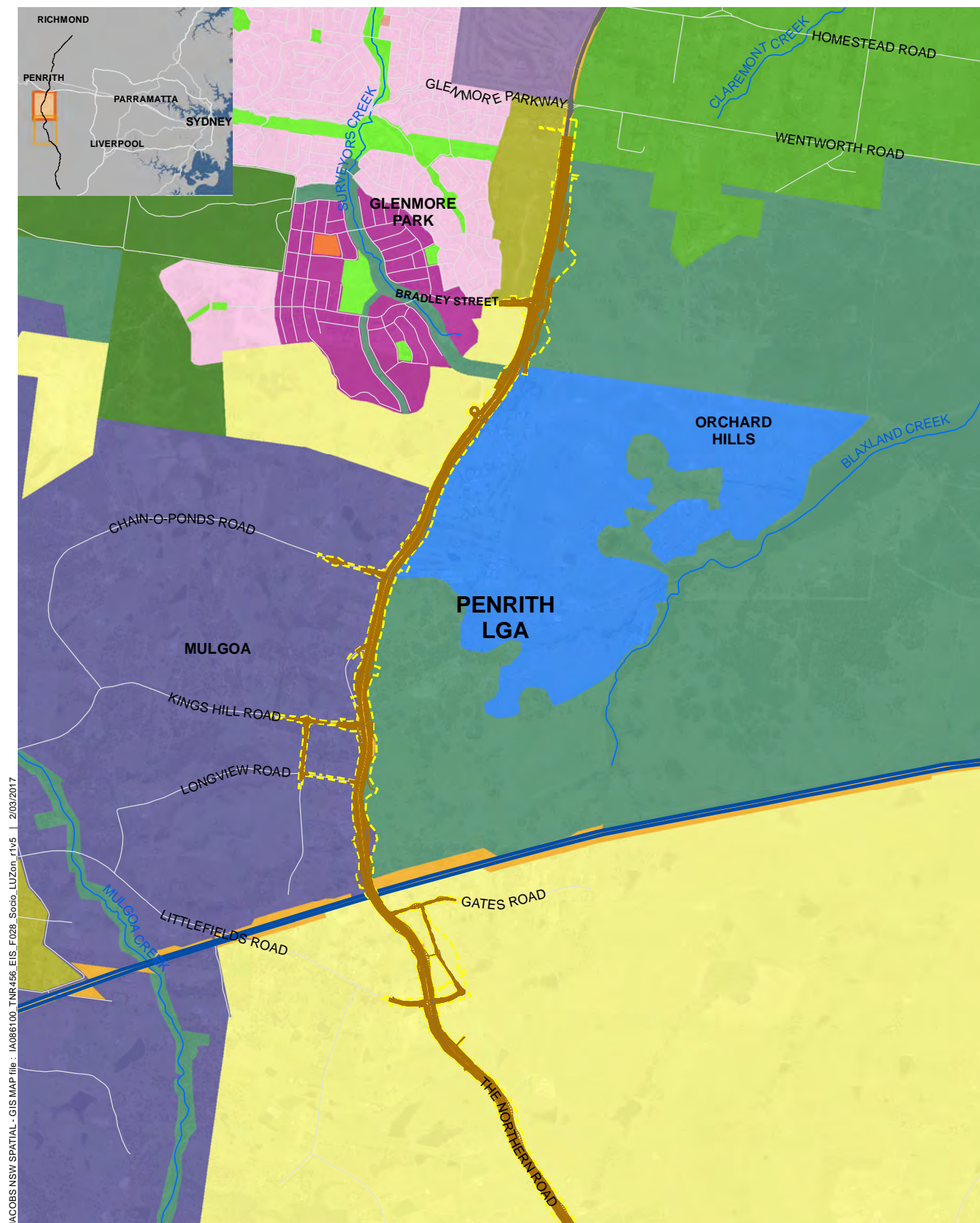
Both the DEOH site and the site of the Western Sydney Airport contain natural drainage lines and named waterways such as Badgerys Creek. The two sites also contain naturally vegetated areas including patches of Cumberland Plain Woodland and Riverflat Eucalypt Forest. The biophysical characteristics of the Commonwealth lands are described in the respective sections of Chapters 7 and 8 of this EIS, along with discussion about the project's likely impacts on biophysical processes and landform features. Additionally, a description and assessment of the potential impacts to natural heritage on the DEOH site is provided in Chapter 8.4.

This chapter describes the project's socio-economic impacts on Commonwealth land in accordance with the Commonwealth EIS Guidelines.

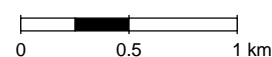


JACOBS NSW SPATIAL - GIS MAP file : IAC66100_TNR456_EIS_F028_Socio_LUZon_r1v5 | 2/03/2017

Figure 7-12 | Land use zoning



JACOBS NSW SPATIAL - GIS MAP file : JAC06100_TNR456_EIS_F028_Socio_LUZon_r1v5 | 2/03/2017



- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- WaterNSW supply pipelines
- Operational boundary
- Local government area

- Zone**
- Low Density Residential
 - Medium Density Residential
 - General Residential
 - Infrastructure
 - Local Centre
 - Environmental Conservation
 - Environmental Living

- Environmental Management
- Primary Production Small Lots
- Public Recreation
- Private Recreation
- National Parks and Nature Reserves
- Rural Landscape
- Special Activities

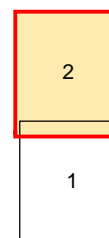


Figure 7-12 | Land use zoning

Areas of public domain

The public domain comprises the community's public space, both functionally and visually. It includes shared urban areas and spaces, the structures that relate to those spaces and the infrastructure that supports and serves them, such as areas that are publicly owned and commonly accessed/ used by the community (for example, parks, public squares and road verges); spaces between public and private activities (for example, outdoor eating and/or trading areas); private spaces that are visible but physically inaccessible to the public (Penrith City Council, 2014).

Key characteristics of the public domain in the study area include:

- Landscaping of the road verge for The Northern Road and other roads, which mainly comprises grassed areas and some established trees, but also includes moderately vegetated areas (for example, south of Bradley Street, near Grover Crescent and south of Luddenham town centre)
- Established trees and landscaping within properties along The Northern Road
- Rural landscapes, including grazing and cropping areas, rural residential uses, and conservation areas
- Luddenham town centre, which is characterised by its 'village' feel, and includes a mix of residential, commercial and community uses along The Northern Road
- Open space and recreation areas, including golf courses.

The public domain in the study area is affected by existing traffic on The Northern Road, including heavy vehicles, impacting noise, air quality, visual amenity and safety for local communities and road users. In particular, traffic volumes through the Luddenham town centre impact on the amenity and quality of the public domain.

Social environment

Population and housing

In 2015, the study area had a total resident population of 42,049 people, of which more than half lived within the Glenmore Park-Regentville area, which is suburban in character. The more rural area of Mulgoa-Luddenham-Orchard Hills had the smallest resident population at 7,867 people.

Over the 10 years to 2015, the population of the study area grew by about 6,559 people, an average of about 1.7 per cent per annum. This was above the rate of population growth for NSW over the same period and was driven by relatively high population growth in the Mulgoa-Luddenham-Orchard Hills area and the Badgerys Creek-Greendale area, particularly between 2010 and 2015. Population growth in the region is expected to continue, focused in the Western and Southern Sydney Priority Growth Area, and around the Western Sydney Airport.

Overall, the study area as a whole tended to have a younger population compared to the NSW population, with a lower median age; higher proportion of children aged 14 years or under and people aged 25-44 years; and lower proportions of older people aged 65 years or over.

The younger age profile of the study area was generally driven by a relatively young population in Glenmore Park-Regentville. At the 2011 Census, Glenmore Park-Regentville recorded a median age of 31 years, seven years below NSW as a whole. The older age profiles of Mulgoa-Luddenham-Orchard Hills and Badgerys Creek-Greendale is likely to reflect the more rural nature and more established communities in these areas.

Communities in the study area as a whole generally display lower levels of diversity compared with NSW, with lower proportions of Aboriginal people and people born overseas and higher proportions of people who speak English only.

In 2011, about 26.3 per cent of people in the study area were born overseas. After Australia, the most common countries of birth were:

- The United Kingdom, Channel Islands and Isle of Man (4.1 per cent)

- Italy (2.2 per cent)
- Malta (1.3 per cent)
- Philippines (1.3 per cent)
- India (1.2 per cent).

There were about 11,070 households in the study area in 2011. Compared to NSW, the study area had high proportions of family households and relatively low proportions of lone person and group households. There were about 10,039 families in the study area in 2011 of which, 46.1 per cent comprised families with children aged less than 15 years. This was higher than the proportion of this family type in NSW as a whole.

The study area, particularly Mulgoa-Luddenham-Orchard Hills, demonstrated relatively low levels of population mobility, with higher proportions of people who had lived at the same address both 12 months and five years prior to the 2011 Census compared to NSW. This demonstrates a stable community and is likely to reflect the rural nature of the area.

Housing cost and tenure

At the 2011 Census, the study area exhibited overall higher levels of home ownership, lower levels of residential tenancy (i.e. rentals), and lower levels of public housing occupancy than the respective NSW averages. Housing costs in the study area are relatively high, with median weekly rent and monthly mortgage costs above the NSW average. At the 2011 Census, an average of 13.7 per cent of households in the study area were paying 30 per cent or more of their income on mortgage payments, compared to 10.5 per cent in NSW. Housing costs and tenure are summarised below in Table 7-57.

Table 7-57 Housing tenure and costs, 2011

Locality	Owner occupied * (%)	Rented (%)	Rented (State housing authority) (%)	Median rental costs (\$/ week)	Median mortgage costs (\$/ month)	Rent payments are 30% or greater of household income (%)	Mortgage payments are 30% or greater of household income (%)
Glenmore Park-Regentville	77.7	21.0	0.8	360	2,200	6.5	16.7
Mulgoa-Luddenham-Orchard Hills	78.5	18.9	0.2	290	2,200	6.2	12.0
BadgerysCreek-Greendale	69.3	27.1	0.4	320	2,358	11.6	12.4
Study area**	75.8	22.1	0.6	323	2,253	8.1	13.7
Penrith LGA	70.6	26.7	4.4	300	1,983	9.8	13.2
Liverpool LGA	66.0	30.4	7.9	295	2,167	12.2	16.7
NSW	66.5	30.1	4.4	300	1,993	11.6	10.5

Notes: * includes dwellings owned outright or owned with a mortgage, ** Median rental and mortgage costs and rent and mortgage payments for the study area refers to the average of SA2s in the study area

Source: ABS (2012a), 2011 Census of Population and Housing, Basic Community Profile (Catalogue number 2001.0); ABS (2013), 2011 Census QuickStats

Community values

Community values include those values held as important to residents for quality of life and well-being. Community values are heavily influenced by the local amenity and character in the study area particularly agriculture, rural residents and local towns such as Luddenham and Mulgoa.

Community values have been extrapolated from the Penrith Community Plan (Penrith City Council, 2010), Growing Liverpool 2023 Strategy (Liverpool City Council, 2013) and include:

- Continued support of agricultural and local food production at Orchard Hills, Luddenham, Mulgoa, Badgerys Creek and Greendale including farming, market gardens, dairy, poultry farms, hobby farms, and fruit growing
- Protecting the study area's unique scenery and its mix of urban and rural landscapes
- Protection and conservation of the environment, biodiversity and natural assets such as rivers, creeks, and bushland areas
- Protecting the ecosystems, natural and physical resources on the larger, less disturbed sites such as the DEOH site and the site of the Western Sydney Airport (both of which are Commonwealth land). The biophysical characteristics of these (and other) sites, which are the source of their social and cultural value, are described in detail in Sections 7.3 (Biodiversity), 8.2 (Soils, water and contamination), and 8.5 (Urban design and visual impact). The description of the natural heritage characteristics of the site provided in Section 8.4 (Non-Aboriginal heritage)
- Protection and respect of the project area's Aboriginal cultural heritage values, through the protection and preservation of a number of scattered sites, some of which were found on Commonwealth land, identified during the Aboriginal heritage assessment which is documented in Section 8.3
- Protection and respect of the area's non-Aboriginal heritage values. This included buildings such as churches, the Chaffey brothers irrigation scheme canals, and other community facilities such as the Luddenham Showgrounds (refer to Section 8.4 Non-Aboriginal heritage)
- Maintaining high levels of access and connectivity while reducing congestion including the provision of improved public transport and active transport
- The importance of a balanced local economy, local employment and creating jobs to keep the community working locally
- Family heritage and connections to the land with some families having lived in the area, or on specific farms, over several generations
- Maintenance of the areas amenity relating to noise, air quality and visual amenity.

The study area has undergone change in recent decades, with the increasing urban development and development of residential estates such as Glenmore Park. These areas offer residents a range of urban residential uses, as well as access to open space, recreation and conservation areas. The development of a Western Sydney Airport is also likely to drive further growth in urban development in the study area and wider region over the coming years.

Social infrastructure

The study area includes a range of community facilities and services catering for communities in the study area and surrounding region. These facilities and services include churches, cultural facilities, community centres, educational facilities and schools, child care centres, emergency services, and sport, recreation and leisure facilities.

Some of these facilities are located within close proximity to the project and may be subject to direct or indirect impacts from the construction and operation of the project. These facilities are outlined in Table 7-58.

Table 7-58 Social infrastructure near the project

Facility type	Facility	Location	Description
Education facilities	Penrith Anglican College	Wentworth Road, Orchard Hills	The school offers primary and secondary education for students in Kindergarten to Year 12. In 2015, the school had an enrolment of 1,236 students. The school provides after hour care for students until 6.00pm. The Junior School Performing Arts Centre (the Lighthouse Theatre) is located at the school. It includes a 550 seat theatre and associated café, which is used for College and professional productions, for example play and music concerts. The theatre is also home to Christ Church @ the College, which holds services at 9.30am each Sunday.
Sport, recreation and leisure facilities	Penrith Golf and Recreation Club	The Northern Road, South Penrith	An 18-hole private golf course. The clubhouse is located near to The Northern Road boundary. Access to the clubhouse is via left-in access only and left and right out access.
	Orchard Hills Golf Club	The Northern Road, Orchard Hills	Golf course is located in the DEOH (ie is situated within Commonwealth land).
	Surveyors Creek Nature Reserve	Glenmore Park	The reserve provides informal recreation opportunities, including fitness trail and nature based recreation. Formal recreation facilities and a community centre are also located at the northern part of the reserve.
	Windmill Park	Saddler Way, Glenmore Park	The park provides informal recreation opportunities, including playground and open space areas.

Socio-economic disadvantage and need for assistance

A community's level of socio-economic disadvantage may influence the ability of that community to cope with or respond to changes. The ABS produces a range of indices that indicate relative levels of socio-economic advantage and disadvantage (Socio-economic Indexes for Areas (SEIFA)). The SEIFA index of relative socio-economic disadvantage is derived from variables such as income, educational attainment, unemployment, and vehicle ownership. Low decile values generally represent areas of disadvantage while high decile values generally represent areas of least disadvantage (Commonwealth of Australia 2013).

Communities in the southern part of the study area, south of Elizabeth Drive, generally demonstrate higher levels of relative disadvantage, with some communities in the bottom 30-40 per cent of communities in NSW in relation to disadvantage. Communities in the northern part of

the study area generally display lower levels of relative disadvantage, particularly in Glenmore Park and Mulgoa.

Need for assistance refers to people who need help or assistance in at least one of the three core activity areas of self-care, mobility or communication due to disability, a long-term health condition or old age. These groups may be more vulnerable to the effects of major projects, such as changes in local access; property acquisition, including loss of social and community networks; and changes in local amenity.

Overall the study area generally had levels of people needing assistance below the Penrith and Liverpool LGAs and NSW averages. At the 2011 Census, about 3.7 per cent of the study area's population needed assistance in at least one of the three core activities, compared to 4.3 per cent and 5.4 per cent in Penrith and Liverpool LGAs respectively, and 4.9 per cent in NSW.

Within the study area, Badgerys Creek-Greendale recorded the highest level of people needing assistance at 5.9 per cent. A further 8.4 per cent of people in this SA2 did not state whether they needed assistance, which was above the NSW average (at 5.7 per cent). Glenmore Park-Regentville recorded the lowest need for assistance in the study area.

Transport and access

The study area is serviced by a range of transport infrastructure and facilities, including major roads, public transport and active transport.

The Northern Road is a key north–south connection, linking Richmond Road and South Windsor in the north with Camden Valley Way at Narellan in the south. The road provides an important radial connection across western Sydney for residents, business and industry. In 2011, car travel was the predominant mode of travel to work for residents in the study area, with about 74.3 per cent of people aged 15 years or over using the car for all or part of their journey to work.

Locally, The Northern Road provides access to residential, rural and commercial properties along The Northern Road and in surrounding areas. Right turn access is currently provided to/ from properties fronting The Northern Road and at intersections with The Northern Road.

The study area is serviced by a number of bus routes, of which two services operate along The Northern Road through the project area. Only one currently operates along The Northern Road between Mersey Road and Glenmore Parkway; Route 789 which connects Penrith to Luddenham.

A number of school bus routes also connect to schools within the study area, some of which use The Northern Road for part of the route. A number of bus stops are located along The Northern Road between Luddenham and the M4 Motorway. Public transport was used for travel to work by about 7.3 per cent of people in the study area aged 15 years or over. This was well below the NSW average and is likely to reflect the limited public transport access in parts of the study area (for example, Mulgoa-Luddenham-Orchard Hills and Badgerys Creek-Greendale).

Existing pedestrian and cyclist facilities along The Northern Road are limited. Between Glenmore Parkway and the M4 Motorway, there is a short, isolated section of road shoulder along The Northern Road that is marked for cycle use. Other pedestrian or cycle facilities along The Northern Road are generally located within Luddenham. About 1.7 per cent of people in the study area aged 15 years or over walked or cycled to work, which was below the NSW average (at 4.8 per cent). This is likely to reflect the more rural nature of the study area and distance to employment centres.

Further information on active transport facilities is discussed in the Section 7-1 Traffic and Transport.

Economic environment

In 2011, income levels varied across the study area, with higher median incomes for the study area as a whole generally driven by very high incomes in Glenmore Park-Regentville. Badgerys Creek-Greendale had a median personal income below the NSW average although household incomes were above the NSW average.

Compared to NSW, the study area generally had lower proportions of low income households (with a weekly income of less than \$600) and higher proportions of high income households (with a weekly income of \$2,000 or more). The higher proportion of high income households in the study area was generally due to high proportions of this household type in Glenmore Park-Regentville and Mulgoa-Luddenham-Orchard Hills.

There were about 19,691 people in the study area aged 15 years or over who were either employed or looking for work at the 2011 Census. This represented a labour force participation rate of 69.2 per cent, which was above the NSW average at 59.7 per cent. Labour force participation varied across the study area, with Glenmore Park-Regentville having high rates of participation, while Badgerys Creek-Greendale reported labour force participation below the NSW average.

The study area had a relatively low rate of unemployment, with 3.9 per cent of the study area's labour force unemployed at the 2011 Census. This is compared to 5.9 per cent in NSW and 5.5 per cent and 7.0 per cent in Penrith LGA and Liverpool LGA respectively.

In 2011, key industries of employment for residents in the study area included:

- Retail trade (employing 11.3 per cent of the study area's population aged 15 years or over)
- Manufacturing (10.5 per cent)
- Construction (10.3 per cent)
- Health care and social assistance (8.8 per cent)
- Public administration and safety (7.3 per cent).

With the exception of health care and social assistance, the proportion of people employed in these industries was above the NSW average.

Agribusiness

In 2010-2011 the study area had a total of 6,541 ha of agricultural land, of which nearly 65 per cent was located in Badgerys Creek-Greendale and about 35 per cent in Mulgoa-Luddenham-Orchard Hills. The study area accounted for about 68.8 per cent of the Penrith and Liverpool region's grazing land, and about 55.2 per cent of land used for cropping.

There were about 338 agricultural businesses in the study area, of which about 129 businesses were farming livestock, and about 217 businesses were farming crops. The Badgerys Creek and Greendale area had the largest number of agriculture, forestry and fishing businesses, accommodating nearly 70 per cent of agricultural, forestry and fishing related businesses in the study area. Agricultural, forestry and fishing related business comprised about 13.7 per cent of total businesses in Badgerys Creek-Greendale and 7.2 per cent of businesses in Mulgoa-Luddenham-Orchard Hills. The majority of businesses in the study area are considered to be small businesses employing less than 20 people.

The Penrith LGA had a total agricultural output of about \$83 million in 2010. At the same time, total agricultural output in the Liverpool LGA was about \$73 million. This represented about 0.7 per cent and 0.6 per cent of total agricultural production in NSW as a whole.

Agricultural enterprises that are making a substantial contribution to the study area's agricultural output include dairies (Leppington Pastoral Company), poultry and egg farms (Inghams, Farm Pride Foods), pastoral and grazing farms. Smaller operations in the study area comprise enterprises such as nurseries, honey producers, market gardens (including vegetable growers) and producers of agricultural products (such as fertilisers).

Local businesses

There were 3,495 registered businesses in the study area in June 2015. Construction had the most businesses; accounting for about 27.2 per cent of all businesses in the study area. This was followed by transport, postal and warehousing (12.0 per cent); rental, hiring and real estate services (9.6 per cent); and agriculture, forestry and fishing (8.0 per cent).

In June 2015, about 97.9 per cent of businesses in the study area comprised small businesses employing less than 20 people with about half that being sole traders or partnerships with no employees. There were very few large businesses (greater than 200 employees) within the study area. These were manufacturing businesses located in the Badgerys Creek-Greendale area.

Luddenham businesses

A range of businesses are located within Luddenham that service the needs of local and regional communities, including:

- Grocery retailers, including supermarket, fruit and vegetable stall, and butcher
- Other retailers, such as pharmacy, newsagent and post office, workwear supplier and florist
- Food services, including cafes, restaurants, bakery and takeaway
- Service stations
- Personal service providers, such as hairdressers and beauty salons
- Health and medical services.

As described in Section 7.4.1 surveys were conducted for businesses in Luddenham town centre. The majority of businesses surveyed have operated within Luddenham for more than six years, with three businesses indicating that they have been operating in Luddenham for more than 20 years. Most Luddenham businesses employ up to about five people, with one indicating they employed 21-50 people.

Most of the businesses surveyed indicated that they served a predominantly 'local' catchment within about 20 km of Luddenham. The main areas identified by businesses included:

- Bringelly, Harrington Park, Oran Park, Narellan and Gregory Hills south of Luddenham
- Penrith and Glenmore Park to the north
- Mulgoa, Wallacia, Warragamba, Silverdale and the Blue Mountains west of Luddenham
- Twin Creeks and Liverpool to the east.

The surveys found that businesses within the town centre also attract some customers from across the greater Sydney area. Based on number plate surveys, about 13 per cent of customers who drove to businesses in the town were from Luddenham, with the next most popular suburbs of origin being Bringelly (seven per cent) and Silverdale (six per cent).

Currently, The Northern Road runs through the Luddenham town centre, where the majority of local businesses are located. This provides a regular stream of passing trade; customers who access a business because they see it while they are walking or driving past.

'Passing trade' generally refers to customers who access a business because they see it while they are walking or driving past, as opposed to customers who have deliberately planned to visit a particular business. In general, the level of reliance of a business on passing trade is likely to be influenced by the type or nature of the business. For example, passing trade is likely to be of higher importance for businesses such as service stations and some takeaway food stores and cafes, compared to speciality retail or personal service businesses.

In relation to businesses within Luddenham town centre, passing trade was identified as important to a number of businesses surveyed, although perceptions about the importance of passing trade varied between individual businesses and was not consistent between similar business types. For example, two grocery retail outlets indicated that passing trade comprised less than 10 per cent of their business, while another indicated that this was between about 25-50 per cent.

The survey identified that:

- Businesses that indicated passing trade made up a relatively small proportion of their customers (that is, less than 10 per cent) included health care, beauty salon, grocer and food store

- Businesses that estimated between 10 per cent and 25 per cent of their customers were associated with passing trade included personal services and speciality retail
- Businesses that indicated that passing trade accounted for up to 50 per cent of customers included grocer and food stores and retail uses (for example, newsagent and clothing/ footwear store).

Business such as the service stations and cafes, estimated that more than half of their customers were associated with passing trade, with one business indicating that more than 75 per cent of customers related to passing trade. This business also indicated that the proportion of customers from passing trade was higher on weekdays than on weekends.

The existing business environment of the study area is expected to change over time due to such things as the development of the Western Sydney Airport and urban growth and development. This is likely to result in the diversification of businesses within the study area and broader region and changes to existing businesses and industries. Increased population density around centres is also likely to drive demand for local services and changes to local business.

7.4.3 Potential construction impacts

This section provides an assessment of the project's likely impacts on the socio-economic environment of the study area during construction.

Property and land use impacts

Temporary leases of land would be required during construction to accommodate ancillary construction facilities such as worksites, compounds and laydown areas. Properties identified for temporary lease mainly comprise areas of rural or vacant land, but also includes residential and commercial uses. Use and access to those areas affected by temporary leases would be temporarily disrupted during construction. These impacts would be temporary and short-term in nature.

Following construction, land occupied by construction works but not required for the ongoing operation of the project would be reinstated to its pre-construction use. This would include reinstatement of any affected infrastructure such as fencing, as agreed with the property owner. While these impacts are likely to be important to affected property owners and tenants, impacts associated with the temporary lease of land would be short-term and are not expected to be significant in the context of the project as a whole.

Details of temporary leases of land required for construction compounds are outlined in Table 7-59. The locations of construction compounds are discussed in Chapter 5.

Table 7-59 Summary of temporary property leases for construction

Compound number	Property (lot number)	Existing land use
C1	Lot 3 DP234403	Rural/ residential
C2	Lot 6 DP249262	Rural/ residential
C3/ C5	Lot 11 DP1092165	Rural/ commercial
C4	Lot 102 DP812653	Rural/ commercial
C6	Lot 2 DP851626	Rural/ commercial
C7	Lot 1 DP851626	Rural
C8	Lot 1 DP250030	Rural

Compound number	Property (lot number)	Existing land use
C9	Lot 2 DP519034	Rural
C10	Lot 105 DP846962	Rural
C11	-	Crown land (road reserve)
C12	Lot 1 DP517853	Residential/ commercial
C13	Lot 5 DP599382	Rural
C14	Lot 9 DP249113	Rural residential
C15/ C16	Lot 1 DP109697	Rural
C17	Lot 1 DP232322	Crown land (road reserve)
C18	Lot 1 DP202647	Residential/ commercial
C19	Lot 1 DP224861	Rural/ residential
C20	Lot 5 DP26658/ Lot 6 DP26658	Rural residential
C21	Lot 2 DP711076	Rural residential
C22	Lot 1 DP711076	Rural residential

Additionally there would be limited long-term impact on farm infrastructure such as dams, irrigation, fencing, sheds and storage areas, and other facilities. Where this infrastructure would be demolished and reinstated or relocated as a result of the project, this would be carried out in consultation with the property owner, prior to the removal of the infrastructure. Refer to agricultural impacts below with regards temporary short-term impacts during construction, as well as Section 7.4.4 for potential long-term permanent impacts during operation.

Land use impacts during construction

The use of land affected by temporary leases during construction would be temporarily disrupted or suspended for the duration of the lease. Any structures, facilities or infrastructure located on the affected lands would likely be demolished and/or relocated, in consultation with the landowner.

On completion of construction, any land not required for the project's long-term operation would be reinstated to its former use.

The construction works are not expected to restrict exploration activities in the vicinity of the project associated with the existing exploration licence (EL 8429).

Social impacts

Population and demography

During construction, the construction workforce would generally be sourced from across the wider Sydney region and is not expected to change population and demography in the study area. Any potential changes would be relatively minor in the context of construction associated with broader investment and development planned to occur in the wider Sydney region in coming years.

Social infrastructure

During construction, potential impacts on social infrastructure near the project may result from:

- Direct impacts through acquisition of community infrastructure

- Increased noise, dust and construction traffic, impacting on amenity for users and workers of some community services and facilities
- Changes in local access and traffic disruptions and delays due to construction activities.

Impacts on amenity may be experienced by users of community services and facilities located close to construction works and compounds due to increased noise and dust from construction activities and increased traffic, including heavy vehicles. These potential impacts are further assessed in the relevant chapter of the EIS including sections 7.1 traffic and transport, 7.2 noise and vibration and 8.6 air quality (dust) impacts.

Overall, potential impacts on social infrastructure from construction activities would be short-term and are not expected to be significant given that the majority of social infrastructure is located away from construction activities.

Community values

Construction of the project would impact positively on short-term local employment through the creation of direct construction related employment on the project and indirect employment in businesses and industries that support the construction works.

Potential impacts on community values during construction may be experienced due to:

- Temporary decrease in local amenity for residents, businesses facilities and natural areas near to construction worksites and work areas due to increased noise and dust from construction activities
- Temporary changes in local access and connectivity, including for motorists, public transport users, pedestrians and cyclists during construction resulting in delays and disruptions
- Increased construction traffic and temporary changes to local access and connectivity
- Temporary decrease in visual amenity due to the presence of construction works including light spill from any night-time construction works.

These impacts would be short-term and may potentially impact on the use and enjoyment of some homes, businesses and facilities, particularly of outdoor areas. Impacts on night-time amenity may also be experienced should works need to be carried out outside of standard day-time hours.

Further assessment of potential impacts, including night-time impacts, are included in the relevant chapters of the EIS including sections 7.1 traffic and transport, 7.2 noise and vibration, 8.5 urban design and visual, and 8.6 air quality (dust) impacts.

If unmanaged, noise, light spill, and dust from construction activities may impact on the health and wellbeing of some residents and occupants of buildings nearest to construction works. These impacts are most likely to occur where night-time work results in sleep disturbance over extended periods or where construction activities create extended periods of high noise or dust level, in particular, the potential for dust from construction activities to impact on health of some sections of the community (eg people who suffer asthma). However environmental management measures and procedures would be established to help manage potential impacts on communities near to construction works. Possible management measures are discussed in the relevant sections as listed above. While these impacts may be a concern for some individuals, overall they are not expected to be significant.

Increased traffic noise and light spill is also expected to impact on the night-time amenity, particularly for those residents near the project and not currently near current road alignment, particularly given the relatively low existing night-time noise and light environment.

The bypass of Luddenham would largely avoid construction-related impacts on amenity in the Luddenham town centre. During construction, traffic would continue to flow through the town, and some additional traffic would be attributable to construction activities. However, construction activities would have only minimal impact on amenity within the town, with the exception of a small number of dwellings situated on the edges of Luddenham (on Eaton Road and adjacent to the

Caltex service station). In Luddenham, the public domain would remain largely unaffected during the project's construction.

Economic impacts

Construction impacts on local businesses and employment

The project would impact positively on employment through the creation of direct employment opportunities through the construction phase. The project would also generate a number of indirect jobs in local, regional and national businesses and industries that support the construction phase, such as retailers who provide goods and services to support the day-to-day needs of the construction workforce, suppliers of construction materials and equipment, and transport operators.

It is estimated that the WSIP as a whole, of which the project is one element, would create about 4,000 direct and indirect jobs during the 10 year lifetime of the program. Based on the expected project cost, it is estimated that around 928 of these jobs would be associated with the project (indicative only). Furthermore, in accordance with the *NSW Government Policy on Aboriginal Participation in Construction* (NSW Finance and Services 2016) a percentage of the project value would be spent to support Aboriginal participation during construction.

Temporary leases of land for the project would impact only one non-agricultural business, being site C18 which accommodates construction equipment and machinery sales business. Potential impacts on businesses affected by temporary lease of land for construction would generally be associated with:

- Direct loss of business from properties being utilised for construction-related purposes
- Changes in access due to restriction of right turns to/ from The Northern Road, increasing travel distances for some customers, employees and delivery drivers.

During construction, potential impacts on local businesses in the study area may result from:

- Increased expenditure by construction workers on local goods and services, resulting in beneficial impacts for local businesses
- Changes in local access to businesses, and traffic disruptions and delays due to construction activities, resulting in adverse impacts for local businesses
- Increased noise, dust and construction traffic, impacting on business amenity at businesses near the project.

These impacts would be temporary and short-term in the context of the project.

Compensation for businesses to cover loss of trade during construction was raised as a concern during consultation for the project. Compensation for the project would be determined in accordance with the *NSW Property Acquisition (Just Terms Compensation) Act 1991*. Roads and Maritime does not pay compensation to properties that are not materially impacted (i.e. property or buildings physically or structurally affected). Effective mitigation measures would be implemented during construction to manage potential impacts on local businesses. Roads and Maritime would also continue to consult with affected business owners through detailed design and construction to inform further management measures.

The construction phase may have a positive effect for some local businesses through increased demand for local goods and services. This includes local shops and food outlets near construction works and in Luddenham town centre that may benefit from increased business in response to day-to-day needs of construction workers. Businesses supplying goods and services to construction are also likely to experience benefits from increased construction activities locally. These impacts would be short-term for the duration of construction.

Access to businesses near the project would be maintained during construction. Where temporary changes are required, these would be determined in consultation with individual business to ensure that potential impacts are appropriately managed. Without effective management, potential

impacts on local business access and amenity during construction may have a moderate level of impact for businesses near the project.

The location of directly affected businesses is outlined in Figure 7-13.

Agriculture impacts

During construction, potential short-term impacts on rural land may be associated with:

- Location of construction compounds, temporarily disrupting use and access to rural land
- Removal and/or relocation of farm infrastructure near to the construction footprint, such as farm dams, fencing and internal roads
- Changes in local access to rural properties, and traffic delays and disruptions due to construction activities
- Increased construction traffic and movement of construction vehicles within the construction footprint, potentially increasing the likelihood of the spread of weeds and pests between properties
- Increased noise, dust and construction traffic, temporarily impacting the amenity of agricultural properties near the project.




Access to rural properties near the project would be maintained during construction. Where temporary changes are required, these would be determined in consultation with individual property owners to ensure that potential impacts are appropriately managed. This includes short-term changes that may impact on access and movement of farm equipment, machinery and livestock between internal property areas or to other properties.




With the implementation of effective mitigation measures, potential impacts on rural properties are not expected to be significant.

The location of directly affected agricultural businesses is outlined in Figure 7-14.



JACOBS NSW SPATIAL - GIS MAP file : JA066100_TNR456 EIS F025 Socio Business r1v4 | 2/03/2017

-  The Northern Road upgrade - Mersey Road to Glenmore Parkway
-  The Northern Road (Existing)
-  Operational boundary

-  Affected businesses
-  Western Sydney Airport site (Commonwealth Land)
-  Defence Establishment Orchard Hills (Commonwealth Land)

0 50 100 m

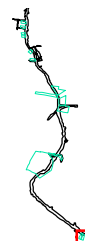
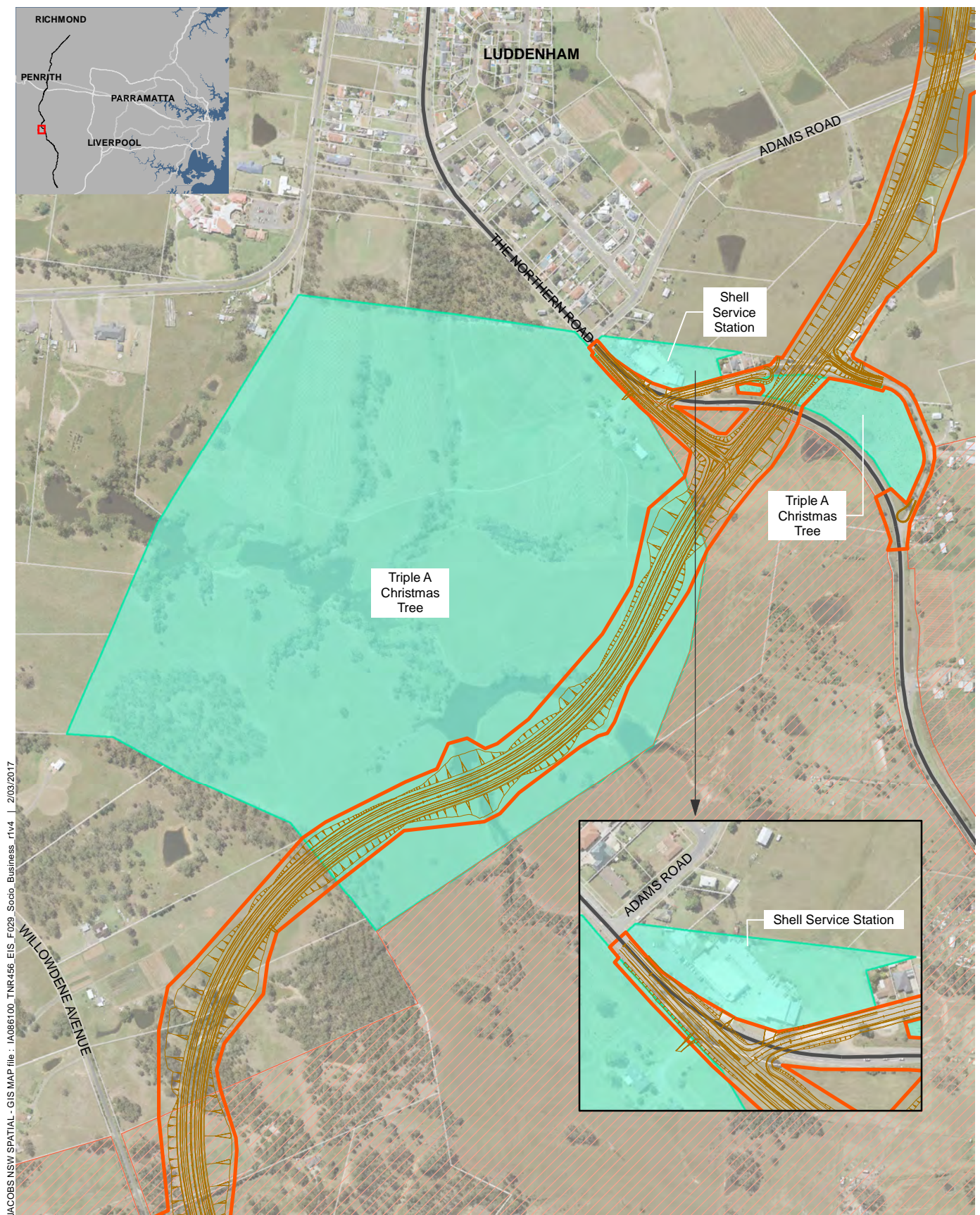


Figure 7-13 | Directly affected businesses



- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- Operational boundary
- Affected businesses
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)

0 200 400 m

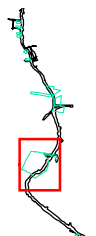


Figure 7-13 | Directly affected businesses

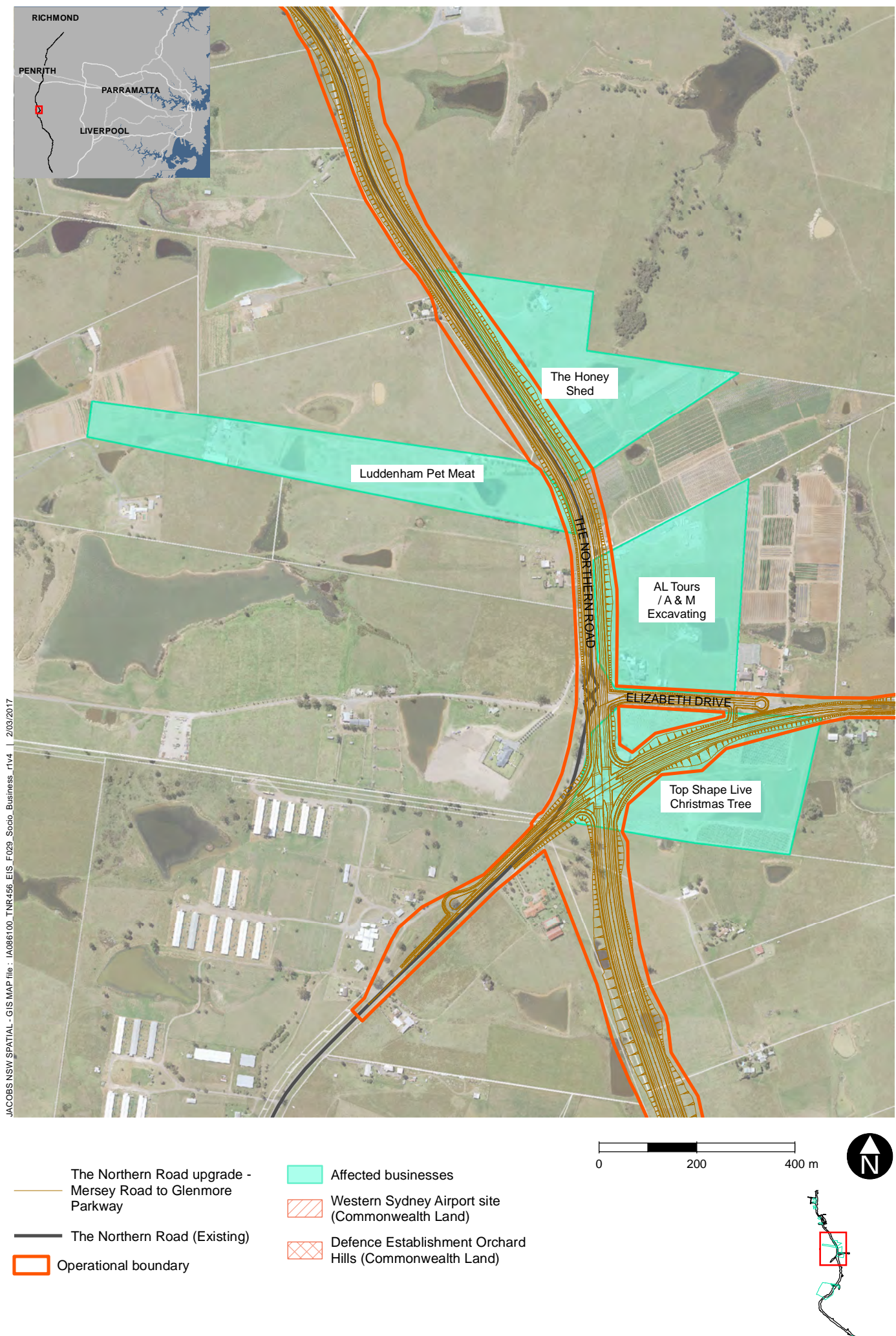
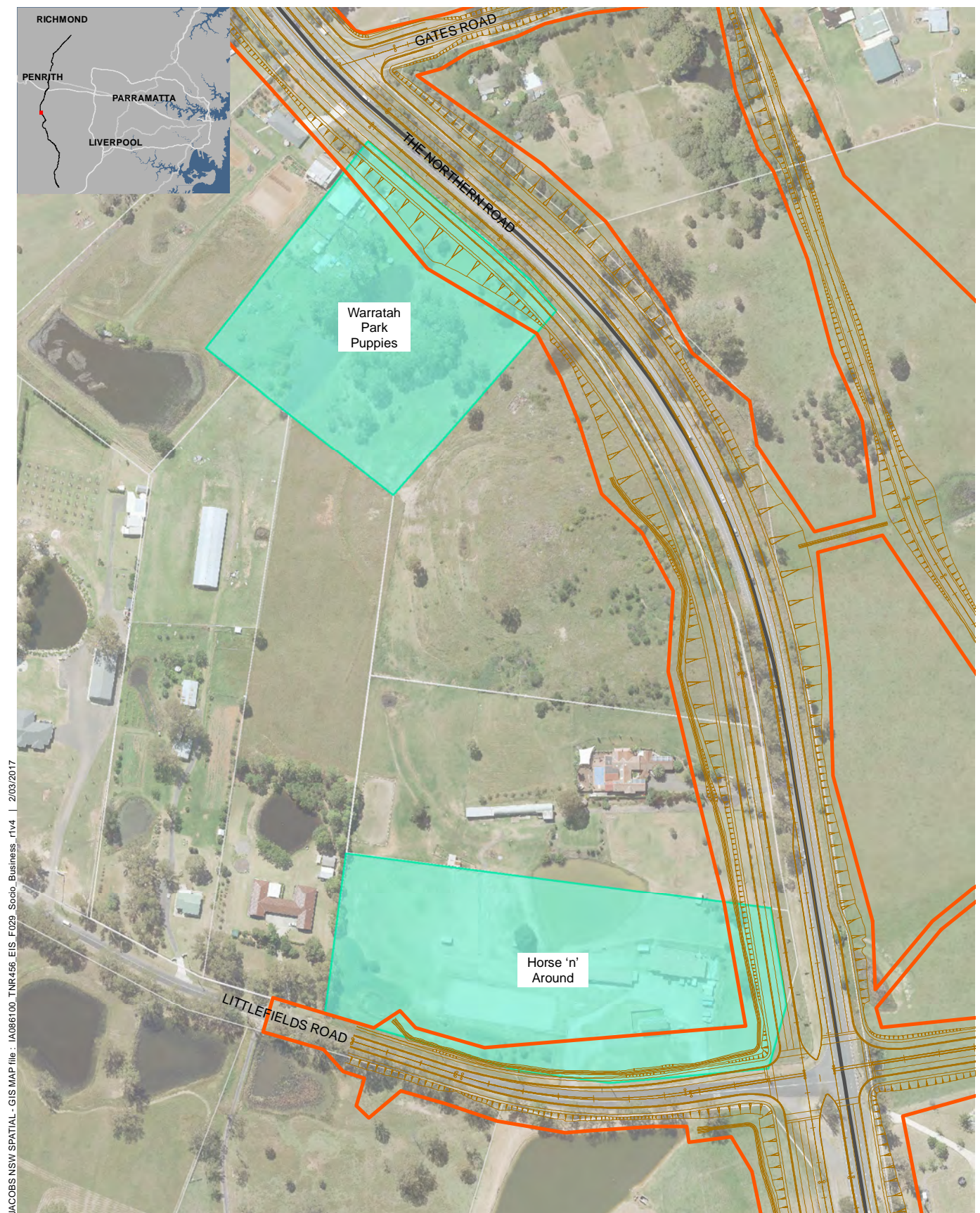


Figure 7-13 | Directly affected businesses



JACOBS NSW SPATIAL - GIS MAP file : JA086100_TNR456_EIS_F029_Socio_Business_r1v4 | 2/03/2017

- | | |
|---|---|
| The Northern Road upgrade - Mersey Road to Glenmore Parkway | Affected businesses |
| The Northern Road (Existing) | Western Sydney Airport site (Commonwealth Land) |
| Operational boundary | Defence Establishment Orchard Hills (Commonwealth Land) |

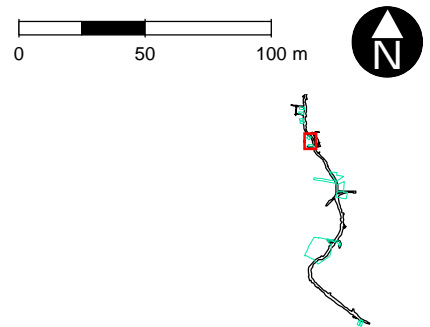
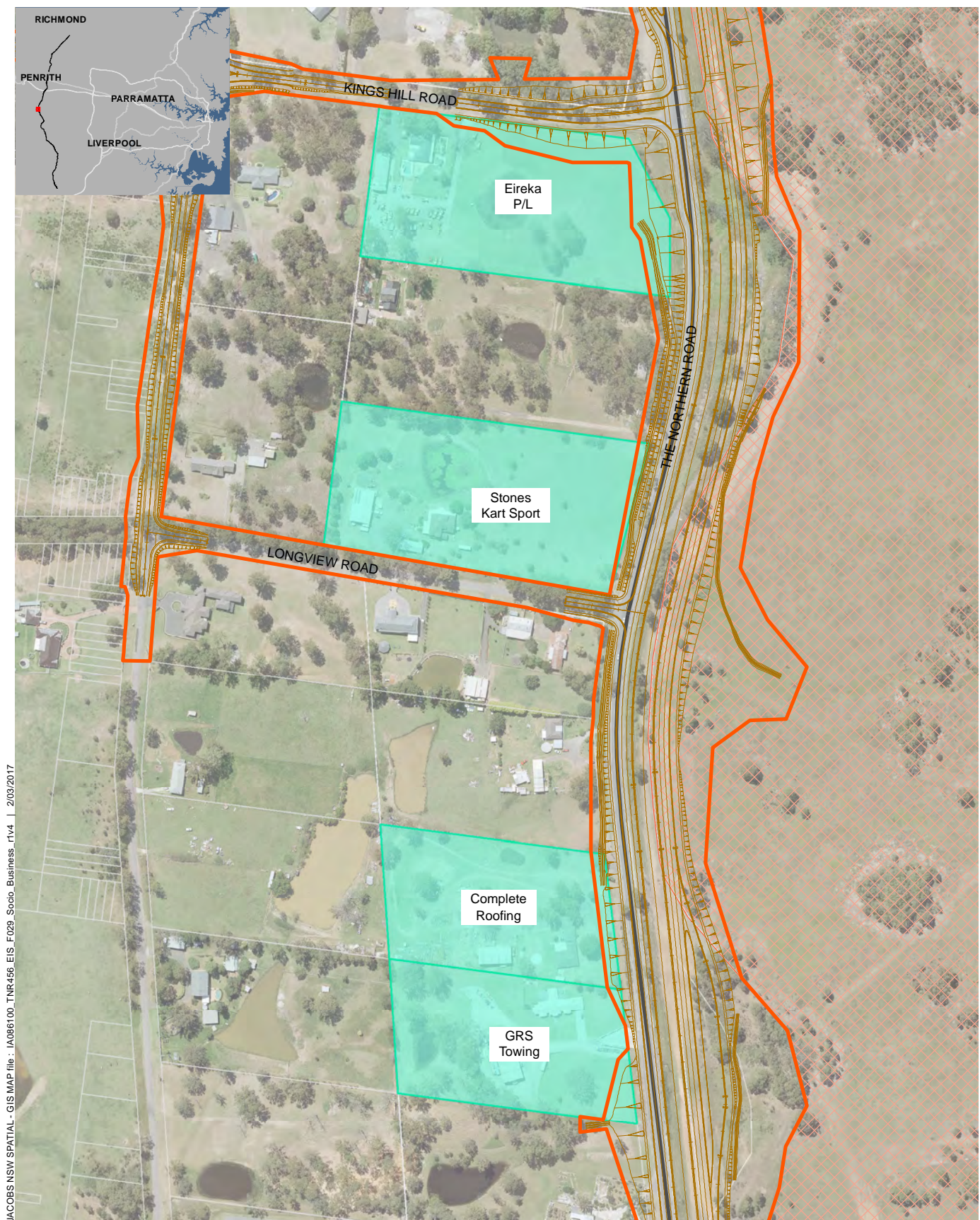


Figure 7-13 | Directly affected businesses



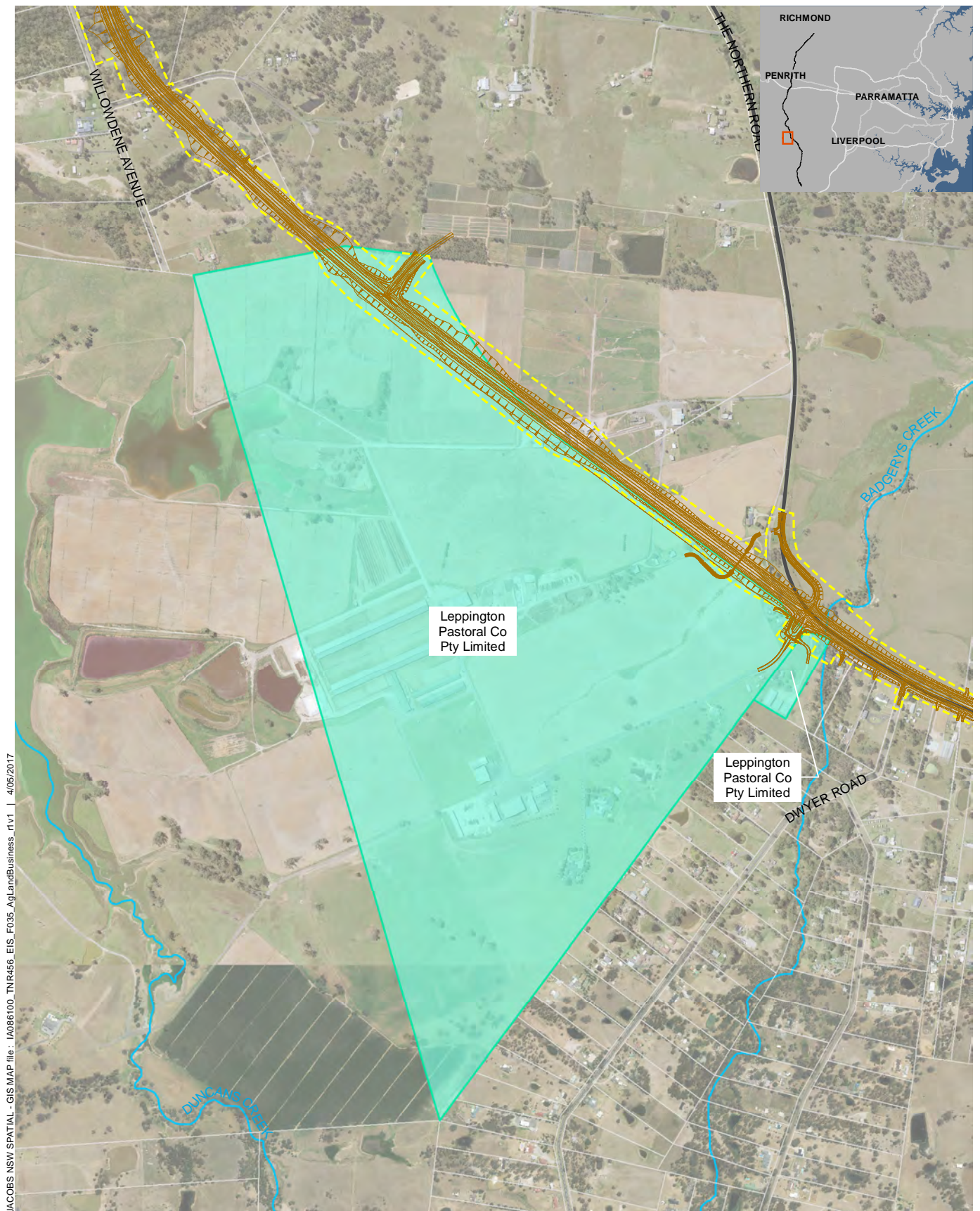
JACOBS NSW SPATIAL - GIS MAP file : JA066100_TNR456 EIS F025 Socio Business_r1v4 | 2/03/2017

- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- Operational boundary
- Affected businesses
- Western Sydney Airport site (Commonwealth Land)
- Defence Establishment Orchard Hills (Commonwealth Land)

0 50 100 m



Figure 7-13 | Directly affected businesses



- The Northern Road upgrade - Mersey Road to Glenmore Parkway
- The Northern Road (Existing)
- - - Operational boundary
- Affected agricultural businesses

0 200 400 m

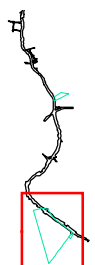
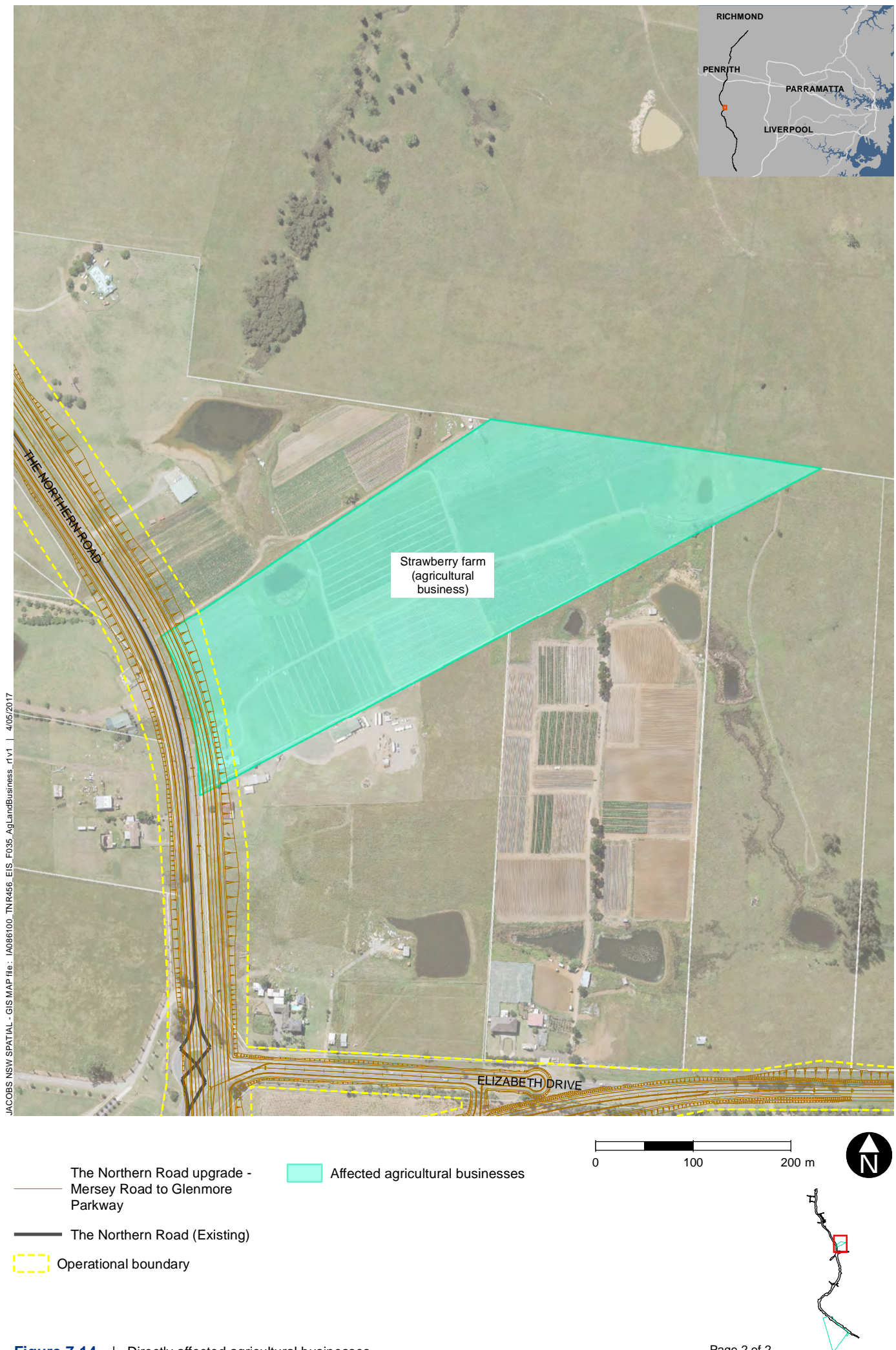


Figure 7-14 | Directly affected agricultural businesses



Access and connectivity

During construction, potential impacts on local access and connectivity would generally result from:

- Increased construction traffic on roads within the study area, including heavy vehicles used to deliver materials and equipment, and construction worker vehicles
- Temporary changes to road conditions near to construction works, including reductions in speed limits, temporary traffic lane closures, and temporary diversions and access changes, resulting in delays and disruptions for motorists and other road users
- Potential changes to bus services, including school bus services, from changes to road conditions and the temporary relocation of some bus stops near to construction works for safety, resulting in possible delays and disruptions for bus users and changes in bus access for some people
- Changes to pedestrian and cycle access near to construction works, resulting in possible disruptions for users.

Some residents in the study area currently have long commuting times to work. Any additional delays or disruptions are likely to be of concern for these people, although these impacts are not expected to be significant in the context of the project.

A detailed assessment of potential construction traffic impacts is included in the Traffic and Transport Working Paper (Appendix G), and summarised in Section 7.1.

7.4.4 Potential operation impacts

This section provides an assessment of the project's likely impacts on the socio-economic environment of the study area during operation.

Property and land use impacts

Property impacts

The operation of the project would require the acquisition of 10 houses and the partial acquisition of land from about 83 owners across 142 lots. These properties would include a combination of privately owned land, as well as land owned by Roads and Maritime, other NSW Government agencies and the Commonwealth Government. The majority of land to be partially or fully acquired for the project comprises residential uses. Other properties affected by property acquisition would include:

- Commonwealth land – Department of Defence uses, particularly land within the DEOH
- Commonwealth land (Department of Infrastructure and Regional Development) identified for the Western Sydney Airport
- Commercial and business uses, including agricultural businesses and home based businesses
- Vacant land
- Land used for water infrastructure.

Generally, affected properties would be partially acquired by Roads and Maritime where only part of the property would be directly impacted by the project. In some instances Roads and Maritime would give consideration to total acquisition (dual offer) or acquisition of any residual parcels created by the location and design of the project. This would provide affected property owners with a level of flexibility or choice during the property acquisition process in relation to property decisions. For example, some property owners may want to retain residual parcels for future use. Roads and Maritime would continue to consult with land owners through the detailed design about these land parcels. The acquisition of land required for the operation of the project would be permanent and would result in long-term impacts to property as a result of the project.

Negotiations to date have identified that severance of some properties would occur which would potentially impact the current use of those properties. This would mainly affects properties currently

used for agricultural uses. Access to residual property parcels would be maintained through the current design via either The Northern Road or the local road network, however some permanent changes may be required. Roads and Maritime would continue to consult with property owners to effectively mitigate potential land use and access impacts where possible through detailed design.

Where partial acquisition of rural properties would occur, infrastructure such as fencing, dams, sheds and other structures, within the project footprint would be demolished or relocated due to the project. Any relocation of rural infrastructure for the project would be undertaken in consultation with the property owner, prior to the removal of the infrastructure.

Some drainage channels would be provided extending from the project boundary to the first farm dam on a number of drainage lines where peak flows would be increased in privately owned land. Where inflows are likely to increase, Roads and Maritime would consult with property owners regarding upgrades to farm dam spillways as part of the project (e.g. with rock armour) to protect the structures. Easements for drainage would be created over each channel to facilitate access for future maintenance.

Disruption caused by changes due to property acquisition can result in a number of impacts including:

- Anxiety and stress about changes as well as uncertainty regarding the acquisition process. Consequential effects on health and well-being
- Disruption to community cohesion, social networks and community relationships, particularly if people need to move away from the local area and from existing social and support networks
- These impacts are likely to have the greatest effect on groups such as the elderly, people with disability, longer term residents and people on lower incomes who are often more reliant on personal and community networks.

During community consultation, it was identified that some properties in the study area have been held in the same family over several generations, particularly rural or farming properties. The owners of these properties are likely to have increased emotional attachment to their farms and the local area. This corresponds with the results of the 2011 Census which found that the study area demonstrated relatively low levels of population mobility, with higher proportions of people who had lived at the same address both 12 months and five years. As such, impacts associated with property acquisition and relocation may be felt more acutely, due to the associated loss of family heritage. These impacts are likely to be substantial for the particular individual families affected.

As well as concerns and uncertainty around the property acquisition process, community consultation also identified that property owners hold concerns about the project's potential impacts on (among other things) property values and property access (see Section 6.3).

Property values are driven by a range of factors. It is likely that external factors, such as the Western Sydney Airport and future urban development, would influence property values more than perceived or actual impacts as a result of road upgrades, including the project.

Table 7-60 provides a summary of property acquisition required for the operation of the project. Property acquisition is also discussed in Chapter 5, and in more detail in Appendix J, including maps showing the project's overall acquisition footprint.

Table 7-60 Summary of property acquisition

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
1	Lot 1 DP235845	Residential	Partial	-	-
2	Lot 97 DP27550	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
3	Lot 1 DP250684	Residential	Partial	-	-
4	Lot 96 DP27550	Residential/ business	Partial	-	-
5	Lot 95 DP27550	Residential/ business	Partial	-	-
6	Lot 94 DP27550	Residential	Partial	-	-
7	Lot 93 DP654182	Residential	Partial	-	-
8	Lot 92 DP27550	Business	Partial	-	-
9	Lot 102 DP812653	Rural/ residential	Partial	-	-
10	Lot 1 DP838361	Rural/ Western Sydney Airport / Commonwealth land	Partial	-	Yes (2)
11	Lot 11 DP1092165	Rural residential	Partial	-	Yes (2)
12	Lot 27 DP259698	Residential	Partial	-	-
13	Lot 28 DP259698	Residential	Partial	-	-
14	Lot 33 DP259698	Rural residential	Partial	-	-
15	Lot 22 DP258581	Rural residential	Partial	-	-
16	Lot 21 DP258581	Residential	Dual offer/ partial	Yes (1)	-
17	Lot 20 DP258581	Residential	Partial	-	-
18	Lot 2 DP851626	Business	Partial	-	-
19	Lot 1 DP851626	Rural	Partial	-	-
20	Lot 2 DP623457	Business	Partial	-	-
21	Lot 21 DP614481	Residential	Partial	-	-
22	Lot 1 DP250030	Residential	Dual offer/ partial	Yes (1)	Yes (1)
23	Lot 1 DP90157	Residential	Partial	-	-
24	Lot 2 DP250030	Residential	Partial	-	-
25	Lot 3 DP250030	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
26	Lot 2 DP519034	Residential	Partial	-	-
27	Lot 104 DP846962	Residential	Partial	-	-
28	Lot 3 DP827223	Residential	Partial	-	-
29	Lot 103 DP846962	Residential	Partial	-	-
30	Lot 102 DP846962	Residential	Partial	-	-
31	Lot 1 DP232996	Rural residential	Partial	-	-
32	Lot 101 DP846962	Residential	Partial	-	-
33	Lot 100 DP846962	Residential	Partial	-	-
34	Lot 5 DP232324	Crown land (road reserve)	Full	-	-
35	Lot 4 DP232324	Crown land (road reserve)	Full	-	-
36	Lot 3 DP911607	Crown land (road reserve)	Full	-	-
37	Lot 1 DP517853	Residential	Partial	Yes (2)	Yes (4)
38	Lot 2 DP517853	Rural residential	Partial	-	-
39	Lot 6 DP32026	Rural	Partial	-	-
40	Lot 5 DP32026	Rural	Partial	-	-
41	Lot 4 DP32026	Rural	Partial	-	-
42	Lot 1 DP1169433	Residential/ business	Partial	-	-
43	Lot 3 DP32026	Residential/ business	Partial	Yes (1)	-
44	Lot 504 DP581138	Residential	Partial	-	-
45	Lot 2 DP32026	Residential/ business	Partial	Yes (1)	Yes (1)
46	Lot DP160890	Residential/ business	Partial	Yes (1)	-
47	Lot 5 DP599382	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
48	Lot 1 DP200435	Residential/ business	Partial	-	-
49	Lot 501 DP580982	Residential	Partial	-	-
50	Lot 12 DP249113	Residential	Partial	-	-
51	Lot 11 DP249113	Residential	Partial	-	-
52	Lot 10 DP249113	Residential	Partial	-	-
53	Lot 9 DP249113	Residential	Partial	-	-
54	Lot 1 DP109697	Residential	Partial	-	-
55	Lot 8 DP249113	Residential	Partial	-	Yes (1)
56	Lot 7 DP249113	Residential	Partial	-	-
57	Lot 101 DP580082	Business	Partial	-	-
58	Lot 11 DP30775	Residential	Partial	-	-
59	Lot 12 DP30775	Sydney Water pumping station	Partial	-	-
60	Lot 9 DP232322	Rural**	Full	-	-
61	Lot 13 DP30775	Residential	Partial	-	Yes (1)
62	Lot 8 DP232322	Rural residential**	Full	-	-
63	Lot 14 DP30775	Residential	Partial	-	-
64	Lot 22 DP32053	Rural	Partial	-	-
65	Lot 15 DP30775	Residential	Partial	-	-
66	Lot 23 DP207317	Residential	Partial	-	-
67	Lot 2 DP32053	Residential/ rural	Partial	-	-
68	Lot 1 DP420840	Residential	Partial	-	-
69	Lot 16 DP30775	Residential	Partial	-	Yes (1)
70	Lot DP341893	Water NSW asset maintenance	Partial	-	-
71	Lot A DP341629	Crown land (road reserve)	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
72	Lot 22 DP843123	Residential	Partial	-	Yes (1)
73	Lot 68 DP651114	Residential	Partial	-	Yes (2)
74	Lot 71 DP668758	Residential	Partial	-	-
75	Lot 73 DP2120	Residential	Partial	-	-
76	Lot 1 DP1064093	Residential	Partial	-	-
77	Lot 1 DP232322	Crown land (road reserve)	Full	-	-
78	Lot 77 DP659462	Business	Partial	-	-
79	Lot 79 DP1085461	Residential	Partial	-	-
80	Lot 1 DP1085051	Residential	Partial	-	-
81	Lot 211 DP2255	Vacant	Partial	-	-
82	Lot 210 DP2255	Vacant	Full	-	-
83	Lot 80 DP2120	Residential	Partial	-	-
84	Lot 10 Sec H DP2234	Vacant	Full	-	-
85	Lot 3 DP202647	Residential	Partial	-	-
86	Lot 36 DP959167	Vacant	Partial	-	-
87	Lot 101 Sec H DP2234	Vacant	Partial	-	-
88	Lot 100 Sec H DP2234	Vacant	Partial	-	-
89	Lot 99 Sec H DP2234	Vacant	Partial	-	-
90	Lot 2 DP202647	Residential	Partial	-	-
91	Lot 98 Sec H DP2234	Vacant	Partial	-	-
92	Lot 97 Sec H DP2234	Vacant	Partial	-	-
93	Lot 96 Sec H DP2234	Vacant	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
94	Lot 37 DP959167	Vacant	Partial	-	-
95	Lot 84 Sec H DP2234	Vacant	Partial	-	-
96	Lot 83 Sec H DP2234	Vacant	Partial	-	-
97	Lot 38 DP959167	Residential	Partial	-	-
98	Lot 75 Sec H DP2234	Residential	Partial	-	-
99	Lot 74 Sec H DP2234	Residential	Partial	-	-
100	Lot 73 Sec H DP2234	Residential	Partial	-	-
101	Lot 72 Sec H DP2234	Residential	Partial	-	-
102	Lot 71 Sec H DP2234	Residential	Partial	-	-
103	Lot 70 Sec H DP2234	Residential	Partial	-	-
104	Lot 69 Sec H DP2234	Residential	Partial	-	-
105	Lot 1 DP202647	Business	Partial	-	-
106	Lot 68 Sec H DP2234	Residential	Partial	-	-
107	Lot 67 Sec H DP2234	Residential	Partial	-	-
108	Lot 66 Sec H DP2234	Residential	Partial	-	-
109	Lot 65 Sec H DP2234	Residential	Partial	-	-
110	Lot 64 Sec H DP2234	Residential	Partial	-	-
111	Lot 63 Sec H DP2234	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
112	Lot 42 DP878814	Residential	Partial	-	-
113	Lot 62 Sec H DP2234	Residential	Full	-	-
114	Lot 23 DP29081	Residential	Partial	-	-
115	Lot 61 Sec H DP2234	Residential	Full	-	-
116	Lot 60 Sec H DP2234	Residential	Partial	-	-
117	Lot 24 DP29081	Residential	Partial	-	-
118	Lot 28 DP29081	Rural residential	Partial	-	-
119	Lot 1 DP569729	Residential	Partial	-	-
120	Lot 11 DP29081	Rural residential	Partial	-	-
121	Lot 10 DP29081	Residential	Partial	-	-
122	Lot 3 DP238092	Commonwealth Department of Defence uses	Partial	-	-
123	Lot 31 DP244610	Residential	Partial	-	-
124	Lot 32 DP244610	Residential	Partial	-	-
125	Lot 30 DP244610	Rural residential	Partial	-	-
126	Lot 8 DP29081	Residential/ business	Partial	-	-
127	Lot 1 DP1088989	Rural residential	Partial	-	-
128	Lot 6 DP29081	Rural residential	Partial	-	-
129	Lot 2 DP224861	Rural residential	Partial	-	-
130	Lot 1 DP224861	Residential	Partial	Yes (1)	-
131	Lot 7 DP4832	Residential	Partial	-	-
132	Lot 500 DP1133119	Residential	Partial	-	-
133	Lot 1 DP551558	Residential	Partial	-	-

Property ID	Property (lot number)	Existing land use*	Acquisition type	Dwellings affected	Buildings (sheds) affected
134	Lot 1 DP238092	Commonwealth Department of Defence uses	Partial	-	-
135	Lot 5 DP26658	Rural residential	Partial	-	-
136	Lot 6 DP26658	Rural residential	Partial	-	-
137	Lot 7 DP26658	Rural residential	Partial	-	-
138	Lot 1 DP711076	Residential	Partial	-	-
139	Lot 2 DP711076	Vacant	Partial	-	-
140	Lot 132 DP1002668	Residential	Partial	-	-
141	Lot 113 DP1015911	Rural	Partial	-	-
142	Lot 3 DP711076	Rural residential	Partial	-	-

Notes:

* Information on existing land use is based on a review of aerial photography and visual inspection

** strip of land located along road reserve

Roads and Maritime would acquire properties for the project in accordance with the provisions of the NSW *Property Acquisition (Just Terms Compensation) Act 1991*. Among other things, the Act provides the basis for assessing compensation.

Permanent adjustments would be required to some private properties for the project. This would generally involve adjustments to driveways, fencing and farm infrastructure due to partial property acquisition. Roads and Maritime has commenced consultation with potentially affected property owners about the acquisition process and potential adjustments required to properties for the project. Consultation would continue during the detailed design and construction phases of the project. While adjustments to properties may be a concern for affected property owners, the impact is not expected to be significant in the context of the overall project.

Access to individual properties along The Northern Road would be maintained, regardless of whether a property is affected by acquisition. However, some permanent changes may be required including the removal of right turns to and from properties located along The Northern Road. While this would result in some property owners having to travel a short distance further to access their properties, the removal of right turns would improve safety around access points and would also help to maintain smooth traffic flows.

Land use impacts during operation

About 58.05 ha of the land impacted by the project's operational footprint comprise land that is currently zoned for infrastructure, mainly transport or other infrastructure corridors. This includes the existing The Northern Road corridor, local roads and land within the WaterNSW Supply Pipelines. Where this land lies within the footprint of the project design it would remain in use as infrastructure and would be zoned accordingly. After completion of construction, the section of the existing The Northern Road that lies within the site of the Western Sydney Airport land would no longer be used as a public road.

Primary production uses comprise the largest area of land directly impacted by the project, with over 100 ha of land used for primary production, zoned for rural uses (RU), impacted by the operational footprint. This represents about 0.48 per cent of land used for primary production in the Penrith and Liverpool region. This land would become transport infrastructure and would no longer be available for primary production. Some farm infrastructure within the operational footprint of the project, in particular between Dwyer Road and Elizabeth Drive where the project would create a new road alignment, would need to be relocated prior to construction.

Land identified as 'special category' comprises nearly 25 ha of directly affected land within the operational footprint. This would mainly include Commonwealth land within the DEOH used for recreation, conservation, dams, or open space buffer. This land would be transferred to road infrastructure and would no longer be available for Department of Defence use. This land is located along The Northern Road frontage and is not expected to impact on the ongoing operations of the DEOH.

The land purchased by the Commonwealth for the Western Sydney Airport at Badgerys Creek is also identified (and zoned) as 'special category'. A narrow strip of this land would be impacted by the upgrade of The Northern Road, between Mersey Road and Willowdene Avenue, south of Luddenham and west of the existing The Northern Road alignment. That part of the planned airport site which would be impacted by the road upgrade is mostly under cultivation or pastoral use (Leppington Pastoral Company). A very small portion of the affected land currently supports some naturally vegetated areas and drainage lines. The current uses would largely be unaffected by the project.

A discussion outlining the potential impacts on the natural heritage of the DEOH site and potential change are covered in Section 8.4.

While peak flood levels would be increased as a result of the project for events up to 100 year ARI, affected areas are limited to undeveloped pastoral land. Due to the relatively steep sided nature of the drainage lines that cross the project corridor, increases in peak flood levels attributable to the project do not translate into a significant increase in the spatial extent of flood affected land for events up to 100 year ARI. Further discussion on the potential impacts of changes in yield to properties is discussed in Section 8.1.

Table 7-61 provides an overview of land use directly impacted by the operational footprint for the project.

Table 7-61 Directly affected land use within the operational footprint

Land use	Penrith LGA		Liverpool LGA		Total region	
	Land in operational footprint (ha)	Proportion of land in LGA	Land in operational footprint (ha)	Proportion of land in LGA	Land in operational footprint (ha)	Proportion of land in the region (%)
Environmental uses	1.39	0.03%	6.34	0.48%	7.73	0.14%
Primary production uses	28.38	0.22%	77.34	0.83%	105.73	0.48%
Transport and other corridors	45.04	2.72%	13.01	0.94%	58.05	1.91%
Urban	4.58	0.03%	1.35	0.01%	5.93	0.02%
Special category	22.60	0.56%	2.25	0.03%	24.85	0.23%
Total	101.99	0.28%	100.28	0.34%	202.27	0.56%

About 102 ha of land zoned for rural uses (RU) would be directly affected by the operational footprint of the project. This includes land zoned for primary production (RU1), rural landscape

(RU2) and primary production small lots (RU4). Land zoned for residential uses (R) comprises about 4.72 ha of land within the operational footprint, the majority of which is land zoned for low density residential (R2). Areas zoned for low density residential that are impacted by the operational footprint are mainly located in the Liverpool LGA. This represents a very small proportion (about 0.10 per cent) of land within the Liverpool LGA zoned for low density residential.

About 30.17 ha of land zoned for environment protection (E) would be impacted by the operational footprint, all of which is located within the Penrith LGA. This mainly includes land zoned for environmental conservation (E2) located within the DEOH, and comprises land with varying density of native vegetation cover, and ephemeral natural drainage lines. Further discussion of the project's impacts on flora and fauna is provided in Section 7-3 - Biodiversity and a discussion on the potential impacts to natural heritage is provided in section 8-4 – Non-Aboriginal heritage.

The operational footprint of the project would not directly affect land zoned for recreational use, although land within the DEOH that is zoned for special activities and used for a nine-hole golf course would be directly affected by the operational footprint of the project. This land would be transferred to road infrastructure.

The project would involve the incorporation of new or modified drainage pathways, extending from the project boundary to the nearest farm dam on a number of drainage lines where peak flows would be increased in privately owned land. In such cases, easements for drainage would be created over each drainage channel to formalise access and facilitate future maintenance.

The project would also result in some localised land use changes but would not affect the broader distribution and supply of these land uses in the project area or broader region.

Operation of the project would not have any impact on the existing exploration licence (EL 8429) which is due to expire on 20 April 2018.

Social impacts

Population and demography

The relocation of residents associated with the acquisition of residential properties and rural properties with dwellings may result in minor changes to local populations. This may include residents who have lived in the area for long periods or whose families have held properties for several generations. While these changes may result in local changes, these changes are expected to be as minor as they would represent a very small proportion of the regional population and are not expected to impact on the population and demography of the study area as a whole. These impacts are likely to add to population changes in the study area associated with property impacts for the Western Sydney Airport and current and planned urban development.

Social infrastructure

The operation of the project would contribute to improved access and connectivity to community services and facilities at the regional, State and national level, within or near to the study area, through improved travel time savings and improved travel time reliability. This includes:

- Regional level community services and facilities, such as
 - Education uses such as the University of Western Sydney, TAFE Western Sydney Institute
 - Major medical and health care facilities, including hospitals and facilities at the Nepean Hospital campus
 - Regional open space, sport and recreation uses, at Western Sydney Parklands and within central Penrith
 - Community support services and service organisations at Penrith
- National level services and facilities, such as
 - The Western Sydney Airport
 - The DEOH site
- Schools near the project, including Penrith Anglican College, and schools at Glenmore Park and Luddenham

- Community services and facilities at Glenmore Park, including sport and recreation facilities, cultural facilities, and community support services
- Services and facilities within the Luddenham town centre, including open space, recreation and cultural facilities.

This would have long-term beneficial impacts for local communities as well as communities across the broader western Sydney region. Users of some social infrastructure located near to the project may experience impacts associated with changes in local access and amenity. This is discussed further in the Access and Connectivity section below.

These impacts would be felt at the regional and national levels, through improved access not only to the planned airport site, but also to the Western Sydney Priority Growth Area and the South West Priority Growth Area. Through improved access and connectivity, the project would help to stimulate economic development that would eventually benefit local communities in terms of improved social infrastructure in the project area. The potential socio-economic cumulative impacts are further discussed in Chapter 9.

The potential long-term impacts of acquisition on community infrastructure would generally be limited to the Orchard Hills Golf Course, located next to The Northern Road, within the DEOH. Although situated within Commonwealth (Defence) land, the golf club is privately operated and is a public recreation facility. Widening of The Northern Road would require the strip acquisition of land within the golf course fronting The Northern Road. This impact may require changes to the layout of some holes (for example, some tee blocks or greens). Roads and Maritime would continue to consult with the golf club and DEOH during the detailed design phase of the project and adjustments would be made as early as possible to minimise disturbance, if required.

Community values

During operation, at a regional level, improved access and more efficient travel has the potential to provide long-term benefits for community cohesion, facilitate social interactions and improve economic transactions across the wider region. Travel facilitates social interactions and economic transactions across the wider region. Where access on major routes is constrained, people avoid making trips that have unacceptable travel times. The project would assist in decreasing travel times for these trips, helping to facilitate community interaction.

The project would include the realignment of The Northern Road around the Western Sydney Airport site and east of Luddenham town centre as well as widening of the existing The Northern Road. Adverse changes to local amenity may be experienced at those properties where The Northern Road moves closer to homes, businesses or community facilities due to the realignment or widening of the road corridor. Increased traffic noise, light spill from the roadway, and changes to the visual environment may impact on the use and enjoyment of these properties, as well as the rural character and environmental and visual amenity of local areas. This impact is likely to have the greatest effect on residents and communities in those areas that are currently removed from The Northern Road or other major roads. These include residents of rural and rural residential properties at Greendale, west of the Western Sydney Airport site, and at Luddenham, south and east of the Luddenham town centre. These potential long-term impacts are further assessed in the relevant chapters of the EIS including sections 7.1 traffic and transport, 7.2 noise and vibration and 8.5 urban design and visual.

The bypass of Luddenham town centre would result in The Northern Road being further away from homes, businesses and facilities in the Luddenham town centre and reducing through traffic, including heavy vehicles, within the town centre. This would reduce traffic noise and improve local air quality, impacting positively on local amenity and the public domain within the town. A reduction in through traffic would also support an improved pedestrian environment and safer and improved access for pedestrians, cyclists and motorists within the town centre and to adjoining areas, further improving local amenity in the town.

Access to Luddenham town centre would include a northern and southern access, which would support access for communities from these directions. Communities to the west would continue to access the town via Park Road, while the realignment of Elizabeth Drive would provide improved

and more direct access for communities east of Luddenham. As such, many people who currently access businesses, services and facilities within the town centre, including schools, churches, medical facilities, shops, and personal services businesses, are likely to continue to do so and the project is not expected to have any significant long-term impacts on any community values associated with these places as community 'meeting places'.

Economic impacts

The project would potentially have a negative impact on some local businesses, particularly in Luddenham, where businesses in the town would no longer be exposed to passing traffic. The extent of the impacts on local businesses is discussed below.

During operation, the project would support improved access and connectivity to employment areas in the study area and the western Sydney region. Some short-term loss of local employment may be associated with the acquisition of some businesses for the project. This is most likely to affect those businesses that would experience changes to business operations or that would be required to relocate, particularly if alternative properties are not able to be found locally. While the potential loss of local employment would be a concern for employees of affected businesses, this is not expected to impact on the overall levels of employment in the study area. In the broader strategic context of the study area, other planned developments associated with the Western Sydney Airport, the Western Sydney Priority Growth Area, are likely to stimulate investment and new employment opportunities that would outweigh any short-term loss of employment resulting from the project.

Operational impacts on local businesses and employment

Acquisition of land for the project would impact about 16 properties that currently accommodate non-agricultural related businesses including construction related businesses, transport and equipment hire businesses, retail and tourist related businesses.

Potential long-term impacts on businesses affected by permanent property acquisition would generally be associated with:

- Direct loss of business from property acquisition
- Demolition of dwellings associated with some home based businesses and infrastructure such as sheds and dams
- Loss of some land used for business activities (for example, tree growing, display or storage of goods, etcetera)
- Changes in access due to restriction of right turns to or from The Northern Road, increasing travel distances for some customers, employees and delivery drivers.

For most businesses, property acquisition for the project is not expected to impact on ongoing business operations for individual businesses and impacts are generally not expected to be minor. However, there are a small number of businesses that may experience impacts associated with the demolition of dwellings and other infrastructure (for example sheds, growing areas, etcetera). This may require changes to business operations or the need for some businesses to relocate, potentially impacting on the viability of some businesses over the short-term or longer term.

Impacts on these businesses are expected to be greater, although the level of impact on individual businesses would be dependent on factors such as the ability of the business to continue operating in the existing location; the nature of the business; location and site requirements; and the ability to relocate to a new property locally (if required).

The level of impact on business viability would be dependent on factors such as the ability of the business to continue operating in the existing location; the nature of the business; requirements around business location and the ability to relocate locally (if required). Temporary disruption to business operations may also occur for businesses that are required to relocate due to acquisition or where infrastructure is required to be relocated within the property. Where business properties are impacted by property acquisition, compensation for reasonable disturbance costs likely to arise

would be considered by Roads and Maritime (Roads and Maritime, 2014). This would include compensation for any temporary disruption to business operations.

Table 7-62 summarises potential impacts on individual businesses that would be directly impacted by property acquisition. The table includes a summary of impacts on properties that accommodate agribusiness enterprises. The location of impacted businesses, including agribusinesses is shown in Figure 7-13 and Figure 7-14 respectively.

Table 7-62 Potential impacts on directly affected businesses

Business	Location	Summary of impact
Eireka Pty Ltd	Corner of Kings Hill Road and The Northern Road, Mulgoa	<p>Widening of The Northern Road and upgrade of the Kings Hill Road and The Northern Road intersection would require strip acquisition of land fronting The Northern Road and Kings Hill Road. Additional land would also be temporarily leased for a construction compound. Land affected by construction and not required for operation, would be reinstated following construction.</p> <p>Affected land mainly includes grassed areas along the boundary with Kings Hill Road and The Northern Road. The project would not impact on any buildings or structures.</p> <p>Access would be maintained to Kings Hill Road, with all movement access provided at the Kings Hill Road and The Northern Road intersection.</p> <p>These impacts are not expected to impact on the ongoing operation of the business.</p>
Stones Kart Sport	Longview Road, Mulgoa	<p>Widening of The Northern Road would require the strip acquisition of land fronting The Northern Road. This land mainly includes landscaping (grass/ trees).</p> <p>The existing property access arrangements to Longview Road would be maintained.</p> <p>Changes to The Northern Road intersection would restrict right turns to and from Longview Road. All turn access to The Northern Road would be provided at Kings Hill Road, which would be accessed via Longview Road and the Vineyard Road extension.</p> <p>This would increase the distance customers would be required to travel by about one kilometre.</p> <p>These impacts are not expected to impact on the ongoing operation of the business.</p>
Complete Roofing	The Northern Road, Mulgoa	<p>Widening of The Northern Road would require the strip acquisition of land fronting The Northern Road. This land mainly includes landscaping (grass/ trees).</p> <p>The existing driveway access would be maintained, although changes to The Northern Road would restrict right turns to and from the business. This would require a u-turn to be performed at either the Kings Hill Road or Littlefields Road dedicated u-turn facility. This would increase the distance required to be travelled by up to about 3.1 km. u-turn facilities would be designed to accommodate</p>

Business	Location	Summary of impact
		<p>movements by large vehicles.</p> <p>These impacts are not expected to impact the ongoing operation of the business.</p>
GRS Towing	The Northern Road, Mulgoa	<p>Widening of The Northern Road would require the acquisition of land at the north-east and south-east corners of the property. This land mainly includes grassed areas.</p> <p>The existing driveway access would be maintained, although changes to The Northern Road would restrict right turns to and from the business. This would require a u-turn to be performed at either Kings Hill Road or Littlefields Road. This would increase the distance required to be travelled by up to about 2.9 km. U-turn facilities would be designed to accommodate movements by large vehicles.</p> <p>These impacts are not expected to affect the operation of the business.</p>
Warratah Park Puppies	The Northern Road, Mulgoa	<p>Widening of The Northern Road would require the strip acquisition of land fronting The Northern Road. None of the businesses buildings or facilities would be directly impacted by the planned acquisition.</p> <p>These impacts are not expected to affect the operation of the business.</p>
Horse N Around	Corner of Littlefields Road and The Northern Road, Mulgoa	<p>The upgrade of the intersection at Littlefield Road and The Northern Road would require the strip acquisition of land fronting Littlefields Road and The Northern Road. Affected land is located along the property boundary with Littlefields Road and The Northern Road. This land mainly includes landscaped areas (grass/ trees).</p> <p>Partial acquisition would not impact on buildings or car parking areas. Widening would result in the northbound lanes being within about 30 m of the nearest building on the property. This building is used as a retail outlet.</p> <p>Changes to property access would be needed for the project. In particular, the driveway at Littlefields Road closest to The Northern Road intersection would need to be closed for safety. Roads and Maritime would continue to consult with the property owner and business owner about possible management measures, including alternative access if required.</p> <p>Full access would be provided at the Littlefields Road and The Northern Road intersection.</p> <p>These impacts are not expected to impact on the ongoing operation of the business.</p> <p>Roads and Maritime is continuing to consult with the business owner about specific management measures to be considered in the detailed design phase.</p>
The Honey	The Northern	Widening of The Northern Road would require the strip

Business	Location	Summary of impact
Shed	Road, Luddenham	<p>acquisition of land fronting The Northern Road. The business is accommodated on a portion of a much larger agricultural property used for livestock grazing and cropping. The affected land is currently used for cropping and grazing purposes.</p> <p>Access to The Northern Road would be maintained, including for tour buses, although changes to The Northern Road would restrict right turns to and from the business. This would require u-turns to be performed at either the existing The Northern Road or Littlefields Road dedicated u-turn facility. This would increase the distance customers would be required to travel by up to about 3.2 km.</p> <p>It was suggested during consultation for this assessment that between 25-50 per cent of customers and farm gate sales were associated with passing trade. While the additional travel may be a deterrent for some 'passing' customers this is likely to be outweighed by the projected increase in traffic using The Northern Road in the future.</p> <p>A number of issues were raised during consultation for this assessment about potential impacts of the project on this business. These included uncertainty relating to the project and impacts of this uncertainty on future business decisions. Impacts on access during construction were also raised as an issue, particularly as the business attracts both domestic and international tourists, including tour buses.</p> <p>Access to the business would be maintained during construction, including for tour buses. Where temporary changes are required, consultation would be undertaken with the business owner to ensure potential impacts are managed.</p> <p>Overall, these impacts are not expected to impact on the ongoing operation of the business.</p>
Luddenham Pet Meat	The Northern Road, Luddenham	<p>Widening of The Northern Road would require strip acquisition of land fronting The Northern Road. This would potentially require the demolition of a dwelling located on the property as well as loss of landscaped areas (grass/ trees). The adjoining shed would not be impacted by the project.</p> <p>Access to The Northern Road would be maintained, although changes to The Northern Road would restrict right turns to and from the business. This would require u-turns to be performed at the existing The Northern Road and Littlefields Road. This would increase the distance customers would be required to travel by up to about 3.8 km. U-turn facilities would be designed to accommodate movements by large vehicles.</p> <p>Consultation would continue during the detailed design and construction phases of the project about potential impacts and possible management measures.</p>

Business	Location	Summary of impact
Strawberry farm	The Northern Road, Luddenham (north of Elizabeth Drive)	<p>Strip acquisition of land fronting The Northern Road would impact on a dwelling, shed and growing area next to The Northern Road. This infrastructure would need to be demolished and where practicable, relocated within the property prior to construction. This may have a temporary impact on farm gate sales.</p> <p>Less than 5 per cent of the farm's growing area would be acquired for the project. Growing areas within the remaining part of this property, not within the project's operational footprint, would remain available for growing purposes.</p> <p>Property access to The Northern Road would be maintained although changes would be made, in consultation with the property owner. Right turns to and from The Northern Road into the property would be restricted. This would require u-turns to be performed at Elizabeth Drive and Littlefields Road. This would increase the distance required to be travelled by up to about 4.4 km. U-turn facilities would be designed to accommodate movements by large vehicles.</p>
AL Tours and A & M Excavation	The Northern Road, Luddenham	<p>Widening of The Northern Road would require the strip acquisition of land fronting The Northern Road. This would potentially impact a dwelling located on the property as well as grassed areas. The sheds on the property would not be impacted by the project.</p> <p>Access to The Northern Road would be maintained, although changes to The Northern Road would restrict right turns to and from the business. This would require u-turns to be performed at the existing The Northern Road and Littlefields Road. This would increase the distance to be travelled by up to about 4.4 km. U-turn facilities would be designed to accommodate movements by large vehicles.</p> <p>Consultation would continue during the detailed design and construction phases of the project about potential impacts and possible management measures.</p>
Top Shape Live Christmas Trees	Corner of The Northern Road and Elizabeth Drive, Luddenham	<p>Partial acquisition of this property would be required for the realignment of Elizabeth Drive. The realignment would sever land containing two dwellings, sheds and areas used for tree growing. Land affected by construction and not required for operation, would be reinstated following construction. This would result in the permanent loss of land used for growing trees. Dwellings and sheds within the operational footprint would also be demolished prior to construction.</p> <p>Additional land may also be temporarily leased for a construction compound. Land affected by construction and not required for operation, would be reinstated following construction. These impacts are likely to affect business operations. Roads and Maritime would continue discussions with the business owner to identify measures to</p>

Business	Location	Summary of impact
		manage any disruptions to business operations associated with any requirement to relocate.
Primary production	2422-2430 The Northern Road, Luddenham	<p>The route alignment around the Luddenham town centre would require the partial acquisition of land used for the primary production (cattle). The affected land mainly comprises grazing land and dam infrastructure.</p> <p>Access to each lot would be directly onto the realigned The Northern Road via a left in left out driveway arrangement.</p>
Primary production	28 Eaton Road, Luddenham	<p>The route alignment around the Luddenham town centre would bisect the lot and require the partial acquisition of land used for the primary production (cattle). The affected land mainly comprises grazing land and dam infrastructure.</p> <p>Access to the main parcel of land would be maintained via Eaton Road. Access to the residual parcel of land would be directly onto the realigned The Northern Road via a left in left out driveway arrangement.</p>
Shell service station	The Northern Road, Luddenham	<p>The realignment of Eaton Road may require the strip acquisition of a small area of land fronting Eaton Road. This land does not appear to be used apart from a small area of garden bed. Strip acquisition may result in the loss of part of the garden bed. The loss of this land is not expected to impact on the ongoing operation of the business.</p> <p>Access to the service station would be maintained to the existing The Northern Road alignment in Luddenham town centre.</p>
Triple A Christmas Tree Farm/Naro Pty Ltd	Between The Northern Road and Eaton Road, Luddenham	<p>The route alignment around the Luddenham town centre would require the partial acquisition of land used for growing trees at Eaton Road. This would result in the permanent loss of this land for tree growing. The remaining part of this property not within the operational footprint would continue to be available for tree growing.</p> <p>The route realignment south west of the existing The Northern Road would also impact on an associated property adjacent to the Luddenham town centre. The affected land mainly comprises grazing land and dam infrastructure. This would result in the loss of this grazing land. Dam infrastructure affected by the project would need to be relocated. The project is not expected to impact on areas used for tree growing or Christmas tree sales on this property.</p> <p>The project would change access between Eaton Road and Luddenham town centre, with the existing right turn to/ from Eaton Road no longer possible. Access from Eaton Road to Luddenham town centre would be via a new intersection at the southern end of Luddenham. Access from Luddenham town centre to Eaton Road would be via the intersection at Elizabeth Road at the northern end of the town. This would increase travel distance by up to about 4.7 km. This may</p>

Business	Location	Summary of impact
		increase transport costs for the business owner.
Market garden and cattle	350-370 Willowdene Avenue, Luddenham	<p>The route alignment around the Western Sydney Airport site would bisect the lot and require the partial acquisition of land used for a market garden and cattle. The affected land mainly comprises grazing land and dam infrastructure.</p> <p>The project would remove direct access between the remaining two parcels. Access from residual parcel to another would be via left in left out access from the realigned The Northern Road. This would increase the travel distance by up to about 3.8 km to access the residual lot.</p>
Leppington Pastoral Company (LPC)	The Northern Road, Greendale	<p>Acquisition of land for the project would result in severance of two areas of land within the LPC Base Farm, and would also result in the demolition of three sheds and relocation of some irrigation, communications and other utilities infrastructure.</p> <p>The facilities and infrastructure would be demolished and where practicable, relocated within the Base Farm, prior to construction and in consultation with the farm owners.</p> <p>The severed parcels of land would be re-connected through the inclusion of an underpass of The Northern Road to the main Base Farm, to provide access for dairy cattle. Farm machinery and other vehicles would be able to cross The Northern Road via the signalised southern access for the Western Sydney Airport, providing all movement access for motorists entering the property.</p> <p>These impacts are not expected to impact on the ongoing operation of the business.</p>
Southern Cross Truck Rentals	Corner Dwyer Road and The Northern Road, Bringelly	<p>Widening of The Northern Road would require the strip acquisition of land fronting The Northern Road. Affected land mainly includes grassed areas. The project would not impact on any buildings or structures.</p> <p>Access would be maintained to Dwyer Road. Right turn access to and from The Northern Road would be restricted at Dwyer Road. This would require u-turns to be performed at either the Western Sydney Airport access or Mersey Road dedicated u-turn facility. This would increase the distance to be travelled by up to about 4.6 km. U-turn facilities would be designed to accommodate movements by large vehicles.</p> <p>These impacts are not expected to impact on the ongoing operation of the business.</p>
Grassington Alpacas	Corner Dwyer Road and The Northern Road, Bringelly	<p>Widening of The Northern Road would require the strip acquisition of land fronting The Northern Road. Affected land mainly includes grassed areas. The project would not impact on any buildings or structures.</p> <p>Access would be maintained to Dwyer Road. Right turn</p>

Business	Location	Summary of impact
		<p>access to and from The Northern Road would be restricted at Dwyer Road. This would require u-turns to be performed at either the Western Sydney Airport access or Mersey Road dedicated u-turn facility. This would increase the distance to be travelled by up to about 1.6 km. U-turn facilities would be designed to accommodate movements by large vehicles.</p> <p>These impacts are not expected to impact on the ongoing operation of the business.</p>
Pressure Welding Australia	1615 The Northern Road Bringelly	<p>Widening of The Northern Road would require the strip acquisition of land fronting The Northern Road. Affected land mainly includes grassed areas. The project would not impact on any buildings or structures.</p> <p>Access would be maintained via The Northern Road. Right turn access to and from The Northern Road would be restricted from the property. This would require u-turns to be performed at either the Western Sydney Airport access or Mersey Road dedicated u-turn facility. This would increase the distance to be travelled by up to about 1.6 km. U-turn facilities would be designed to accommodate movements by large vehicles.</p> <p>These impacts are not expected to impact on the ongoing operation of the business.</p>

During operation and at a regional State and national level, the project would have long-term beneficial impacts on business and industry through improved access and connectivity to growth areas in Western Sydney. The upgraded corridor would cater for traffic growth expected along The Northern Road corridor associated with increased residential and commercial development in the South West Priority Growth Area, Western Sydney Priority Growth Area and nearby areas, by improving road and intersection capacity. Additionally, the project would provide connectivity to the Western Sydney Airport through the provision of high capacity traffic and freight links between the airport and the M4 Western Motorway, and south western Sydney, (including Campbelltown, the F5 Freeway / M5 South-West Motorway, and the planned M12 Motorway).

This would have long-term beneficial impacts for regional and national business and industry, as improved connectivity associated with the project would add to the economic stimulus that would be generated by the Western Sydney Airport and the planned development of the surrounding strategic growth areas. The project would also improve road safety and provide long-term improvements to public and active transport facilities, promoting sustainable and efficient journeys. The potential socio-economic cumulative impacts are further discussed in Chapter 9.

Locally, once operational, the project would improve road safety and accessibility, supporting general improvements to local business and industry in the study area. However, the project would restrict right turn access to businesses along The Northern Road. Access to businesses along The Northern Road would be restricted to left-in and left-out access only. U-turn facilities would be provided at locations along The Northern Road alignment or on nearby roads. This would require changes in how some customers access individual businesses in the study area and would result in increases in travel distances for some businesses and business customers and suppliers.

For many businesses, the additional travel distance required would be up to about 3.0 km (or about three minutes), although for some businesses, this would be up to about 5.9 km (or about five minutes). Outside of Luddenham town centre, the majority of businesses affected by access changes include home based businesses. They comprise of construction related businesses,

transport services, plant and equipment hire, agricultural businesses, recreational uses, and specialist retail (for example, equestrian, pet and rural supplies), which are likely to be less reliant on passing trade. While the additional travel may be a deterrent for some 'passing' customers of businesses outside of Luddenham town centre, any possible reduction in passing trade is likely to be minor and would be off-set in part by the increased exposure to potential customers associated with the projected increase in traffic using The Northern Road in the future. Business and car park surveys indicated that businesses in the Luddenham town centre attract customers from across the study area and wider region. The majority of customers are generally drawn from localities within about 20 km of Luddenham, although some customers travel much further to access particular businesses.

Feedback from the survey of business owners identified passing trade as important to a number of businesses, such as service stations and cafes. It was estimated by these business owners that passing trade accounted for more than about 75 per cent of their customers. These businesses may potentially be affected by a reduction in through traffic within the Luddenham town centre. Following the implementation of the bypass, businesses in the town are likely to continue to be attractive for customers from across the study area and wider region. Access to Luddenham town centre would be maintained from the new The Northern Road alignment from the north and south. This would allow motorists, including potential passing trade, to continue to travel through the town centre, without needing to 'back-track', which would support access for customers from these areas. In addition, the realignment of Elizabeth Drive would provide improved and more direct access for customers east of Luddenham. This is likely to contribute to businesses in the Luddenham town centre remaining accessible and attractive to customers who prefer to access services within the town centre and assist in maintaining a level of passing trade.

A small number of businesses also indicated that 'passing trade' made up a relatively small proportion of their customers. These mainly included service industries. Feedback from the business survey also suggested that people often preferred to access some services in Luddenham rather than Penrith as businesses tend to provide easier parking, are more accessible and the town is less busy. A reduction in through traffic, particularly heavy vehicles, would help to enhance business amenity and improve local access within the town. This was seen as a benefit for customer access by some business owners, as was improved road safety provided by the project.

With the project, traffic volumes within the Luddenham town centre are expected to reduce in the short-term (2021) from existing traffic volumes. However, over the longer term (2031), traffic volumes are expected to return to levels similar to existing traffic volumes, mainly due to growth and development associated with the Western Sydney Airport and urban development within the region. Without the bypass, traffic levels in Luddenham town centre would continue to increase, impacting on business amenity within the town centre and customer access to local businesses. This may reduce the attractiveness of businesses within the town for some customers, who currently value the ease of access offered by local businesses. Further information about traffic impacts during operation is provided in Section 7-1.

A reduction in traffic within the town centre may reduce levels of trade for those businesses that currently rely on passing traffic for their customers. Businesses surveyed for this assessment that felt most at risk from a reduction in traffic included service stations, cafés and some retail uses. Reduced trade associated with reductions in traffic could potentially have flow on effects on local employment for some businesses. The extent of impact on individual businesses is unknown and would depend on a range of factors for example, existing business operations and viability, any proposed future plans, and the nature of the business.

Reduced trade associated with a reduction in traffic in the short-term may be off-set in part by increased construction activity within the study area associated with the development of the second Sydney airport and urban development projects. This would result in an increase in construction workers in areas within or near the study area and potentially demand for goods and services locally and regionally.

The increased development and population growth occurring more broadly in the study area may have a positive long-term impact on businesses and support increased customers over time. In the longer term, this would assist in offsetting in part the impacts of the bypass. In the short-term, ensuring local communities and business customers are aware of changes in access to local businesses would be important to minimising potential business impacts associated with local road changes. It is likely that any potential impacts on businesses associated with changes in customer access would reduce over time as customers and local and regional communities become familiar with the new access arrangements, and are not expected to be significant in the context of the project as a whole.

Agricultural impacts

The project would directly impact a total of about 104.2 ha of agricultural land in the study area, including land used for cropping, grazing, horticulture and intensive animal production. This represents about 0.5 per cent of agricultural land in the wider Penrith and Liverpool region.

Acquisition for the project would impact on land used for dairy farming, honey production, grazing, cropping and horticulture. Potential impacts on directly affected agricultural businesses would generally be associated with:

- Loss of productive land, including land used for pasture, feed crop and horticulture production
- Impact on farm infrastructure such as dams, irrigation, fencing, sheds and storage areas, and other facilities
- Severance or fragmentation of larger agricultural properties, potentially isolating some parts of agricultural properties and impacting on the efficiency of farm management, and farming operations associated with the movement of livestock and/ or farm machinery and equipment
- Potential impacts on the movement of farm equipment and livestock, including between different areas of farming properties
- Changes to farm access, including for vehicles transporting produce or delivering farming equipment and supplies.

Urban development is placing pressure on the agricultural industry in the study area and wider region and reducing agriculture land availability. Acquisition of land for the Western Sydney Airport has also impacted on farming land in the region. While this land continues to be used for farming purposes, future development of the airport would result in the loss of land currently being used for agricultural purposes. This is discussed further in Chapter 9 – Cumulative impacts.

The project would result in the severance or fragmentation of some larger rural properties particularly around the Luddenham bypass where the project moves away from the existing The Northern Road corridor. Severance impacts have mainly been avoided by locating the realigned road corridor near property boundaries, however, were unavoidable near the Luddenham bypass due to the realignment of The Northern Road for the Western Sydney Airport. The main location where the realigned corridor has resulted in the severance of agricultural land is at the LPC property at Bringelly. The project would maintain internal property access to the isolated land parcel east of The Northern Road corridor through the provision of a livestock underpass of The Northern Road. While these changes are likely to be important to the operators of LPC Base Farm, the impacts are not expected to be significant in the context of the project as a whole.

Where partial acquisition of agricultural properties occurs, farm infrastructure such as fencing, dams, sheds and other structures, within the project footprint would need to be demolished due to the project. While adjustments to properties may be a concern for affected property owners, the impact is not expected to be significant in the context of the overall project. Consultation would be undertaken with agricultural property owners about potential impacts on farm infrastructure and adjustments required to things such as fencing, farm infrastructure and relocation of impacted structures.

Access to agricultural properties would be maintained by the project, although permanent changes may be required for some properties due to intersection changes and restrictions on some turning movements.

Access and Connectivity

During operation, the project would improve regional access and connectivity for motorists and other road users, through reduced travel times and improved connections to the regional road network, major centres and key growth areas in the western Sydney region; and improved road safety and driving conditions. This would have positive long-term impacts for private motorists as well as commercial and business travellers.

At a local level, the project would improve access and connectivity to and from areas surrounding the project, including within the Luddenham town centre. The existing The Northern Road would continue to provide local access for residents, businesses and visitors and for motorists wanting to connect to the new road. The realignment of The Northern Road to bypass Luddenham town centre would help to reduce through traffic within the town centre. This would support improved access and connectivity to homes, businesses and facilities within the town centre and to surrounding areas, including for motorists, pedestrians and cyclists.

The project would involve the bypass of Luddenham town centre, restrictions to right turns to and from businesses along The Northern Road and some local streets, and upgrade of some intersections. Access to businesses along The Northern Road would be provided by left-in and left-out access only. U-turn facilities would be provided at locations along The Northern Road alignment or on nearby roads. This would require changes in how some customers access individual businesses in the study area and would result in increases in travel distances for some businesses and business customers.

Once operational, the project would improve active transport opportunities within the study area by providing a new shared path for pedestrians and cyclists on the western side of the road and new pedestrian footpath on the eastern side of the road where warranted. Pedestrian crossings would also be provided at upgraded intersections, which would also support improved access and safety outcomes for pedestrians and cyclists. The bypass of Luddenham would also provide opportunities to improve access for pedestrians and cyclists within the town centre.

7.4.5 Summary of impacts to the environment of Commonwealth land

A summary of potential socio-economic impacts to the environment of Commonwealth land as a result of construction and operation of the project is provided in this section. Affected Commonwealth land includes the DEOH land, and land that has been acquired by the Commonwealth for the purposes of developing the Western Sydney Airport at Badgerys Creek.

Potential construction impacts

During construction, the project's construction footprint would encroach into DEOH land, along most of this site's boundary with The Northern Road, within a strip of land of varying width. While the extent of encroachment of construction into the DEOH land would be large, the main facilities within the DEOH site are not situated within the construction footprint and would not be directly affected. Construction of the project would impact upon the natural and physical resources within the construction footprint of the DEOH site, including the removal of Cumberland Plain Shale Woodland and Riverflat Eucalyptus Forest communities and their associated habitat. The impact to biodiversity on Commonwealth land is discussed further in Section 7.3. While construction noise and dust would potentially impact on the DEOH land, these impacts are considered to be minor and would not require additional management measures over and above those listed in Section 7.4.6.

Construction would also encroach into DEOH land that is currently part of the Orchard Hills Golf Club, resulting in impacts to the recreational value of the land from the loss of some playable land comprising some greens and fairways. The extent of these impacts is illustrated in the property acquisition maps attached to Appendix J. In addition, construction would result in some loss of

amenity on the golf course due to potential construction noise and dust issues. The construction impacts on the environment of Commonwealth land within the golf club are considered to be moderate, and would be managed through the implementation of measures outlined in Section 7.4.6.

During construction the project would also potentially impact on Commonwealth land at the site of the Western Sydney Airport. A small area of airport land, most of which is currently primarily used for rural purposes, would be impacted by construction. Similar to the DEOH site, the project would impact upon the natural and physical resources within the construction footprint of the site, including the removal of Cumberland Plain Woodland and Riverflat Eucalyptus Forest communities and their associated habitat. The impact to biodiversity on Commonwealth land is discussed further in Section 7.3. A discussion on the potential impacts to natural heritage is provided in Section 8.4 – Non-Aboriginal heritage. The nature of the impact would be in relatively narrow strips of land, the impact of which would be minor in socio-economic terms. Two construction compound sites (C5 and C7; see Figure 5-12) would potentially impact on airport land however the use of these two sites would be temporary and the land would revert to its current (or planned) use after the project's construction is complete. The nature and significance of the project's likely socio-economic effects on the environment of Commonwealth land at the Western Sydney Airport site during construction would be the same as the impacts described and assessed above in Section 7.4.3.

Potential operation impacts

During the project's operation, acquisition of Commonwealth land within the DEOH (including the Orchard Hills Golf Club) and the site of the Western Sydney Airport would result in permanent change to the use of the affected land, most of which is currently used for either rural or recreational (golf club) purposes. Within the DEOH land, land acquisition would comprise a strip of land of varying width. In the long-term the project's operation would result in little or no impact to the socio-economic environment of Commonwealth land, as the current uses (Defence, recreation) would continue and the planned future use of land for the Western Sydney Airport would not be affected or compromised.

7.4.6 Environmental management measures

Table 7-63 outlines environmental management measures that have been developed to specifically manage potential socio-economic impacts of the project.

Expected environmental outcomes

Project-specific environmental management measures have been developed with the aim of minimising or mitigating, as far as practical, potential socio-economic impacts of the project's construction and operation. These are described in Table 7-63.

Broadly, the expected environmental outcomes of the environmental management measures are to avoid or minimise impacts on communities, businesses and social infrastructure from the construction and operation of the project. Broad outcomes that would be achieved through:

- Implementation of environmental management measures, for example noise and dust mitigation, and traffic management strategies
- Early and ongoing consultation and communication to ensure local and regional communities, businesses, transport users and managers of community facilities are informed about the project's construction and operation
- Relocation of affected farm infrastructure in consultation with affected property owners.

Expected effectiveness

Roads and Maritime have experience in managing potential impacts on local and regional communities and businesses as a result of road developments of a similar scale and scope to this project.

Many of the mitigation measures outlined involve effective and ongoing communications with the community and affected land owners. Should the project be approved, it is anticipated conditions of approval for the project would require preparation of a Draft Community Involvement Plan (CIP), Community Communications Strategy (CCS) or similar document for the construction phase of the project. Community and stakeholder involvement would be tailored to each phase of the project enabling appropriate consideration and balancing of community and stakeholder's social, economic, environment and functional issues to achieve best for project outcomes. A key approach to consultation would be to provide two-way communication channels enabling timely intervention aimed at resolving issues raised by the community and stakeholders.

As such, the environmental management measures outlined in Table 7-63 are expected to be effective, given the communities ability to provide feedback on their effectiveness to Roads and Maritime.

Roads and Maritime will, in consultation with Liverpool Council, provide appropriate support for preparation of plans to revitalise Luddenham town centre, for the purpose of encouraging motorists to continue to pass through or visit the town. Any streetscape and landscape treatments would be determined after finalisation of any town centre revitalisation plans. The effectiveness of this consultation would only be measured once any actions or recommendations that are discussed are implemented. As such, at this stage it is difficult to accurately assess the likely effectiveness of this mitigation.

The Construction Environmental Management Plan (CEMP) prepared prior to construction would also address the requirements of the project approvals, the environmental management measures outlined in the EIS and all applicable legislation. With regard to socio-economic aspects, mitigation measures are expected to minimise and manage impacts on community life throughout the construction phase. The local and broader community would be notified in advance of construction activities, temporary arrangements, traffic management arrangements and any special construction activities of short duration. As such, impacts to the community are expected to be relatively minor and temporary.

Audits and reporting on the effectiveness of environmental management measures is generally carried out to show compliance with management plans and other relevant approvals and would be outlined in detail in the CEMP prepared for the project.

Table 7-63 Socio-economic and land use environmental management measures

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
General impacts	SE-1	<p>A Draft Community Involvement Plan would be prepared to guide community engagement during construction of the project and would be updated throughout construction. Communication would be with the local community, stakeholders and the wider region. The Draft Community Involvement Plan includes:</p> <ul style="list-style-type: none"> • Guiding principles overall approach to community and stakeholder involvement • A comprehensive list of identified stakeholders • A register of specific issue communications strategies • Requirements for the project regarding access to information, complaints and inquiries procedures and community consultation • A range of communication tools applicable to the project • Contact names and details • Complaints procedures 	Construction contractor / Roads and Maritime	Construction	<p>Proven to be effective.</p> <p>To ensure flexibility in the communications approach to the project, communications and engagement activities would be monitored, assessed and reported regularly.</p>
	SE-2	Areas affected by construction would be reinstated and restored in accordance with the urban design and landscape strategy	Construction contractor	Construction	See Chapter 8.5

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
Noise and vibration during construction and operation	SE-3	Mitigation measures specific to construction noise and vibration can be found in Section 7-2 of the EIS for this project	Construction contractor/ Roads and Maritime	Pre-construction and during construction	See Chapter 7.2
Air quality during construction and operation	SE-4	Mitigation measures specific to construction air quality can be found in Section 8-6 of the EIS for this project	Construction contractor/ Roads and Maritime	Pre-construction and during construction	See Chapter 8.6
Property acquisition	SE-5	Provide appropriate compensation in accordance with the (NSW) <i>Land Acquisition (Just Terms Compensation) Act 1991</i> for properties to be partially or fully acquired for the project	Roads and Maritime	Pre-construction	N/A
	SE-6	Impact from the acquisition on owners' remaining holdings would be considered in the acquisition process. As required and in consultation with owners, Roads and Maritime would engage the use of appropriately qualified professionals to carry out property assessments and identify alternate opportunities for any remaining land holdings	Roads and Maritime	Pre-construction	N/A
	SE-7	Undertake property adjustments and relocation of infrastructure (for example, fencing, dams, property access) in consultation with the property owner	Construction contractor	Construction	Expected to be effective if carried out in accordance with consultation requirements
	SE-8	Undertake any adjustments to the Orchard Hills golf course, in consultation with the managers of the Orchard Hills Golf Club	Roads and Maritime/ Construction	Construction	Expected to be effective if carried out in accordance with consultation requirements.

Chapter 7 – Assessment of key Issues

The Northern Road Upgrade – Mersey Road, Bringelly to Glenmore Parkway, Glenmore Park
Environmental impact statement / draft Environmental Impact Statement

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
			contractor		
Business and economic activity	SE-9	On-going consultation with local business owners, including owners of agricultural businesses, located close to construction works about the timing, duration and likely impact of construction activities on their business operations would be carried out	Construction contractor/ Roads and Maritime	Construction	Expected to be effective. To ensure flexibility in the communications approach to the project, communications and engagement activities would be monitored, assessed and reported regularly.
	SE-10	Relocate and/or remove farm infrastructure, including farm dams, as required and in consultation with affected land owners	Construction contractor	Construction	Expected to be effective if carried out in accordance with consultation requirements.
	SE-11	Maintain a business impact risk register to identify and manage the specific impacts associated with construction related works for individual businesses	Construction contractor	Construction	Expected to be effective. Monitoring and exporting would be required to measure the effectiveness.
	SE-12	Access to existing businesses would be provided on a continuous basis throughout the construction of the project	Construction contractor	Construction	Proven to be effective. Access arrangements would be outlined in the TMP, the effectiveness of those arrangements and the need for any alternative and/or temporary access arrangements would be agreed with affected property owners.

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
	SE-13	Appropriate road signage would be provided in accordance with the Roads and Maritime Services guidelines Tourist Signposting (2012) to provide guidance to passing patrons on access to shops and services, including within Luddenham town centre	Construction contractor	Construction	Proven to be effective.
	SE-14	Roads and Maritime will, in consultation with Liverpool Council, provide appropriate support for preparation of plans to revitalise Luddenham town centre, for the purpose of encouraging motorists to continue to pass through or visit the town. Any streetscape and landscape treatments would be determined after finalisation of any town centre revitalisation plans	Roads and Maritime	Operation	Expected to be effective. Roads and Maritime have experience with similar bypass projects in NSW, effectiveness of this consultation would only be measured once any actions or recommendations that are discussed are implemented
	SE-15	Roads and Maritime would undertake the project in accordance with the NSW Government Policy on Aboriginal Participation in Construction (NSW Finance and Services 2016)	Roads and Maritime / Construction contractor	Construction	Expected to be effective. Contractors for all projects covered by this policy must provide an Aboriginal Participation Plan to the contracting agency within 60 days of the contract being awarded.
Access and connectivity	SE-16	The Traffic Management Plan would include a signage strategy (consistent with Roads and Maritime policy) to provide guidance to passing patrons on access to shops, services and businesses during construction	Construction contractor	Construction	Proven to be effective. Monitoring and reporting requirements of the TMP to confirm effectiveness of measures.

Impact	Ref #	Environmental management measures	Responsibility	Timing	Effectiveness of measures
	SE-17	Access to properties would be provided on a continuous basis throughout the construction of the project Where temporary changes to property access are required, alternate access should be determined in consultation with affected property owners and tenants	Construction contractor	Construction	Proven to be effective. Access arrangements would be outlined in the TMP, the effectiveness of those arrangements and the need for any alternative and/or temporary access arrangements would be agreed with affected property owners.
	SE-18	Access for pedestrians and cyclists near construction works would be maintained, including consideration of pedestrian access needs for elderly people, children and people with disability	Construction contractor	Construction	Proven to be effective. Monitoring and reporting requirements of the TMP to confirm effectiveness of measures.
	SE-19	Mitigation measures specific to Traffic and Transport can be found in Section 7-1 of the EIS for this project	Construction contractor	Construction	See Chapter 7.1
Cumulative impacts	SE-20	Mitigation measures specific to cumulative impacts can be found in Chapter 9	Refer to Chapter 9	Refer to Chapter 9	See Chapter 9

7.4.7 Residual Impacts

Residual impacts are defined as those impacts that remain following the implementation of mitigation measures. A summary of residual socio-economic impacts is presented below, including reasoning as to why avoidance or mitigation of these impacts would not be achieved.

Construction

Potential residual socio-economic impacts that may occur as a result of construction include:

- Short-term changes to traffic and access, including reduced travel speeds, increased delays near construction works and temporary changes to accessibility for pedestrians and cyclists. This may require some motorists, pedestrians or cyclists to travel further to reach their destination. This would be necessary to ensure construction work is carried out safely. This impact would be minor and is not considered to be significant.
- Short-term changes in local amenity for some residents, businesses and visitors near the project, associated with increased noise and dust. Overall, these impacts would be temporary and are expected to be managed to an acceptable level, although, some people may experience ongoing amenity impacts that affect the use and enjoyment of their property. This impact is not considered to be significant.

Due to the application of effective environmental management measures, especially ongoing communications, residual, negative socio-economic effects to the community and business in Luddenham and along the entire proposed alignment from construction activities are considered to be temporary and of an acceptable nature.

Construction of the project would also result in short-term beneficial residual impacts to businesses in the Luddenham area.

Operation

Potential residual socio-economic impacts that may occur during the project's operation may include:

- Impacts on community cohesion through disruption to social networks and community relationships. This impact would be associated with property acquisition for the project and would mainly relate to individuals who are required to move away from the area. However, there are unlikely to be residual impacts on community cohesion in the socio-economic study area as a whole, and the overall impact on community cohesion is not considered to be significant.
- Impacts on the amenity and well-being of individuals who are required to move from their property as a consequence of property acquisition. This impact is considered to be substantial in terms of the effect on some individuals who would be directly affected.
- Permanent loss of some land used for agricultural, commercial and residential uses, associated with acquisition of property and change in land use to transport corridor. This would be necessary due to the design of the project and is not expected to be significant in the context of the region as a whole.
- Changes in local access and connectivity for local residents, businesses and visitors. These changes may require some motorists to travel further to access residential properties, businesses and other facilities near the project and within surrounding areas. This would be necessary due to the design of the project, and is not considered to be a significant impact.
- The median would assist in improving road safety by removing the need for opposing-lane overtaking and the associated risk of head-on crashes. The additional travel distance is considered to be moderate, for those motorists affected by traffic detours, but is not considered to be significant.

- Short term and long-term impacts on local businesses and employment, resulting from acquisition of land that is currently used for business purposes.

As discussed above in Section 7.4.4 however, in the longer term the developments planned for this part of western Sydney, including the Western Sydney Airport, are likely to stimulate new business and employment opportunities that would outweigh any residual short-term negative economic impacts resulting from the project.

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