



Urban Design and Visual Impact Assessment Technical Paper

**The Northern Road Upgrade,
Mersey Road to Glenmore Parkway**

Version 10 - 08 March 2017

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The Northern Road Upgrade between Mersey Road and Glenmore Parkway

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Prepared for



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CONTENTS

1.	INTRODUCTION	1
1.1	PURPOSE	1
1.2	STRUCTURE OF THIS TECHNICAL PAPER	2
1.3	THE STUDY AREA	3
1.4	BACKGROUND	3
1.5	ASSESSMENT GUIDELINES	4
1.6	STUDY METHOD	5
2.	CONTEXTUAL ANALYSIS	8
2.1	LOCATION	8
2.2	PLANNING CONTEXT	12
2.3	URBAN DESIGN GUIDANCE	19
2.4	EXISTING SITE CONDITIONS	20
2.5	SUMMARY OF KEY FINDINGS	41
3.	DESCRIPTION OF THE PROJECT	43
3.1	OVERVIEW	43
3.2	A NOTE ON LANDSCAPE CHARACTER AND VISUAL IMPACTS	46
4.	URBAN DESIGN OBJECTIVES	53
4.1	URBAN DESIGN VISION FOR THE NORTHERN ROAD	53
4.2	URBAN DESIGN OBJECTIVES AND PRINCIPLES	54
5.	URBAN DESIGN CONCEPT	61
5.1	OVERVIEW	61
5.2	URBAN DESIGN STRATEGY	62
5.3	ROAD DESIGN ELEMENTS	66
5.4	LANDSCAPE DESIGN	70
5.5	URBAN DESIGN CONCEPT	73
6.	LANDSCAPE CHARACTER IMPACT	97
6.1	LANDSCAPE CHARACTER ASSESSMENT	97
6.2	LCZ 1: BRINGELLY	99
6.3	LCZ 2: DUNCANS CREEK	104
6.4	LCZ 3: LUDDENHAM PLATEAU	108
6.5	LCZ 4: COSGROVE CREEK	114
6.6	LCZ 5: MULGOA-ORCHARD HILLS	118
6.7	SUMMARY OF LANDSCAPE CHARACTER IMPACTS	123

CONTENTS

7.	VISUAL IMPACT	125
7.1	VISUAL IMPACT ASSESSMENT	125
7.2	VIEWPOINT 1	128
7.3	VIEWPOINT 2	130
7.4	VIEWPOINT 3	132
7.5	VIEWPOINT 4	134
7.6	VIEWPOINT 5	136
7.7	VIEWPOINT 6	138
7.8	VIEWPOINT 7	140
7.9	VIEWPOINT 8	142
7.10	VIEWPOINT 9	144
7.11	VIEWPOINT 10	146
7.12	VIEWPOINT 11	148
7.13	VIEWPOINT 12	150
7.14	VIEWPOINT 13	152
7.15	VIEWPOINT 14	154
7.16	VIEWPOINT 15	156
7.17	VIEWPOINT 16	158
7.18	VIEWPOINT 17	160
7.19	VIEWPOINT 18	162
7.20	VIEWPOINT 19	164
7.21	VISUAL IMPACT ASSESSMENT SUMMARY	166
8.	MITIGATION STRATEGY	169
8.1	MITIGATION TO BE INCORPORATED IN DETAILED DESIGN	169
8.2	MITIGATION DURING CONSTRUCTION	171
8.3	RESIDUAL IMPACTS	171
9.	CONCLUSION	173
10.	References	175

I. INTRODUCTION

1.1 PURPOSE

This Urban Design Technical Paper has been prepared by Spackman Mossop Michaels (SMM) for Roads and Maritime Services (Roads and Maritime). It contains the urban design concept and the Landscape Character and Visual Impact Assessment (LCVIA) for the proposed upgrade of The Northern Road (the project) between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park, in the Liverpool and Penrith Local Government Areas (LGAs).

This paper supports and forms part of the Environmental Impact Statement (EIS) prepared by Jacobs for the project. It addresses the environmental assessment requirements set out by

- Roads and Maritime *Environmental Impact Assessment Practice Note. Guideline for Landscape Character and Visual Impact Assessment. EIA-N04* (EIA-N04)
- The Secretary's Environmental Assessment Requirements (SEARs) issued under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)
- The Commonwealth EIS Guidelines, as per the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

SMM has worked on this project in conjunction with the Roads and Maritime project development team, the Roads and Maritime Centre for Urban Design, Roads and Maritime specialist advisors and planners, and engineers and technical staff from Jacobs.

In addition to supporting the environmental assessment process, this technical paper seeks to facilitate an integrated urban design and engineering outcome for the project, consistent with Roads and Maritime policy. Integration of the LCVIA in the development of the engineering design highlights potential issues as well as opportunities to minimise or avoid potential impacts during concept development. Should the project be approved, the LCVIA provides guidance for the development and refinement of the concept design to ensure good urban design outcomes.

INTRODUCTION

1.2 STRUCTURE OF THIS TECHNICAL PAPER

Consistent with *EIA-N04*, the structure of this technical paper is as follows:

1. **Introduction**
Introduction and overview.
2. **Contextual analysis**
An overview of the study area and surrounding context, including a brief overview of relevant planning documents and existing site conditions including physical and urban design aspects of the area.
3. **Description of the project**
The description summarises the main features of the project, including the underlying design parameters. Key features of the proposed upgrade are illustrated on an overview plan and typical sections.
4. **Urban design objectives**
The agreed urban design vision, objectives and principles adopted for the project.
5. **Urban design concept**
The urban design concept defines the urban design concept for the project. It includes an illustrated urban design strategy, detailed recommendations for road design elements, and landscape design principles. The concept design is illustrated in a series of plans and cross sections. The urban design concept provides the basis for the development of detailed designs, should the project be approved.
6. **Landscape character impact**
The landscape character impact assessment determines the likely impact on the landscape character as a result of the project, giving regard to both the magnitude of the project and the sensitivity of the landscape to change.
7. **Visual impact**
The visual impact assessment identifies the area from which the project is likely to be seen, followed by an assessment of the likely impact of the project on a number of select views. The visual impact results from the combination of the magnitude of the project and the sensitivity of the chosen view.
8. **Mitigation strategy**
The mitigation strategy identifies a series of measures to avoid or reduce the identified visual and landscape character impacts, as well as recommendations towards better realisation of the project urban design objectives. They are provided for consideration and to guide the future design stages. The Mitigation strategy also discusses residual impacts. These are lasting impacts that will not be able to be removed through the application or implementation of mitigation measures.
9. **Conclusion**
Summary of key findings.

INTRODUCTION

1.3 THE STUDY AREA

The study area comprises an approximately 1.6 kilometre section of The Northern Road between Mersey Road in Bringelly and Glenmore Parkway in Glenmore Park. It includes the diversion of The Northern Road around the site of the Western Sydney Airport and a bypass around the Luddenham town centre - refer **Figure 3**.

1.4 BACKGROUND

The Northern Road is located in the west of the Sydney Metropolitan Region, about 45 kilometres from the Sydney CBD. It extends for some 35 kilometres from Camden Valley Way in Narellan to Richmond Road in Penrith. It is a state road and has been identified as a principal arterial road in several infrastructure planning documents including the South Western Sydney Urban Design Strategy (Cox 2015), the South West Growth Centre Road Network Strategy (SMM 2011), and the Growth Centres Road Framework (RTA 2011).

The Northern Road provides an important link road orbiting the extents of the Sydney Metropolitan area. It caters for traffic from existing and planned residential and commercial developments in Sydney's south-west and north-west. Historically, it formed part of a link road from Singleton in the Hunter Valley to Wollongong in the Illawarra, via Windsor, Campbelltown and Appin (refer **Figure 2**).

The upgrade of The Northern Road has been identified in the Western Sydney Infrastructure Plan (WSIP), a 10 year, \$3.6 billion road investment program funded by the Australian and NSW governments, aimed at integrating transport in the region to capitalise on the economic benefits from the Western Sydney Airport at Badgerys Creek - also refer **section 2.2.3**.

To support future growth in the region, Roads and Maritime proposes to widen The Northern Road to provide additional travelling lanes plus a bus lane in each direction. The proposed upgrade involves a new road alignment between Mersey Road and Elizabeth Drive, including a number of new intersections with the existing road network and the Western Sydney Airport. It will divert The Northern Road around the site of the Western Sydney Airport and provide a bypass around the Luddenham town centre.

The upgrade would also provide new street lighting, traffic lights and turning lanes at some intersections, a central depressed drainage median, upgraded drainage infrastructure including flood mitigation, a shared path for pedestrians and cyclists on the western side of the road and a new footpath on the eastern side of the road where appropriate. A more detailed description of the proposed upgrade is provided in **section 3**, together with overview plans. More detailed illustrated plans are provided in **section 5**.

INTRODUCTION

1.5 ASSESSMENT GUIDELINES

The following table outlines the SEARs, the requirements of the Commonwealth EIS guideline and the respective sections of this technical paper that have addressed the requirements. This ensures a clear link between the requirements and how they have been addressed in the design and LCVIA for the proposed upgrade.

Secretary's Environmental Assessment Requirements (EP&A Act)

Requirement	Relevant section in this technical paper
Urban Design and Visual Amenity - including:	Section 4: Urban design objectives and Section 5: Urban design
<ul style="list-style-type: none"> A consideration of the urban design and visual amenity implications of the proposal, including supporting infrastructure, during construction and operation 	Section 6: Landscape character impact
<ul style="list-style-type: none"> A consideration of impacts on views and vistas (including impacts on extant views to the eastern escarpment of the Blue Mountains), streetscapes, existing significant vegetation, key sites and buildings 	Section 6: Landscape Character Impact and Section 7: Visual impact
<ul style="list-style-type: none"> Measures to ameliorate visual impacts during construction and operation 	Section 8: Mitigation strategy
<ul style="list-style-type: none"> Measures to manage lighting impacts during construction and operation. 	Section 4: Urban design objectives and Section 6: Landscape character impact

Commonwealth EIS Guidelines (EPBC Act)

Requirement	Relevant section in this technical paper
<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"> The qualities and characteristics of locations, places and areas. 	Section 2: Contextual analysis and Section 6: Landscape character impact
<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"> Lighting impacts on everyday activities and on sensitive environmental receptors (all sensitive receptors within the community and natural environment). 	Section 4: Urban design objectives Section 6: Landscape character impact
<p>An assessment of residual impacts after the proposed avoidance and mitigation measures have been taken into account, including the reasons why avoidance or mitigation of impacts may not be reasonably achieved.</p>	Section 8: Mitigation strategy

INTRODUCTION

1.6 STUDY METHOD

The development of the concept design and the LCVIA is an iterative process aimed at refining the concepts to reduce and mitigate the potential impacts wherever possible.

The method used follows *EIA-N04* and involved the following:

- Develop an understanding of the study area through site visits and field investigations, review of relevant literature and analysis of aerial photographs, spatial data and topographic maps
- Review of the engineering concept design and supporting material
- Review of the SEARs and Commonwealth EIS guidelines
- Contextual analysis of the study area and surroundings including identification of Landscape Character Zones (LCZs)
- Assessment of the likely impact of the proposed upgrade on the identified LCZs
- Identification of the likely visual catchment of the proposed upgrade
- Selection of viewpoints within the visual catchment, representing a range of different land uses and viewers
- Assessment of the likely impact of the proposed upgrade on the selected viewpoints by comparing the sensitivity of the views and the magnitude of the project
- Identification of urban and landscape design opportunities to maximise integration of the proposed upgrade with the natural and built context of surrounding areas, including means to mitigate adverse visual and landscape character impacts for consideration during future design phases.

The following describes the method used to assess the proposed upgrade in more detail.

1.6.1 Landscape character impact assessment

A number of LCZs are identified through the contextual analysis. They are generally based on the study area's surrounding land use, vegetation cover and topography to identify areas of distinct characteristics. The purpose of dividing the study area into character zones is to make the assessment process easier to undertake and understand.

Within each LCZ the impact of the proposed upgrade is based on the sensitivity of the zone, and the magnitude of the proposed upgrade in that zone:

- **Sensitivity** refers to how sensitive the existing character of the setting is to the proposed change, or its inherent capacity to absorb change. For example, a pristine natural environment will be more sensitive to change than an industrial area
- **Magnitude** refers to the physical size and scale of the project. For example, a large intersection will have a greater magnitude than a localised road widening, and therefore have a greater impact on the landscape character
- The combination of sensitivity and magnitude provides the rating of the **landscape character impact** (refer to **Figure 1**).

1.6.2 Visual impact assessment

The extent of area from where the proposed works would be able to be seen is referred to as the visual catchment or visual envelope. It is largely defined by the landform of the study area. Direction of travel or of the view is another factor influencing visibility of the project. Factors such as built structures or vegetation need to be considered where they limit or obscure views. However, vegetation, whilst often blocking potential views, is not considered as a permanent obstruction as it can be removed or destroyed.

As distance is an important factor in how the works are perceived, very large visual catchments are typically defined by zones of proximity from the proposed works, for example zones of 100 metres, 300 metres and beyond.

Within the LCZs, a number of viewpoints and groups of viewpoints are identified at varying locations and view directions. The visual impact of the proposed upgrade has been assessed by considering both the sensitivity of the view and the magnitude of the proposed works within that view:

- **Sensitivity** refers to the quality of the view and how it will be affected by the proposed works. It is measured by assessing the chosen view's composition, its inherent capacity to absorb change and the type and number of viewers such as road users and local residents
- **Magnitude** refers to the physical character, size and scale of the proposed works and their proximity relative to the viewer. For example, a development situated one kilometre from the viewpoint will have a much reduced visual impact relative to one 100 metres away
- The combination of sensitivity and magnitude provides the rating of the **visual impact** (refer to Figure 1).

		MAGNITUDE			
		High	Moderate	Low	Negligible
SENSITIVITY	High	High impact	High to Moderate	Moderate	Negligible
	Moderate	High to Moderate	Moderate impact	Moderate to Low	Negligible
	Low	Moderate	Moderate to Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Figure 1: Visual and landscape character impact assessment grading matrix (source: EIA-N04)

1.6.3 Qualitative assessment

For the purposes of this technical paper, the study identifies the existing landscape character and the capacity of the study area to absorb the changes associated with the proposed upgrade of The Northern Road. In the process, the likely magnitude and sensitivity of viewers have been described in a qualitative manner:

This has been based on the authors' extensive experience as landscape architects and urban designers specialising in the field of landscape character and visual assessment including assessment of a larger number of projects of a similar nature.

1.6.4 Mitigation measures

Mitigation measures are a series of strategies, principles or treatments recommended to ameliorate the identified landscape character and visual impacts of the proposed upgrade. They include ways to lessen the magnitude or visual effect of the proposed works, and to maximise integration with the setting and surroundings. They may also include treatments near critical view areas to reduce the visual impact.

2. CONTEXTUAL ANALYSIS

2.1 LOCATION

The study area for this technical paper is the approximately 1.6 kilometre section of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park (refer to **Figures 2 and 3**).

2.1.1 Metropolitan context

The Northern Road is an important arterial link between Camden and Windsor. It is an historic route that dates back to the early settlement of the Hawkesbury and Macarthur areas. It runs north-south through the South West Priority Growth Area (SWPGA). Together with the North West Priority Growth Area (NWPGA) the SWPGA is earmarked to accommodate the majority of Sydney's residential growth over the next 25 years.

Major urban growth will also occur between the two priority growth areas. The Western Sydney Airport will be a major catalyst for growth. Located between Elizabeth Drive and Badgerys Creek, the airport will be the anchor in a major corridor of existing and new employment lands stretching from Bringelly to Minchinbury. The Western Sydney Priority Growth Area (WSPGA) will consist of new employment lands that wrap around the Western Sydney Airport and stretch north and east to join up with employment lands in the Western Sydney Employment Area (WSEA). The Northern Road in the southern part of the study area closely follows the western boundary of the WSPGA - refer **Figure 2** and **Figure 3**.

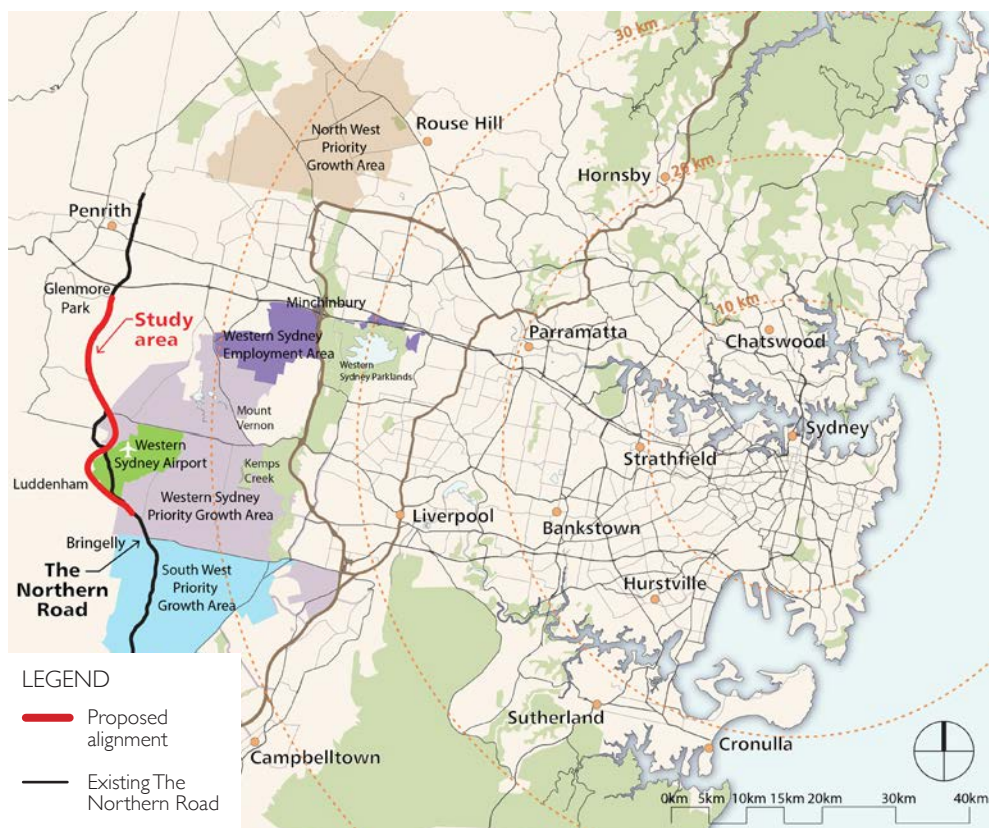


Figure 2: Metropolitan context of The Northern Road and the study area

CONTEXTUAL ANALYSIS

2.1.2 Local context

Located around the periphery of the Western Sydney Airport, and connecting to Penrith, the study area will be an important gateway to the airport, and to employment and residential lands within the WSPGA and the SWPGA respectively.

The Northern Road is also an important urban arterial road skirting the west of the Sydney metropolitan area. It will function as the main north-south connecting route between Camden and Campbelltown, and Penrith and Windsor.

Much of the study area is currently situated within a rural setting. Planning for the Western Sydney Airport, the WSPGA and SWPGA is underway and will result in substantial changes to the area. As a result, the southern extents of the study area will be progressively transformed from rural lands to employment, infrastructure and other urban uses including town centres and residential areas.

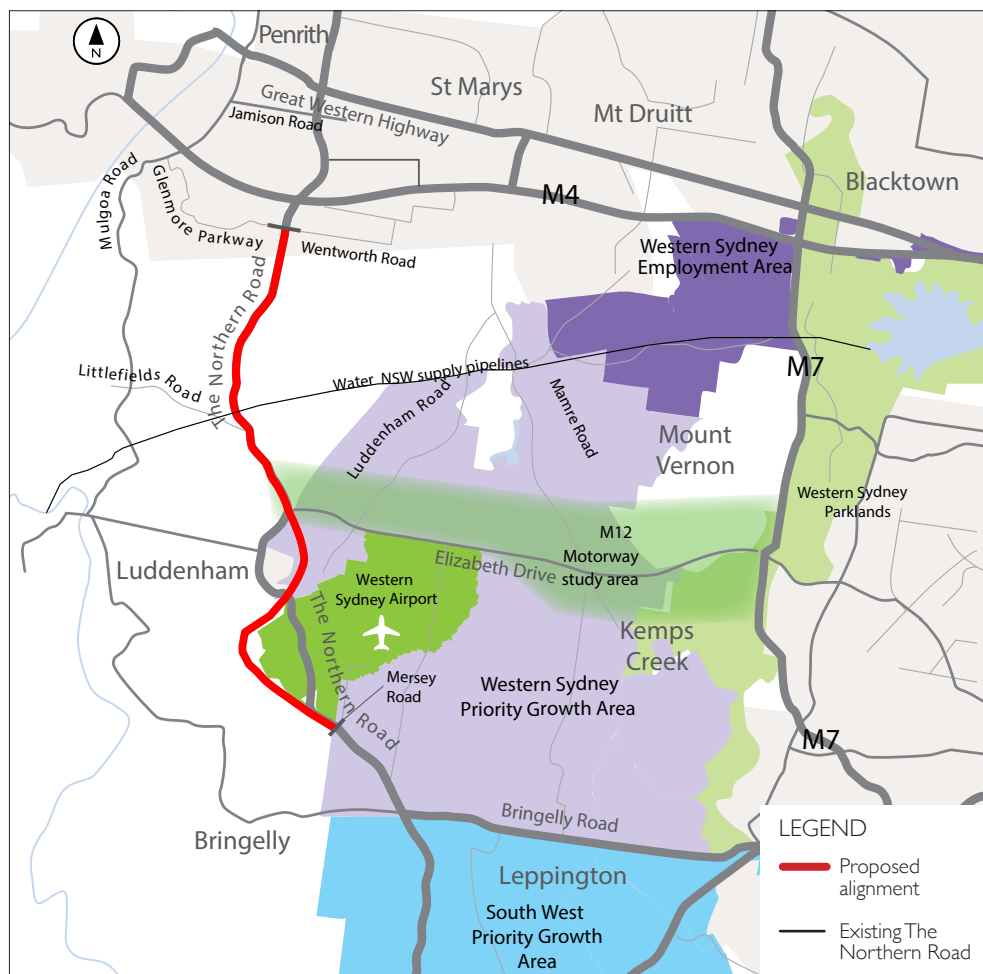


Figure 3: Local context of the study area (source: adapted from: Roads and Maritime Services 2015, p. 3)

CONTEXTUAL ANALYSIS

2.1.3 Places of interest

Particular features and places of interest that provide destinations for the local community in the area surrounding the proposed upgrade include (refer **Figure 4**):

1. Penrith Golf & Recreation Club
2. Penrith Anglican College
3. Orchard Hills Water Filtration Plant
4. Surveyors Creek Nature Reserve
5. Defence Establishment Orchard Hills (DEOH)
6. Orchard Hills Golf Club
7. Mulgoa Nature Reserve
8. Eureka Farm Equipment
9. Stones Kart Sport Shop
10. Complete Roofing
11. Mulgoa village
12. Water NSW supply pipelines
13. The Honey Shed
14. Luddenham Pet Meat and Pet Supplies
15. Luddenham Showground
16. Luddenham town centre
17. Workers Hubertus Country Club
18. Wallacia village and Panthers Wallacia Golf Course
19. Leppington Pastoral Company
20. Royal Australian Air Force Telecommunications Unit
21. Luddenham Raceway Gokart and Paintball Centre
22. Top Shape Live Christmas Trees

CONTEXTUAL ANALYSIS

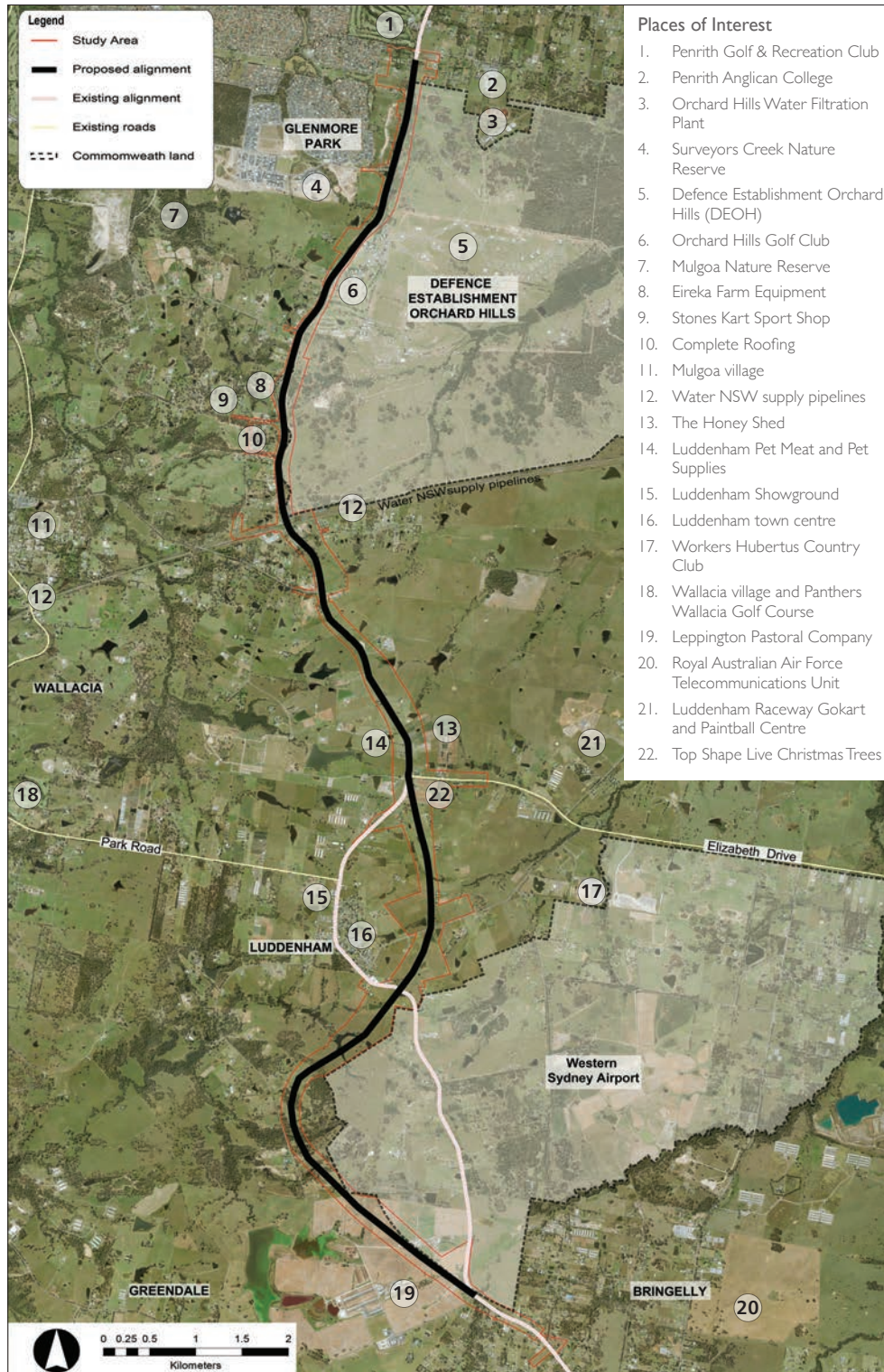


Figure 4: Aerial photograph showing places of interest surrounding the study area

CONTEXTUAL ANALYSIS

2.2 PLANNING CONTEXT

2.2.1 A Plan For Growing Sydney

The Sydney Metropolitan Strategy *A Plan for Growing Sydney* (the Plan) sets the metropolitan planning context. It provides the framework for Sydney's future over the next 20 years, directing growth and land use planning decisions.

It outlines a vision for Sydney to be a strong global city and a great place to live, with a competitive economy, world-class services, transport and housing choice within communities that are strong, healthy and well connected.

The Plan identifies western Sydney as the 'key to Sydney's success'. Given the projected growth over the next 20 years, western Sydney will likely be the driver of future productivity in Sydney and NSW.

Particular opportunities for western Sydney identified by the Plan include (refer **Figure 5**):

- Investment in transport infrastructure, such as the South West Rail Link, a possible extension to the South West Rail Link from Badgerys Creek to the western rail line, the Western Sydney Rail Upgrade Program and the Outer Sydney Orbital
- Rezoning of land in the SWPGA to maintain a steady supply of greenfield sites for urban residential development
- Development of the WSPGA as the single largest new employment space in the Sydney Metropolitan Area, supporting manufacturing and industrial activity, particularly the freight and logistics sectors
- Development of a second airport at Badgerys Creek and associated investment in road and rail related infrastructure as a major stimulus to the western Sydney economy and broadening employment opportunities with up to 60,000 jobs in the long term
- Creation of a transport gateway focused on the Western Sydney Airport at Badgerys Creek
- Improving transport connections between centres including upgrades to The Northern Road, Elizabeth Drive and Bringelly Road.

The upgrade of The Northern Road is therefore a direct result of strategic planning as outlined in the Plan.

Metropolitan Rural Area

The Metropolitan Rural Area (MRA) is that part of the Sydney Metropolitan Area generally located outside established urban areas - refer **Figure 5**. The MRA provides a rural and bushland backdrop to the metropolitan urban area and holds important environmental, economic and social assets.

Managing the MRA is a key objective of *A Plan for Growing Sydney*, and a critical part of managing Sydney's natural environment and biodiversity as well as of securing local food production (Direction 4.1). This will involve balancing local growth needs with environmental protection, resource management, agriculture, tourism and culture, research activity, military uses and community safety.

Much of the study area is located within or along the edges of the MRA. The intention for these lands to remain rural is of relevance as it will influence the future landscape character of the study area.

CONTEXTUAL ANALYSIS

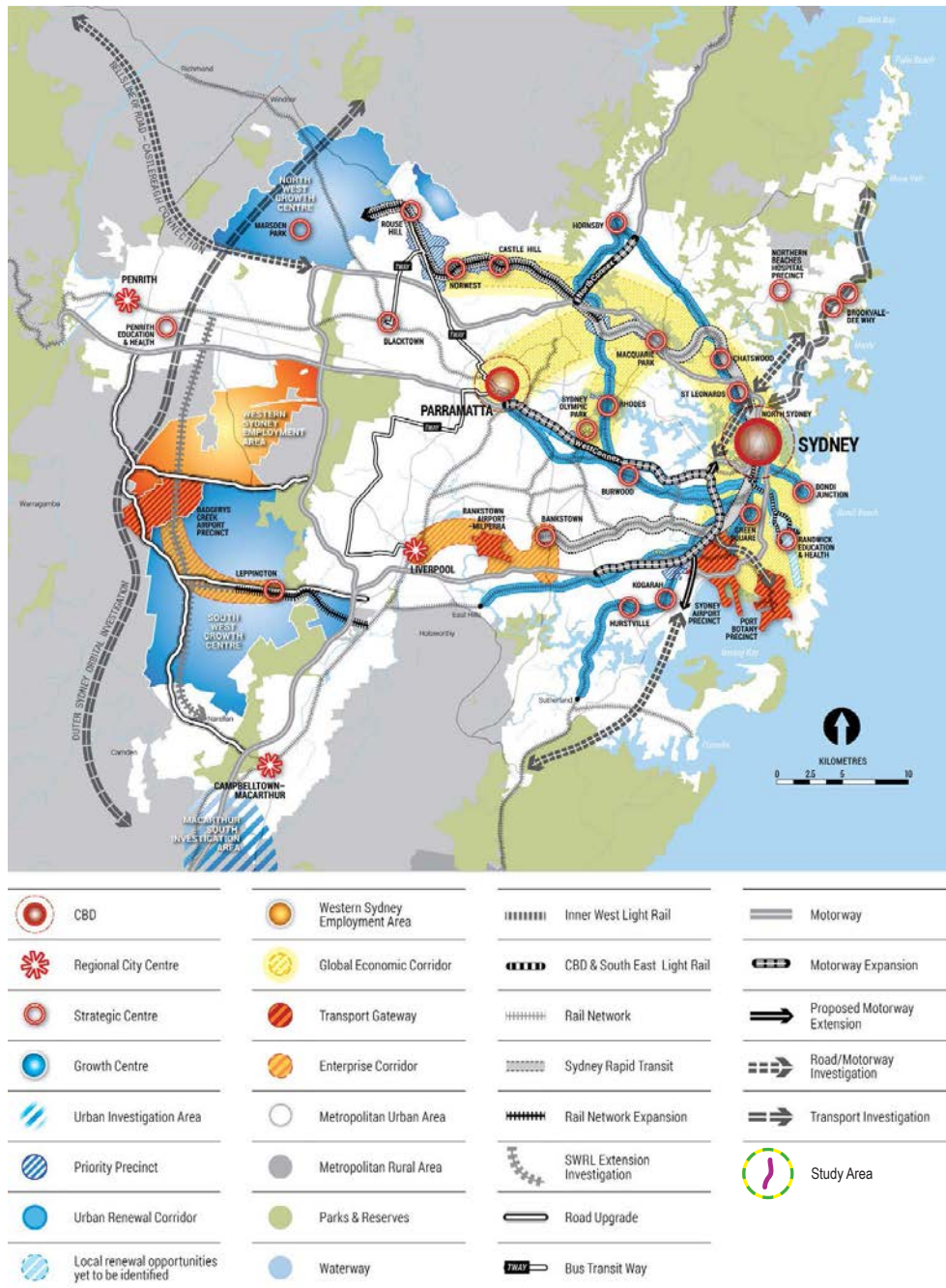


Figure 5: The study area in the context of major urban growth areas and the Metropolitan Rural Area (source: A Plan for Growing Sydney, Figure 4: Connecting Jobs and Homes, DP+E 2014, p. 15)

CONTEXTUAL ANALYSIS

2.2.2 Sydney Green Grid

The *Sydney Green Grid* is a framework for the creation of an interconnected network of open spaces, parks, bushland and waterways, embedded in *A Plan for Growing Sydney*. It aims to connect open space, local centres, workplaces, community destinations, leisure facilities and residential areas through an active transport network of greenspace corridors and enhanced tree canopies, with walkways and cycle ways across the Sydney metropolitan area, to create green connections.

The 'Green Grid' has been identified by the Department of Planning and Environment as a key part of planning and building Sydney for the future. It will provide Sydney's green infrastructure and will be an essential component of the city for maintaining and improving both ecological and human health.

2.2.3 Western Sydney Infrastructure Plan

The WSIP is a joint initiative by the Australian and NSW governments aimed at building a stronger and more prosperous western Sydney, transforming the region's economy through major infrastructure upgrades and making western Sydney a better place to live and do business.

Building on *A Plan for Growing Sydney*, the WSIP will invest \$3.6 billion over 10 years to deliver major road infrastructure in western Sydney, to capitalise on the economic benefits from developing the Western Sydney Airport and to support an integrated transport solution for the region.

The WSIP seeks to provide improved road transport capacity ahead of projected traffic demand resulting from planned residential and employment development in the NWPGA, SWPGA and the WSPGA. Relevant proposals include the upgrade of The Northern Road and Bringelly Road, a new Werrington Arterial and a proposed M12 Motorway that will provide direct access from Sydney's motorway network to the Western Sydney Airport - refer **Figure 6**.

CONTEXTUAL ANALYSIS

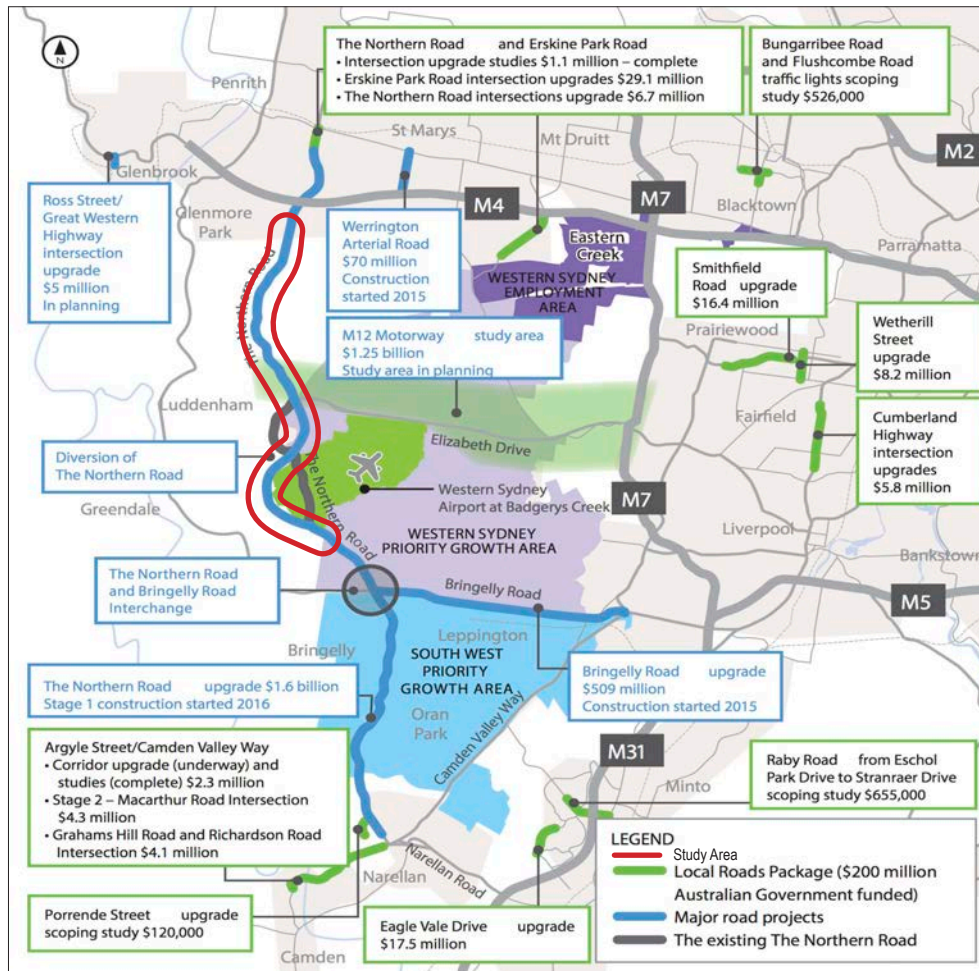


Figure 6: Western Sydney Infrastructure Plan (adapted from: Roads and Maritime Services 2015, p. 3)

CONTEXTUAL ANALYSIS

2.2.4 Local planning instruments

The study area spans the Penrith and Liverpool LGAs. Land use and development in and adjoining the study area is controlled by the Penrith Local Environmental Plan (LEP) 2010 and the Liverpool LEP 2008 respectively.

As can be seen from **Figure 7**, a number of land uses adjoin the study area. They include:

- Rural land use zones (RU) adjoining much of the southern study area south of the Water NSW supply pipelines. They include:
 - RU1 Primary production areas south of Elizabeth Drive and west of The Northern Road in Luddenham, Greendale and Bringelly
 - RU2 Rural landscape areas on both sides of the corridor between the Water NSW supply pipelines and Elizabeth Drive, as well as in Mulgoa opposite the DEOH. It is noted that much of the latter has been identified as an urban release area
 - RU4 Rural small holdings at the edges of Luddenham town centre and in Bringelly
 - RU5 Village, in Luddenham town centre
- Residential zones including
 - R1 General residential and R2 Low density residential areas set back from the road corridor in parts of Glenmore Park, as well as in the Luddenham town centre
 - R5 Large lot residential living in the Luddenham town centre and in Bringelly
- Two small neighbourhood business zones (B1) in Luddenham town centre
- Special purpose zones including
 - SP1: the DEOH and the site of the Western Sydney Airport at Badgerys Creek
 - SP2: the Water NSW supply pipelines
- Environment protection zones (E) including
 - E2 Environmental conservation around the perimeter of the DEOH in Orchard Hills and Luddenham
 - E3 Environmental management areas in the Mulgoa Creek catchment
 - E4 Environmental living areas in parts of Glenmore Park.

Scenic and landscape values

It is noted that much of the study area and adjoining lands in the Penrith LGA have been identified as possessing scenic and landscape values - refer **Figure 8**. Particular objectives for this land are provided by clause 7.5 of Penrith LEP 2010. They include:

- To identify and protect areas that have particular scenic value either from major roads, identified heritage items or other public places, and
- To ensure development in these areas is located and designed to minimise its visual impact.

Translation of scenic and landscape values into statutory and planning instruments indicates that these values are both significant and widely held. The implications for the proposed works, and for the development of the concept design are:

- The landscape of the study area is important and has been singled out for its scenic and landscape values within the Penrith LGA
- Statutory identification of scenic and landscape values suggests a high level of visual sensitivity to change in the landscape

CONTEXTUAL ANALYSIS

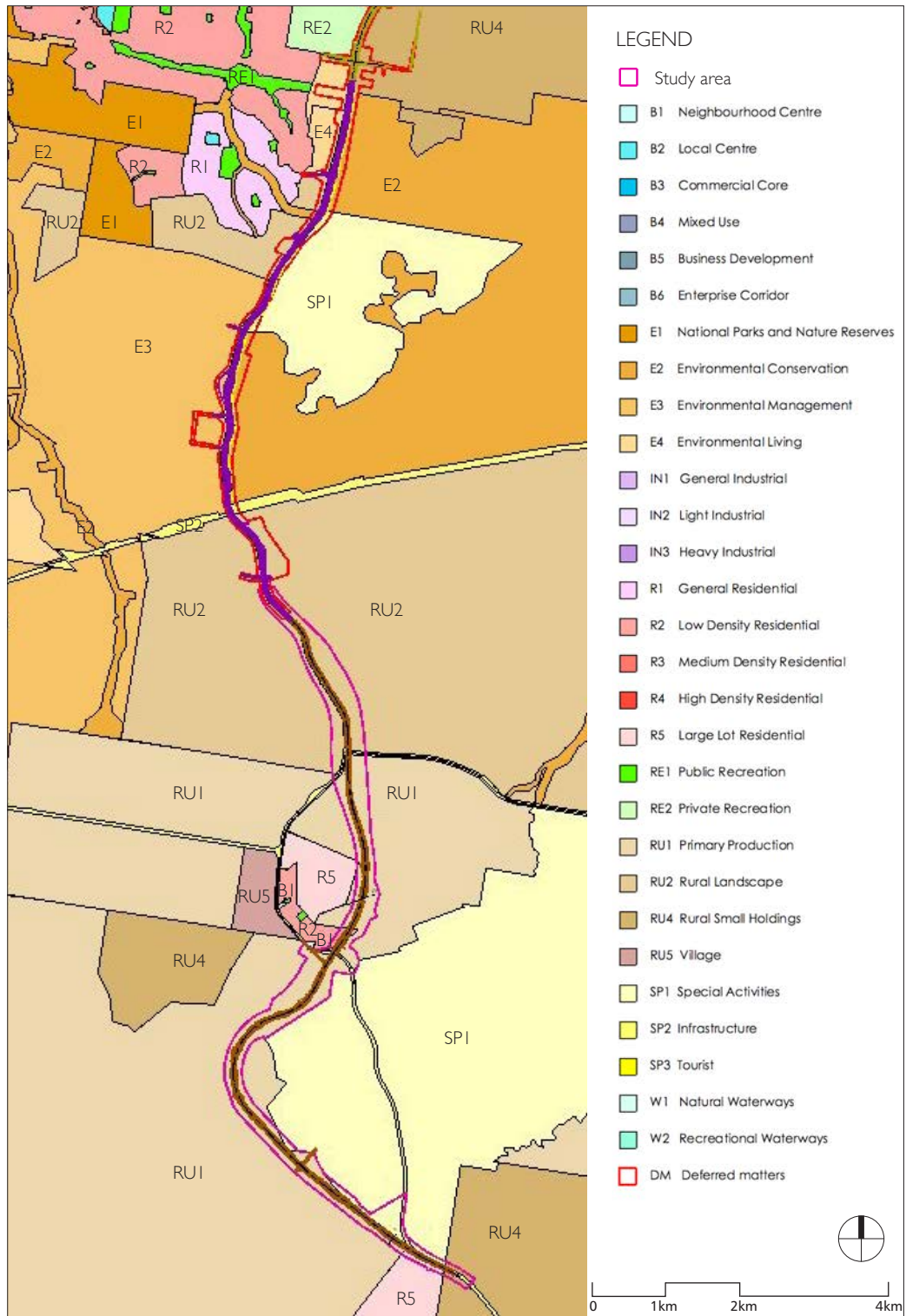


Figure 7: Land use zoning (source: Jacobs)

CONTEXTUAL ANALYSIS

- Given that these lands are also identified to be part of the MRA in *A Plan for Growing Sydney*, conversion of rural lands to residential or urban land uses are unlikely in the foreseeable future
- There is a statutory requirement to protect scenic landscape values including the need to
 - Carefully consider and manage the potential impacts of the proposed works on scenic and landscape values
 - Complement or enhance scenic landscape values as part of the proposed works.

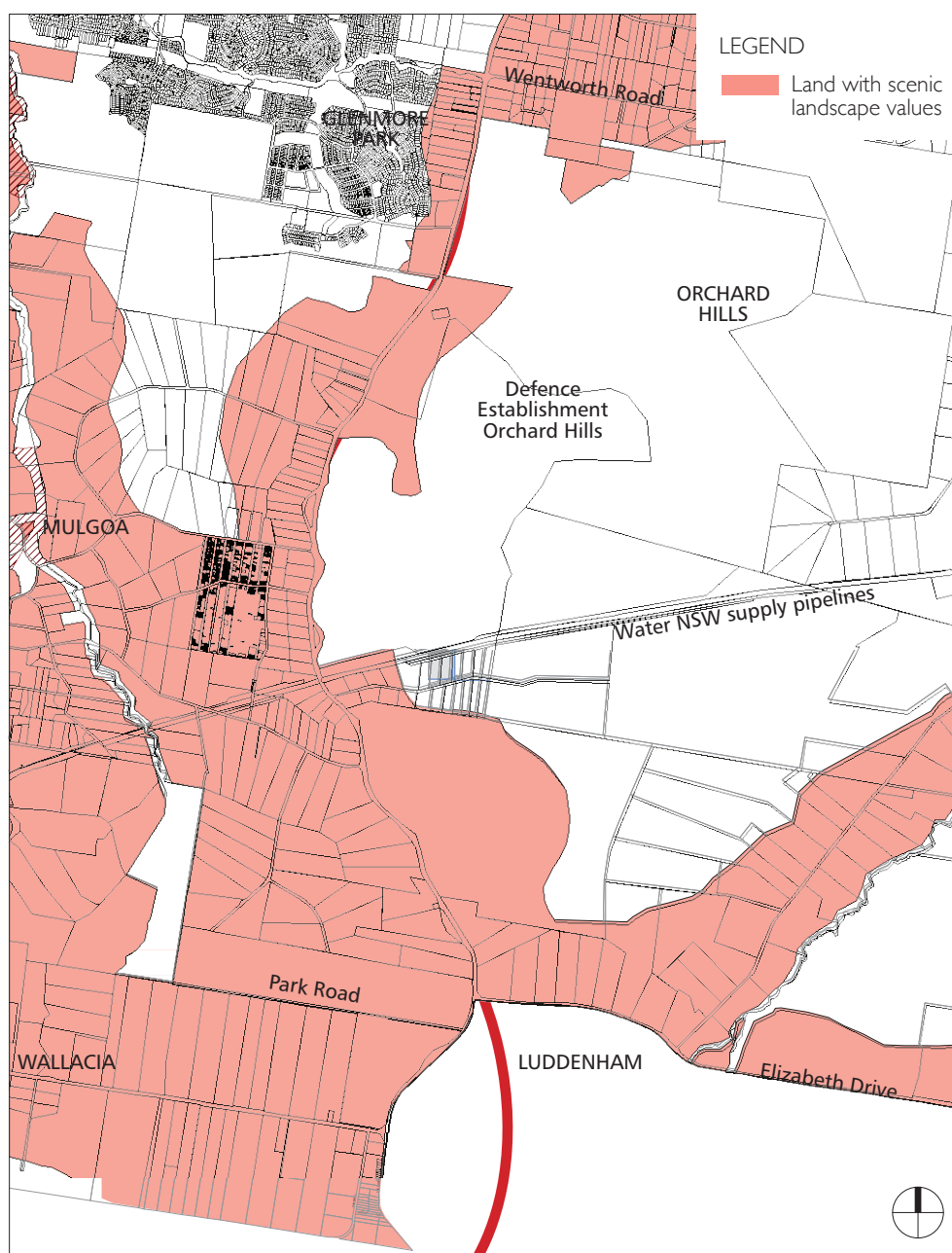


Figure 8: Land with Scenic and Landscape Values - Extract from Sheets 6, 7, 13 and 14, Penrith LEP 2010

CONTEXTUAL ANALYSIS

2.3 URBAN DESIGN GUIDANCE

The following provides a brief overview of relevant documents that guide the urban design concept for the proposed works.

2.3.1 Beyond the Pavement

Beyond the Pavement. Urban Design Policy Procedures and Design Principles is the Roads and Maritime urban design policy. It provides guidance on urban design outcomes and expectations, and how to integrate urban design into the infrastructure design process. It identifies urban design principles for Roads and Maritime's projects and provides relevant case studies.

Through *Beyond the Pavement* Roads and Maritime commits to providing excellent outcomes for the people of NSW, governed by 9 overarching urban design principles that include both physical outcomes and performance based principles.



2.3.2 South West Growth Centre Road Network Strategy

The *South West Growth Centre Road Network Strategy* was prepared in 2011 to guide the road network planning for south-western Sydney, with a focus on the area loosely defined by the F5 Freeway, Elizabeth Drive and The Northern Road.

The Strategy built on and further developed earlier work such as the *Growth Centres Road Framework*, to integrate land use and transport by guiding the future planning and design of both the road network and adjoining land uses. It has since been superseded by the *Draft South Western Sydney Urban Design Strategy* that considers a larger study area extending to the M4 Motorway.



2.3.3 South Western Sydney Urban Design Strategy

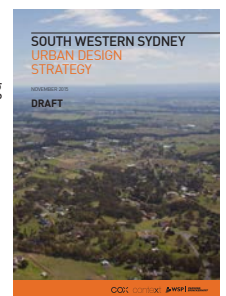
The *Draft South Western Sydney Urban Design Strategy* (SWSUDS) was published in November 2015, in response to the WSIP. Building on the *South West Growth Centre Road Network Strategy* it aims to realise a clear character and identity for the region bound by the M4, M7 and the Hume Highway by providing urban design direction for the development of the road network.

The SWSUDS is built on the premise that the road network holds the potential to shape and define the character of an area. A fundamental landscape element in western Sydney is its Cumberland Plain ecology. Its retention and integration into the road network hierarchy is seen as the defining character element of south-western Sydney.

Based on other Roads and Maritime policies including *Beyond the Pavement*, the SWSUDS outlines urban design and road planning principles and recommendations to achieve urban design integration and the desired landscape and urban design outcomes.

The SWSUDS further defines the road hierarchy for the region and provides design guidelines for different types of roads and intersections. This is refined by a 'corridor approach' for major routes that identifies unique issues and values for each road corridor. It considers the corridors' existing character in the context of likely future development to identify an appropriate response.

The SWSUDS is a key document for consideration in the assessment of the potential landscape character impacts of the proposed works, as well as in the development of mitigation measures and the urban design concept.



CONTEXTUAL ANALYSIS

2.4 EXISTING SITE CONDITIONS

2.4.1 Landform & views

The landscape of the study area is typical of the Cumberland Plain and defined by its situation along a well defined ridge that constitutes the watershed between the South Creek and Nepean River catchments.

For the most part of the study area the existing alignment of The Northern Road closely follows this ridge as it gradually descends in elevation, from a high point south of Luddenham towards Glenmore Park.

In terms of the views available to the motorist, there are three distinct sections within the study area - refer **Figure 9**. They are:

- The southern section between Mersey Road and the transmission line easement, near 1,972 The Northern Road
- The central section between the transmission line easement and the Water NSW supply pipelines
- The northern section between the Water NSW supply pipelines and Glenmore Parkway.

In the southern section there are generally mid distance views over rolling paddocks. Due to tree cover and topography, there are limited long distance views, although there are occasional glimpses of the Blue Mountains to the west, including from the existing The Northern Road alignment.

The central section is the most open section of the study area. The Blue Mountains are an almost constant feature in the west. North and south of the Luddenham town centre motorists enjoy panoramic views from the road corridor; ranging from the Blue Mountains in the west to the prominent ridge line that defines the Western Sydney Parklands to the east. The exception is Luddenham town centre where built structures limit views from the road corridor.

The northern section of the study area between the Water NSW supply pipelines and Glenmore Parkway in contrast is much more enclosed. There are only occasional brief glimpses of the Blue Mountains. Views to the east are contained by a ridge line running in close proximity to the road corridor; limiting views from the road corridor to short-distance views into immediately adjoining lands.

2.4.2 Hydrology and fish habitat

There are a number of creeks and tributaries surrounding the study area, all part of the wider Hawkesbury-Nepean Catchment - refer **Figure 9**. Within the study area a number of creeks and farm dams are found. They are often associated with vegetation remnants.

Farm dams make an important contribution to the landscape character and the experience of the drive along The Northern Road, including its visual values. Creeks have also been identified as regional recreational links integral to the realisation of the Sydney Green Grid.

Creeks in the area have been assessed for their importance as fish habitat and for fish passage. No watercourse crossings have been mapped as Key Fish Habitat by Department of Primary Industries (DPI) Water (2007). However five waterways crossing the study area are considered Type 1 – Key Fish Habitats, based on the *DPI Policy and Guidelines for Fish Habitat Conservation and Management (2013)*. They contain a combination of native aquatic plants and/or woody snags.

CONTEXTUAL ANALYSIS

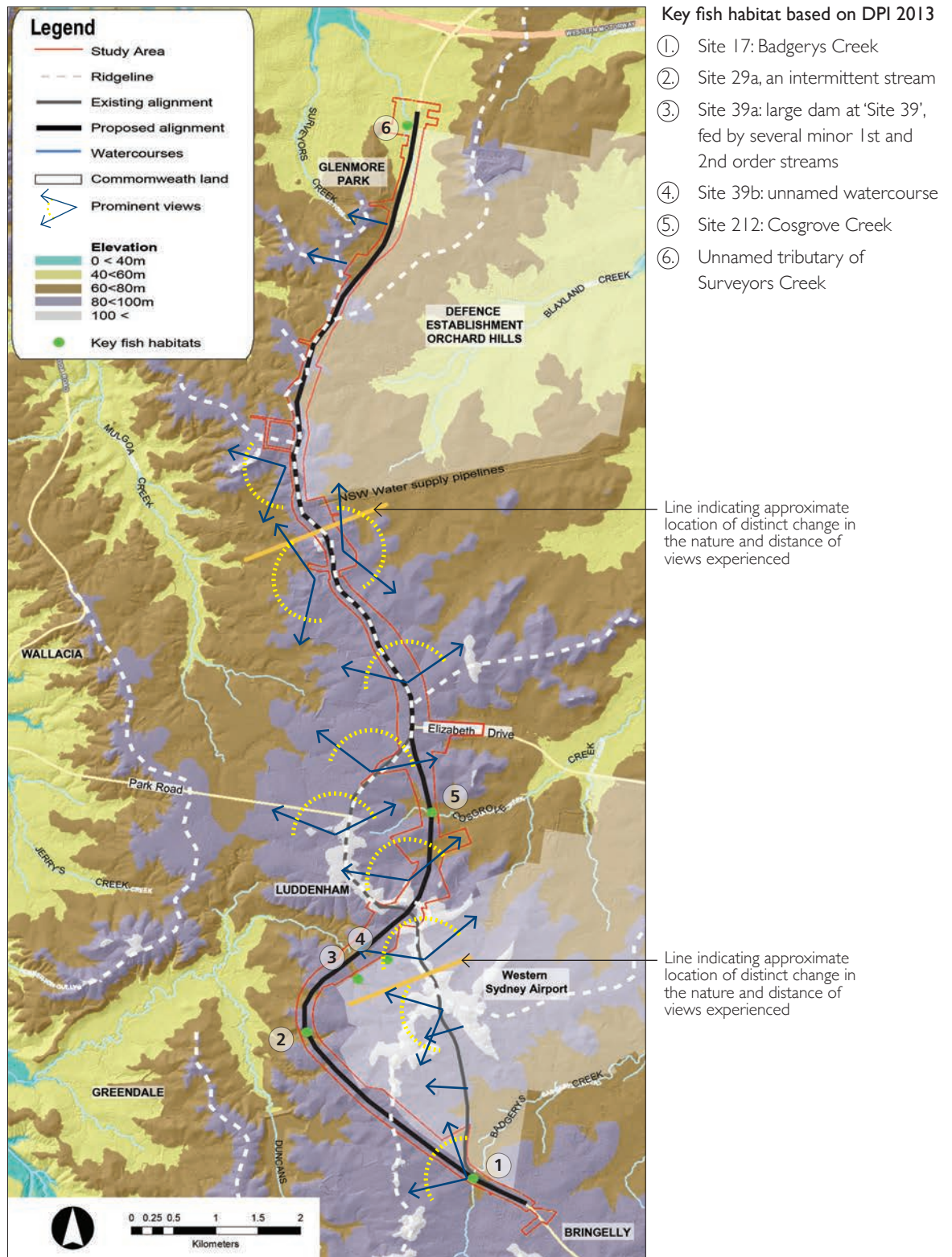


Figure 9: Topography, views, water courses and fish habitat

CONTEXTUAL ANALYSIS

There are also intermittently flowing waterways identified as Class 2 – Moderate Key Fish Habitat due to the presence of limited in stream aquatic vegetation.

The key waterways crossed by the project are - refer **Figure 9**:

- Badgerys Creek (site 17)
- An intermittent stream at 'Site 29a'
- The large dam at 'Site 39', fed by several minor 1st and 2nd order streams with minimal channel definition, only flowing when the upstream dams overflow (site 39a and 39b)
- Cosgrove Creek (site 212)
- Unnamed tributary of Surveyors Creek

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. No threatened or protected fish species are expected to occur within the study area due to the limited water and aquatic habitat present.

For more information refer the *Biodiversity Assessment Report* (Appendix I of the EIS).

2.4.3 Vegetation

Native vegetation cover

The native vegetation of the study area is an important feature in defining the landscape of the area. Together with the topography it influences the character of the landscape, as well as the views and vistas.

Remnant native vegetation is found throughout the study area and in adjoining areas. It generally occurs in scattered clumps of trees and as individual specimen along the edges of the road corridor; or in private properties adjoining the road corridor. A number of private properties retain larger stands of remnant vegetation. Larger stands are also typically associated with creeks.

The analysis of the vegetation cover undertaken by the SWSUDS clearly highlights the changing character and density of vegetation cover in the area surrounding the proposed works. As can be seen on **Figure 10**, the heaviest vegetation cover exists around the southern end of the study area, as well as in the section north of the Water NSW supply pipelines.

In contrast, areas between Badgerys and Duncans Creek retain limited vegetation. The landscape around Willowdene Avenue in Luddenham, around the Luddenham town centre and along Mulgoa Creek is more varied, consisting of a mix of open and vegetated areas.

Native vegetation communities

Native vegetation generally consists of Cumberland Plain Woodland. It is highly modified as a result of past and current land uses, including agricultural uses which have resulted in substantial clearing of the original vegetation cover.

There are a number of ecologically vulnerable remnants within the study area - refer **Figure 11**. They include:

- Cumberland Plain Woodland and Shale Gravel Transition Forest - protected under the EPBC Act

CONTEXTUAL ANALYSIS



Figure 10: Extent of native vegetation cover (adapted from Figure 2.17 from Cox 2015, p. 23)

CONTEXTUAL ANALYSIS

- Cumberland Plain Woodland, listed as an Endangered Ecological Community (EEC) under Schedule 3 of the *Threatened Species Conservation Act 1995* (TSC Act) and including the following communities:
 - Forest Red Gum - Rough Barked Apple Grassy Woodland on alluvial flats of the Cumberland Plain
 - Grey Box - Forest Red Gum Grassy Woodlands on flats of the Cumberland Plain'
 - Grey Box - Forest Red Gum Grassy Woodlands on shale of the southern Cumberland Plain'
- River-Flat Eucalypt Forest on Coastal Floodplains of the Sydney Basin Bioregion, listed as an EEC under Schedule 3 of the TSC Act.

For more detailed information on the local ecology refer to the *Biodiversity Assessment Report* (Appendix I of the EIS).

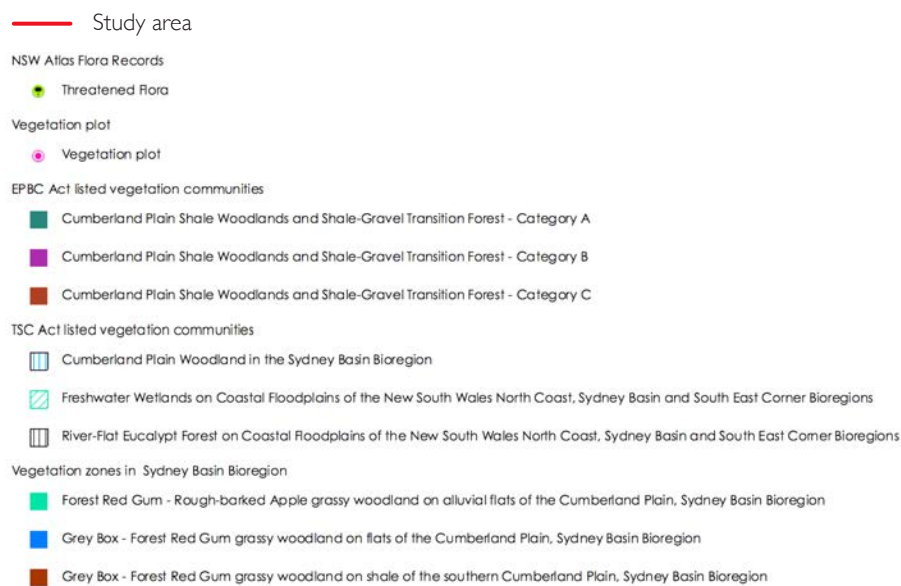
Cultural plantings

The area is mainly characterised by its remnants of native vegetation which has been cleared extensively for rural uses. The predominant use is for pasture, creating expansive open areas.

Cultural plantings are typically associated with residential gardens and front yards of rural dwellings. The area is also used for orchards and tree farms including an historic orchard on Gates Road (refer section **2.4.5 Heritage**) and a number of Christmas tree farms, including near Elizabeth Drive and Eaton Road.

Overall, there is little prominent cultural planting.

LEGEND - Figure 11



CONTEXTUAL ANALYSIS



Figure 11: Aerial photograph showing distribution of ecologically vulnerable remnant vegetation (source: Jacobs)

CONTEXTUAL ANALYSIS

2.4.4 Land use and settlement pattern

The study area is located at the periphery of the Sydney metropolitan area and currently remains rural. It is characterised by a mix of paddocks and open areas interspersed by stands of remnant vegetation of varying sizes, as well as rural residences and structures associated with rural production such as machinery or animal sheds.

Luddenham is a distinct rural town and the local service centre in the study area, featuring basic shops and services as well as schools, churches and a number of historic buildings. The relatively tight clustering of buildings in a small town centre clearly distinguishes it from the remainder of the study area. It also differs from Bringelly south of the study area which does not have a defined urban centre.

The DEOH, while representing a different land use, nevertheless is consistent in character with surrounding agricultural land uses, containing a similar mix of open and vegetated areas.

The Orchard Hills Golf Club is unique in character and provides a contrast to surrounding areas, through its formal arrangement of manicured lawns and straight lines of trees lining the fairways.

Planned changes to land use and development patterns

It is noted that development of the Western Sydney Airport at Badgerys Creek, the WSPGA and the SWPGA will result in substantial changes to the existing land use and settlement pattern. It will progressively transform the character of the landscape surrounding the study area from rural to urban. The extent of area likely to be transformed by employment lands and other urban uses is shown in **Figure 12**.

CONTEXTUAL ANALYSIS

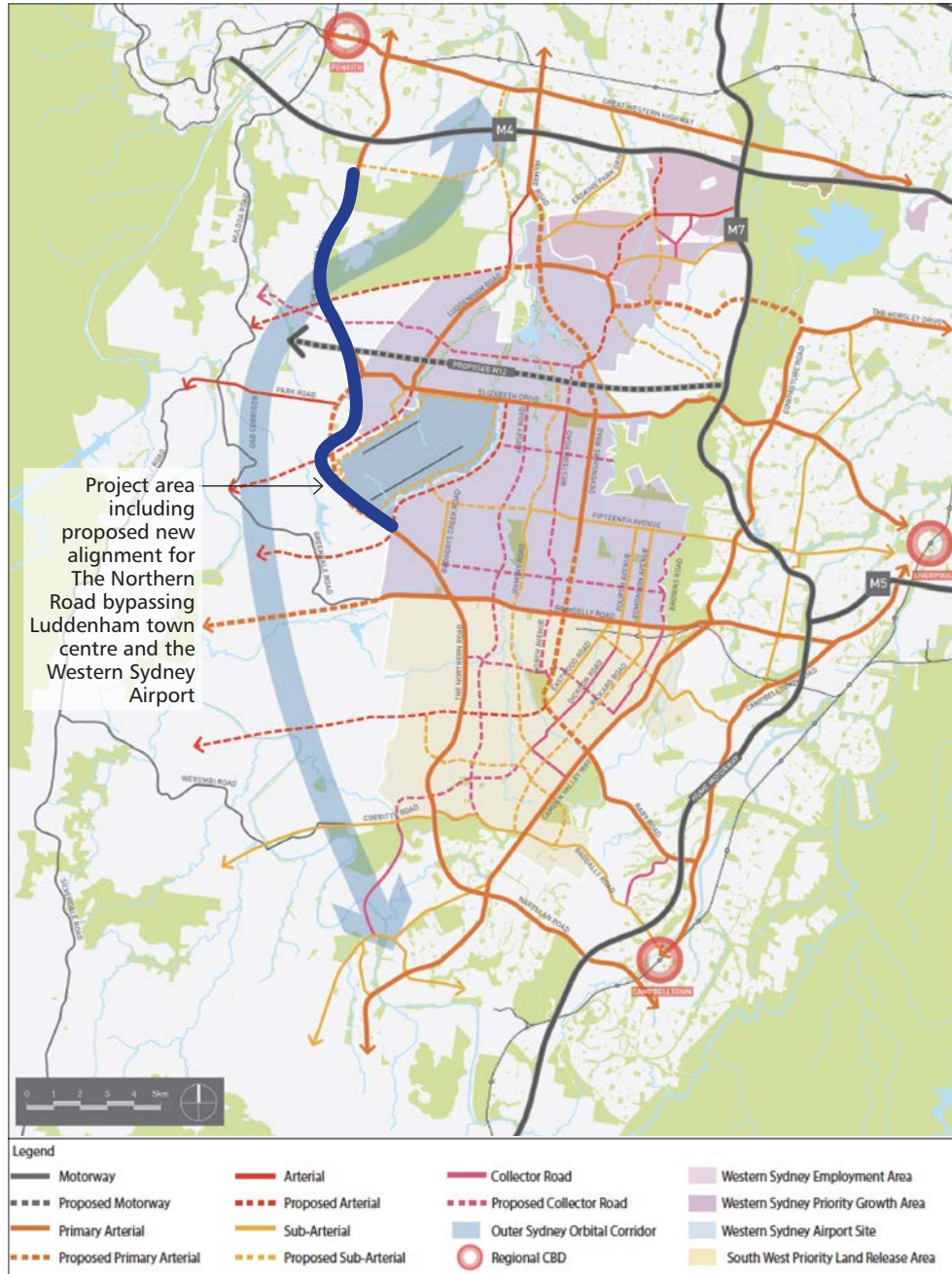


Figure 12: Proposed future urban areas and road network (adapted from Figure 2.40 from Cox 2015, p. 43)

CONTEXTUAL ANALYSIS

2.4.5 Heritage

The *Non-Aboriginal Heritage Working Paper* for the project (Appendix N of the EIS) identified ten potential heritage items within the study area - refer **Figure 13**.

Of these, four were identified as having heritage significance, as follows:

- Orchard Hills Cumberland Plain Woodland (Chaffey Brothers Irrigation Scheme Canal) – listed on the Commonwealth Heritage List (CHL)
- Water NSW supply pipelines
- Miss Lawson's Guesthouse Site
- Lawson's Inn site – listed on the Liverpool Local Environmental Plan (LLEP).

A number of Aboriginal heritage sites have also been identified within and surrounding the study area as outlined in the *Aboriginal Cultural Heritage Assessment Report* (Appendix M of the EIS) - refer **Figure 13**.

For more information refer to the *Aboriginal Cultural Heritage Assessment Report* (Appendix M of the EIS) and the *Non-Aboriginal Heritage Working Paper* (Appendix N of the EIS).

CONTEXTUAL ANALYSIS

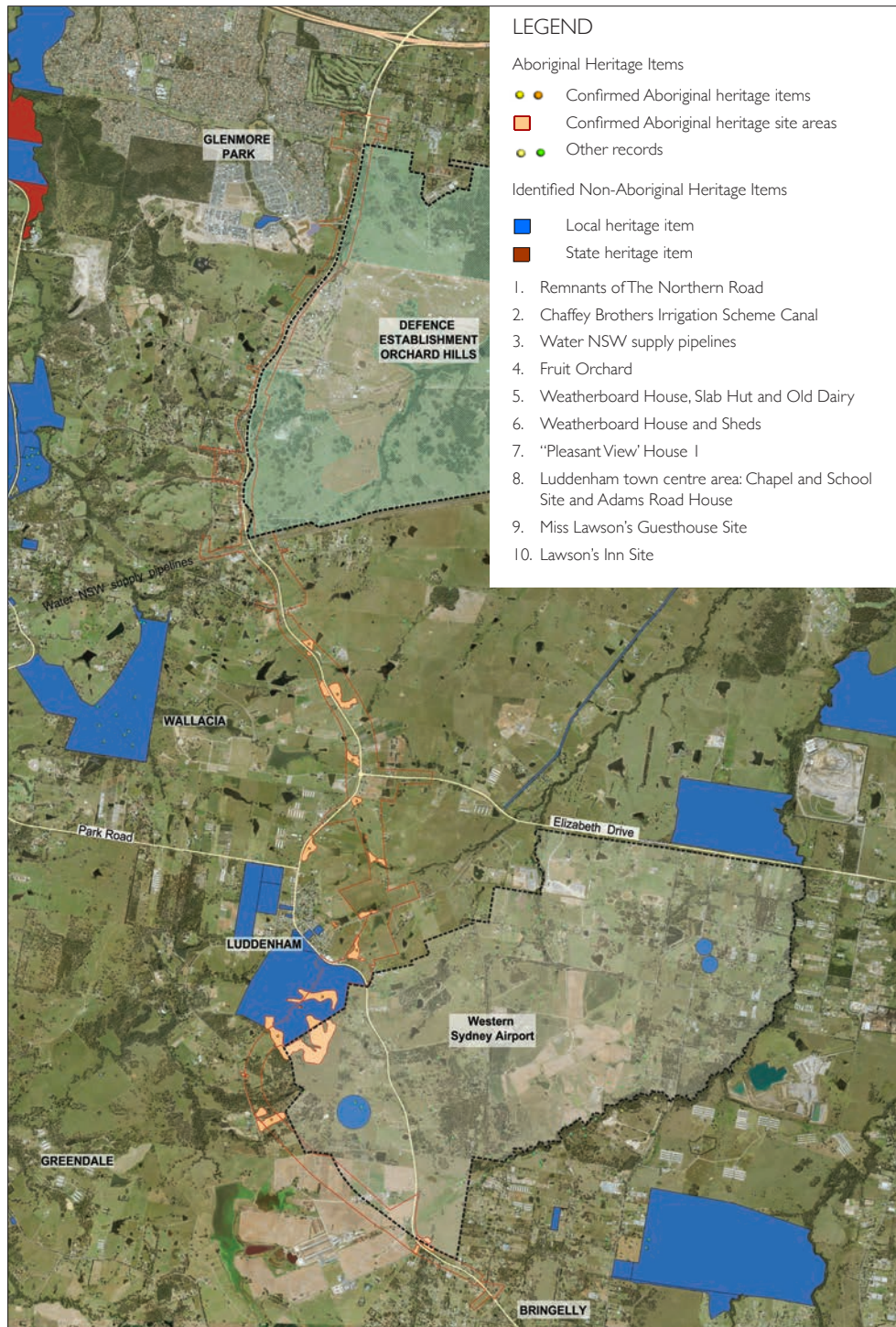


Figure 1.3: Aboriginal and Non-Aboriginal heritage items (source: Jacobs)

CONTEXTUAL ANALYSIS

2.4.6 Utilities

The following utilities have been identified along or near the study area - refer **Figure 14**:

- **Electricity**
A substation near the Water NSW supply pipelines.
High and low voltage transmission and distribution lines, including TransGrid 330kV transmission lines that cross the road corridor
 - Near the northern extent of the study area, about 350 metres south of Glenmore Parkway
 - At the southern extent about 70 metres directly south of Vicar Park Lane
- **Water**
Water NSW and Sydney Water mains including the Water NSW 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.

Relocation of utilities and services

A number of utilities and services may be impacted by the project. This may include the need for realignment. The extent of impacts cannot be confirmed until the detailed design.

Strategies to address impacts may include protection or relocation of the utility, or adjustments to the project design to avoid any impacts. Either the construction contractor or the relevant utility provider would undertake utility adjustments.

CONTEXTUAL ANALYSIS



Figure 14: Above-ground utility services (source: Jacobs)

CONTEXTUAL ANALYSIS

2.4.7 Movement network and public transport

Road network

The Northern Road is an important urban arterial road. Skirting the west of the Sydney metropolitan area it links the Camden and Campbelltown areas with Penrith and Windsor. It will become increasingly important with progressive development of the SWPGA and NWPGA, as well as the WSPGA and the Western Sydney Airport.

At the local level The Northern Road provides access to rural holdings along its length, as well as the Luddenham town centre and the DEOH. It is complemented by a series of lower order roads that provide access to residential subdivisions and rural properties off The Northern Road. They include Glenmore Parkway, Wentworth Road, Chain-O-Ponds Road, Grover Crescent, Kings Hill Road, Gates Road, Littlefields Road, Eaton Road, Adams Road and Mersey Road - refer **Figure 15**.

Park Road and Elizabeth Road are state roads, providing links to Wallacia and Kemps Creek respectively.

In addition, there's a network of local roads within Luddenham town centre. Willowdene Road provides access between Luddenham town centre and rural properties to the south.

A number of changes to the road network are planned for the area, to support future growth. They are shown in **Figure 16**.

Public transport

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.

Within the study area there are currently fourteen bus stops associated with this route, located as follows and shown on **Figure 15**:

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A. Adams Road:</p> <ol style="list-style-type: none"> 1. Northbound stop located on Adams Road (stop ID: 2745186) <p>B. North of Elizabeth Drive at The Northern Road:</p> <ol style="list-style-type: none"> 2. Southbound stop (stop ID: 2745120) 3. Northbound stop (stop ID: 2745123) <p>C. 2,787 The Northern Road:</p> <ol style="list-style-type: none"> 4. Southbound stop (stop ID: 2745119) 5. Northbound stop located at 2,787 The Northern Road (stop ID: 2745124) <p>D. The Northern Road north of Gates Road:</p> <ol style="list-style-type: none"> 6. Southbound stop located at (stop ID: 2745118) | <p>E. The Northern Road south of Longview Road:</p> <ol style="list-style-type: none"> 7. Southbound stop at (stop ID: 274818) 8. Northbound stop (stop ID: 2745125) <p>F. The Northern Road south of Chain-O-Ponds Road:</p> <ol style="list-style-type: none"> 9. Northbound stop (stop ID: 2745126) 10. Southbound stop (stop ID: 274817) <p>G. Defence Establishment at Orchard Hills:</p> <ol style="list-style-type: none"> 11. Southbound stop (stop ID: 274816) 12. Northbound stop (stop ID: 2745127) <p>H. The Northern Road</p> <ol style="list-style-type: none"> 13. Southbound stop located at Truck Stop (stop ID: 274815) 14. Northbound stop (stop ID: 2745128). |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

CONTEXTUAL ANALYSIS

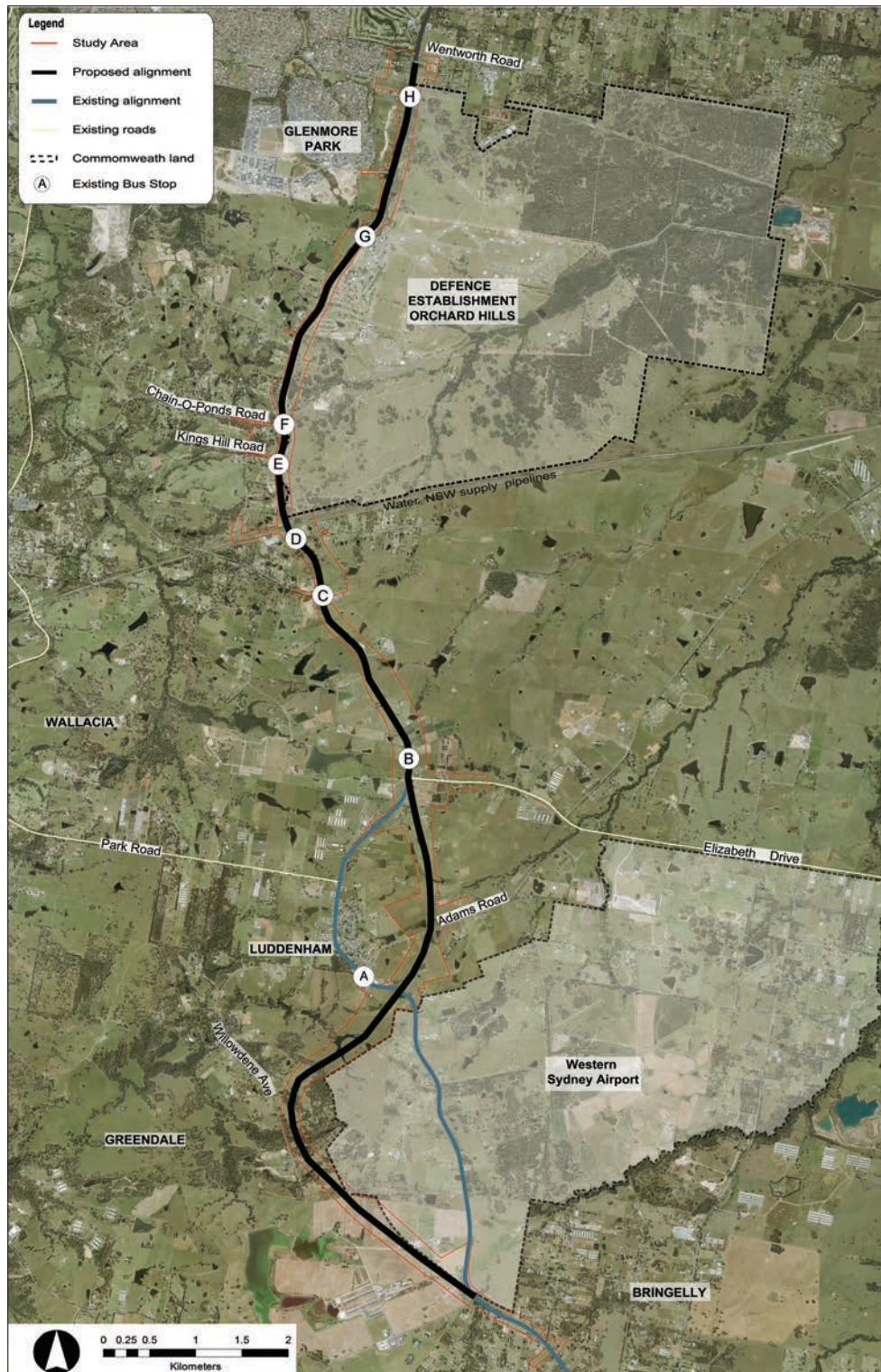


Figure 15: Existing bus stop locations

CONTEXTUAL ANALYSIS

Future public transport - buses

The SWSUDS identified a number of road corridors for the provision of bus priority infrastructure, to provide a strategic bus network that is separate from the busiest traffic routes - refer **Figure 16**.

The proposed strategic bus network is generally focused on providing internal through connections within existing and future employment areas including the WSPGA. It also provides links to future residential growth areas south of Bringelly Road.

Future public transport - rail

The NSW Government has investigated preserving an additional public transport corridor in Sydney's South West to provide a north-south rail connection through the SWPGA and WSPGA including the Western Sydney Airport. However, public transport would only partially provide a resilient connection to the Western Sydney Airport site and would be used to support existing road users and freight tasks.

Even with the provision of increased public transport there would still be a growth in traffic demand that would need to be accommodated.

CONTEXTUAL ANALYSIS

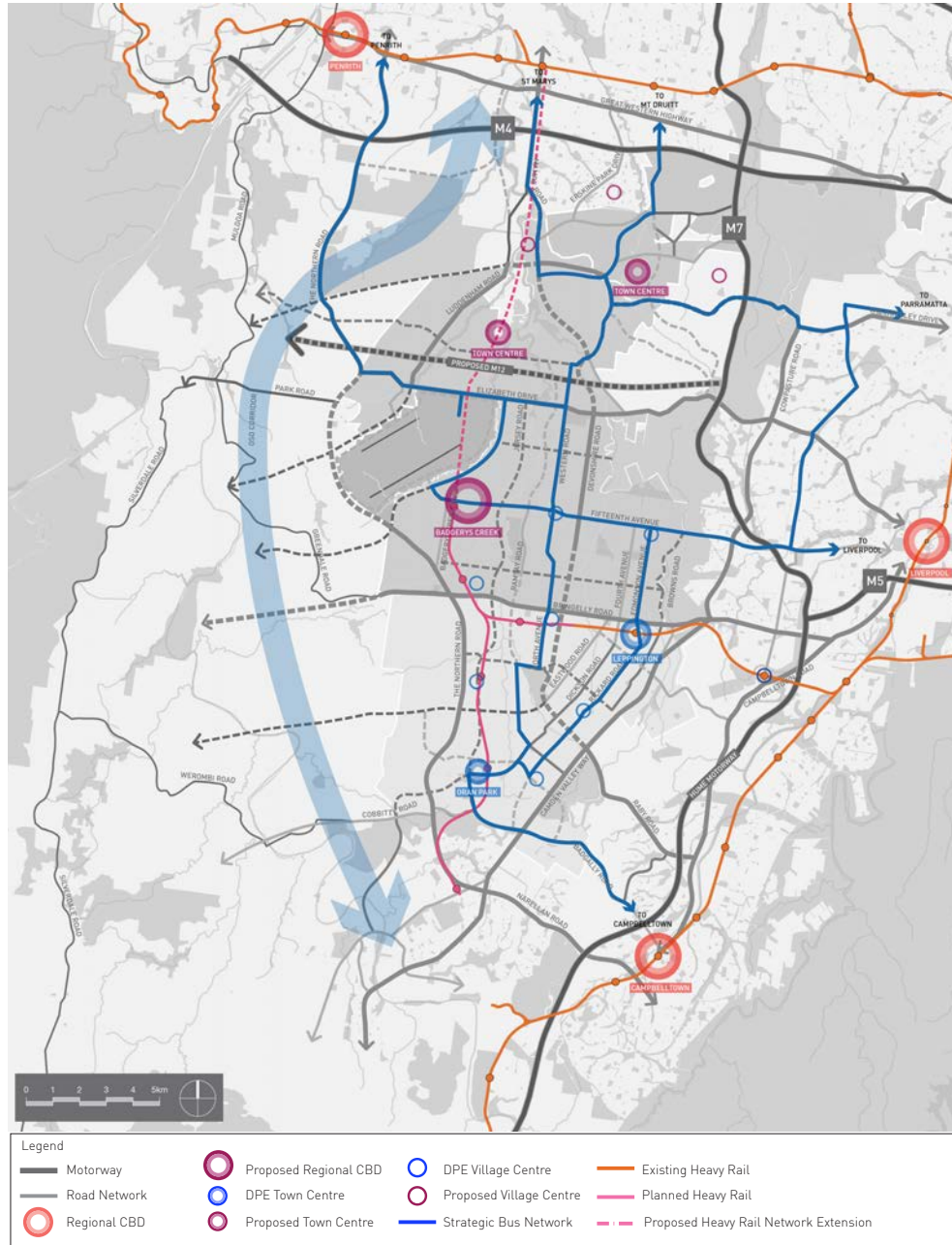


Figure 16: Proposed future urban areas and road network (Figure 2.43 from Cox 2015, p. 47)

CONTEXTUAL ANALYSIS

2.4.8 Landscape character zones

The landform and vegetation, views and vistas, settlement pattern and built structures within and adjoining the study area combine to define the landscape character of the study area.

Within the study area, a number of different LCZs can be defined based on the interplay of existing natural and built features. The LCZs are (refer **Figure 17**):

1. Bringelly - between Mersey Road and the transmission line easement
2. Duncans Creek - the Duncans Creek catchment around Willowdene Avenue
3. Luddenham Plateau - between Eaton Road and Littlefields Road
4. Cosgrove Creek - the valley surrounding Adams Road
5. Mulgoa-Orchard Hills - north of Littlefields Road.

The following provides a detailed description of each LCZ.

LCZ 1 - Bringelly

The Bringelly LCZ is situated in the upper catchment of Badgerys and Duncans Creeks and includes much of the land within the Leppington Pastoral Company. The landscape is generally broad with gently sloping ridges creating an open and expansive rural landscape setting, interspersed with remnant vegetation, farm dams and buildings. Denser vegetation along Badgerys Creek provides a frame at the southern end of this LCZ.

Currently the landscape itself is the visually most prominent element. Much of the motorist's experience relies on this 'borrowed' rural landscape outside the road corridor.

North of the TransGrid easement along the existing The Northern Road alignment, the major north-south ridge crosses the corridor. This high point represents the transition from the Bringelly LCZ to the Luddenham Plateau. From here, the major ridge runs first south-west and then south, approximately half way between the existing and proposed alignments of The Northern Road.

Long-distance views within the Bringelly LCZ are limited as a result. There are occasional glimpses of the Blue Mountains in the west with the majority of views extending into the mid distance across open pastures.

The existing character of The Northern Road in the Bringelly LCZ is consistent with its rural setting. It consists of a two lane road (one lane for each direction) with a curving horizontal and rolling vertical alignment that creates a distinct "country road" character.

It is noted that the character of this LCZ will change substantially as the Western Sydney Airport will be developed.

CONTEXTUAL ANALYSIS

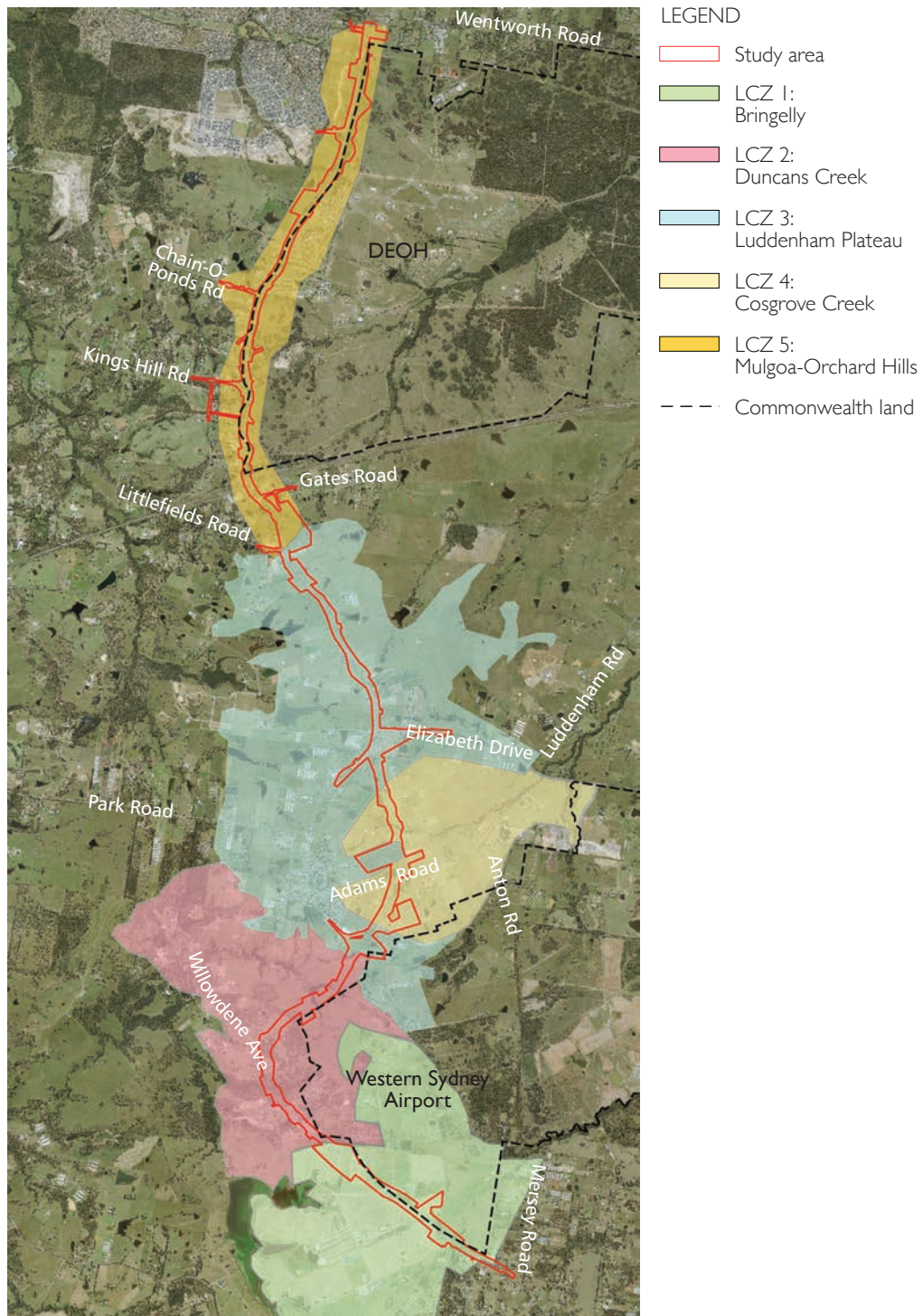


Figure 17: Landscape Character Zones surrounding the study area

CONTEXTUAL ANALYSIS

LCZ 2 - Duncans Creek

The Duncans Creek LCZ is located west of the main ridge line. It is centred around the Duncans Creek catchment and generally includes areas surrounding Willowdene Avenue.

The Duncans Creek LCZ is visually diverse. It includes a mix of open pastures and extensive stands of Cumberland Plain Woodland both around dams and along creek lines. Land uses include rural residential living, and a combination of small and large farms including horse studs.

Contrasting with the open and more gently sloping landscape around The Northern Road's existing alignment and areas further east, the Duncans Creek LCZ contains a number of steep and narrow valleys that cross Willowdene Avenue and retain extensive stands of native vegetation. As a result of the complex pattern of steep topography and remnant vegetation, the area is visually self-contained and views are generally limited to short-distance views.

Willowdene Avenue is the major public road providing access to the Duncans Creek LCZ. It is a generally narrow two-lane country road that gently curves to follow the natural undulations of the landscape without major cut or fill embankments.

The parts of the Duncans Creek LCZ east of the proposed new road alignment are located within the site of the Western Sydney Airport. This area will change substantially as the airport is developed.

There are currently no published plans that indicate that the part of the LCZ west of the proposed new road alignment will change in the foreseeable future. The proposed new road alignment is therefore likely to form the boundary between two distinct future land uses and their respective landscape character.

LCZ 3 - Luddenham Plateau

The Luddenham Plateau LCZ is characterised by its location along a broad ridge from where the landscape drops away to the east and west, creating the character of a high plateau characterised by open sky and expansive views in all directions. This landscape setting provides for panoramic views into the surrounding landscape, ranging from the Blue Mountains in the west to Cecil Hills and the Western Sydney Parklands in the east.

The LCZ has been extensively cleared, and retains only scattered remnants. The majority of land is used for a variety of agricultural purposes with the exception of the Luddenham town centre, located towards the southern end of the LCZ. Luddenham is a small rural settlement that is distinct from surrounding areas by its relatively tight clustering of buildings.

Luddenham town centre is the local centre servicing surrounding rural areas. It features community services and institutions including a post office, churches and schools, the local showground and parks, as well as a number of shops including cafes, service stations and a supermarket. They are surrounded by a small conglomeration of residential dwellings on suburban blocks.

Vegetation within the town consists of a mix of native vegetation remnants and cultural plantings associated with residential properties including exotic trees and shrubs and manicured lawns.

While buildings and trees limit views to a degree, there are some expansive views from Luddenham town centre towards the east and west, including along a number of streets, from properties around the perimeter of the town and from parks or across vacant lots.

CONTEXTUAL ANALYSIS

The Northern Road within the Luddenham Plateau LCZ generally follows the ridge line. As a result motorists enjoy extensive panoramic and long-distance views. In particular the Blue Mountains provide an almost constant backdrop to the west, with the exception of Luddenham town centre where views are partially interrupted by buildings and vegetation.

Views create highly memorable moments along the route and much of the motorists' experience is defined by the 'borrowed' landscape outside the road corridor. Long-distance views to the Blue Mountains and the Western Sydney Parklands are also important because they connect the corridor to its larger landscape setting and create a unique sense of place.

The character of The Northern Road within the LCZ is consistent with the rural setting. It is comprised of a two lane road (one lane for each direction) with a gently curving horizontal and vertical alignment.

It is noted that the character of the parts of the LCZ east of the proposed new road alignment will change substantially as the Western Sydney Airport will be developed. Similarly to the Duncans Creek LCZ, there are no current plans that indicate major changes to land uses around Luddenham town centre and along The Northern Road north of Elizabeth Drive.

LCZ 4 - Cosgrove Creek

Cosgrove Creek LCZ is located between Eaton Road and Elizabeth Drive and includes land along Cosgrove Creek and its tributaries. The land in this area has been extensively cleared and retains only scattered remnants, mostly along Cosgrove Creek and its tributaries. The majority of the land is used for rural uses including rural residential living and small farms.

As for the Duncans Creek LCZ, the character of Cosgrove Creek is unique in comparison to the majority of the gently undulating landscape surrounding much of the study area. It is characterised by a series of small but sharply defined and relatively steep valleys that are in sharp contrast to the broad landscape of the Luddenham Plateau.

Adams Road is at the heart of the LCZ and follows the main valley floor along Cosgrove Creek. It provides an important link between the Luddenham town centre and the north-eastern parts of Luddenham around Luddenham Road. Within the Cosgrove Creek LCZ Adams Road is a two-lane country road framed by relatively steep hills to the south and a series of farm dams stepping down along the valley on its northern side.

Due to the topography, views from within the Cosgrove Creek LCZ are generally limited to short- to mid-distance views contained by surrounding ridge lines. However, the area is exposed to views into it from surrounding elevated areas, in particular from the higher ridges of the Luddenham Plateau such as along The Northern Road and Eaton Road.

It is noted that Cosgrove Creek is located within the WSPGA. As a result, the landscape character of this zone will likely change substantially over the coming decades, as the area is progressively developed for employment lands.

CONTEXTUAL ANALYSIS

LCZ 5 - Mulgoa - Orchard Hills

The character of the landscape changes at Littlefields Road as the main north-south ridge narrows and the topography surrounding the road corridor becomes more varied, steeper and more sharply defined. Land use consists of smaller rural holdings, rural residential living as well as the DEOH. The Mulgoa-Orchard Hills LCZ retains considerably more remnant native vegetation than is the case for the LCZs to the south.

The Mulgoa-Orchard Hills LCZ is characterised by being visually largely self-contained, as topography and vegetation cover combine to close off the panoramic views characteristic of the Luddenham Plateau. There are mid-distance views to the east framed by the rolling ridges and remnant woodlands within the DEOH. The major north-south ridge for the most part is located just west of the road corridor and is relatively steep, limiting views towards the west to areas immediately adjoining the road corridor. As the road rises and falls between a series of high points, there are occasional brief glimpses towards the Blue Mountains.

The Northern Road is consistent with the rural setting. It consists of a two lane road (one lane for each direction) with a gently curving horizontal and vertical alignment.

The character of this LCZ is unlikely to change in the foreseeable future as there are no known plans for land use changes. While residential estates are being developed in areas such as Glenmore Park, they are located west of the main ridge line and are not visible from The Northern Road corridor.

CONTEXTUAL ANALYSIS

2.5 SUMMARY OF KEY FINDINGS

The following summarises the key findings and values from the analysis in terms of the opportunities they represent for the urban and landscape design:

1. **Distinct land uses**

The section of The Northern Road proposed to be upgraded will be defined to a large extent by adjoining land uses.

Opportunity:

Design the corridor to reinforce and reflect this distinction, as follows:

- Rural landscape in the north comprising of rural, rural residential and Defence uses
- A combination of rural, airport and employment lands in the south

2. **Interface location of the re-aligned corridor section**

In the southern part of the study area, The Northern Road will be located at the interface between rural and urban (future airport and employment lands).

Opportunity:

Design the corridor to enhance the interface and reinforce the rural character of areas to the west.

3. **Areas of scenic and landscape values:**

Large parts of the study area and surrounding lands in the Penrith LGA are recognised as possessing important scenic and landscape values that are captured by environmental planning instruments.

Opportunity:

Protect scenic and landscape values, by minimising the scale of the infrastructure where possible and by reinforcing the existing landscape and scenic character.

4. **Panoramic views**

The area around the Luddenham town centre is located on a high plateau that affords panoramic views in all directions, extending east to Western Sydney Parklands and west to the Blue Mountains. The Blue Mountains provide a constant blue ribbon framing the western outlook. These views are integral to the sense of place of the area, provide a sense of geographic location for motorists and contribute substantially to the scenic value and tourism potential of the drive along The Northern Road.

Opportunity:

Retain panoramic views for both motorists and viewers from surrounding areas, to maintain the sense of place as well as a visually exciting drive.

5. **Remnant Cumberland Plain Woodland**

The area retains areas of endangered Cumberland Plain Woodland, in particular around the perimeter of the Western Sydney Airport site and north of the Water NSW supply pipelines.

Opportunity:

Protect and enhance remnant vegetation. Carefully balance softworks for the proposed upgrade with the operational requirements of the Western Sydney Airport and the desire to maintain distinct views.

CONTEXTUAL ANALYSIS

6. Creeks and farm dams

There are a number of creeks in the area, as well as a large number of farm dams. Both are frequently associated with vegetation remnants and make an important contribution to the landscape and visual character and the experience of the drive, including its scenic values. Creeks have also been identified as holding potential to provide regional recreational links, integral to the realisation of the *Sydney Green Grid* (refer **section 2.2.2**).

Opportunity:

Celebrate creek crossings and design them to enhance their potential as ecological links, as well as potential future regional pedestrian cycling links as identified in the *Sydney Green Grid*.

3. DESCRIPTION OF THE PROJECT

3.1 OVERVIEW

3.1.1 Key features

Roads and Maritime is seeking approval to upgrade 16km of The Northern Road between Mersey Road, Bringelly and Glenmore Parkway, Glenmore Park (the project). 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 separated by a wide central median) with a wide central median allowing for provision of an additional travel lane in each direction in the future, if required
- An eight-lane divided road between Bradley Street, Glenmore Park 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)
- 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 provide a bypass to access the Luddenham town centre
- About eight kilometres of upgraded and widened road between the existing Elizabeth Drive, Luddenham and about 100m 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:
 - 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
 - Traffic light intersection for service vehicle access to the Western Sydney Airport, incorporating 160m of new road connection to the airport boundary
 - Traffic light intersection connecting the realigned The Northern Road with the existing The Northern Road (west of the new alignment) south of Luddenham
 - An un-signalised (give way controlled) intersection 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 gates, Orchard Hills, incorporating a u-turn facility.
- New traffic light signals 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.

PROJECT DESCRIPTION

- 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, southwest of Elizabeth Drive
 - Chain-O-Ponds Road, Mulgoa
 - The existing Elizabeth Drive, Luddenham around 800m east of The Northern Road.
- A bridge 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 300m east of The Northern Road with a connection to the realigned Elizabeth Drive, Luddenham
 - Extension of Littlefields Road east of The Northern Road, Mulgoa
 - New roundabout on the Littlefields Road extension, Mulgoa
 - A new service road between the Littlefields Road roundabout and Gates Road, including an un-signalised intersection (give way controlled) 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 pedestrian paths on the eastern side of The Northern Road
- Drainage infrastructure upgrades
- 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 located 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
- Utility services relocations
- 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.

PROJECT DESCRIPTION

3.1.2 Road design standards

The road geometry and earthworks has been designed using the following engineering standards listed in order of precedence:

- Roads and Maritime and RTA Publications (including 'RTA Road Design Guide')
- Austroads Publications
- Australian Standards
- Other Reference Documents and Standards.

The engineering design parameters for the road works component are summarised in the following sections.

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 some areas of local steepening to 1 in 2 where required
Fill batter slope	Generally 1 in 4 but some areas of local steepening to 1 in 2 where required
Bench width	4 m cut; 4.5 m fill
Design Vehicle	B-double

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 Chain-O-Ponds Road – 70 km/h Bradley Street – 80 km/h
Design speed	Design speed generally the same as the posted speed

PROJECT DESCRIPTION

Design parameter	Value adopted in the design
Minimum grade	1 %
Maximum grade	6 %
Cut batter slope	Generally 1 in 4 but some areas of local steepening to 1 in 2
Fill batter slope	Generally 1 in 4 but some areas of local steepening to 1 in 2
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 (List others north of Adams Road)

3.1.3 Road design drawings

The plans in **Figures 18, 19 and 20** on the following pages show the key design features of the proposed road design concept for the proposed upgrade. Typical road design cross sections are provided in **Figures 21 to 23**.

3.1.4 Water Quality and drainage design

A number of operational water quality swales are proposed across the project to capture suspended solids and reduce nutrients, including eleven swales which have been optimised to provide additional water quality treatment upstream of the five identified sensitive receiving waterways for the project (i.e. Key Fish habitat - refer **section 2.4.2**).

Optimisation measures include increased base width and rock check dams that would slow down runoff, allowing it to temporarily pond. For further detail refer the *Soils, water and contamination assessment* (Appendix L of the EIS).

Aquatic impacts

The project would require the traversing of minor waterways and farm dams. The construction and operation of the project has the potential to impact aquatic ecosystems due to changes in water quality, habitat loss and instream barriers. Inappropriate design or type of water crossing can impede or prevent fish from travelling within their natural range and barriers to fish passage can prevent breeding or re-population of waterways through restricting access to spawning grounds. For more information refer to the *Biodiversity Assessment Report* (Appendix I of the EIS).

Water crossing structures have been designed to minimise the impacts of altering the natural flow regimes of the rivers and streams within the region. The design took into consideration all waterways within the study area. Detailed design of these culverts would ensure that barriers to fish are not created, and that they are designed as fish friendly crossings, to ensure that barriers to fish are not created and impacts to the existing hydrology are minimised. For further detail refer the *Soils, water and contamination assessment* (Appendix L of the EIS) and the *Flooding and Hydrology Technical Working Paper* (Appendix K of the EIS).

PROJECT DESCRIPTION

The urban design concept has responded to this approach by maximising native vegetation along existing creek lines and to connect existing bushland remnants where possible within the construction footprint, to enhance the ecology and drainage systems of the area - refer **section 4** and **section 5**.

3.2 A NOTE ON LANDSCAPE CHARACTER AND VISUAL IMPACTS

As a result of the road design parameters and the physical manifestation of that design, it can be expected that there will be an impact on the existing landscape character and views.

All works associated with the proposed works are assessed as part of the LCVIA including permanent and temporary works.

Temporary impacts are short term, direct and indirect impacts during the construction phase of the proposed works. Examples include establishment and use of construction site compounds and general daily construction activities, including material storage and stockpile sites.

Construction site compounds would comprise offices and material laydown areas and would be fenced and generally covered in hardstand. Offices would generally be prefabricated and material storage areas would include purpose built temporary structures as required. Construction site establishment would involve the placement of temporary concrete safety barriers and fencing to create a safe work zone.

Temporary works and structures have the potential to have lasting impacts. An example would be where mature vegetation required to be cleared to allow establishment of a construction compound. The visual and landscape character impacts from the loss of established vegetation would persist following removal of the compound. Wherever possible, compound site locations have been limited to areas that would not require vegetation clearing beyond that already required for the project.

The landscape character and visual impacts of the proposed works are described in **section 6** and **section 7** of this technical paper.

PROJECT DESCRIPTION

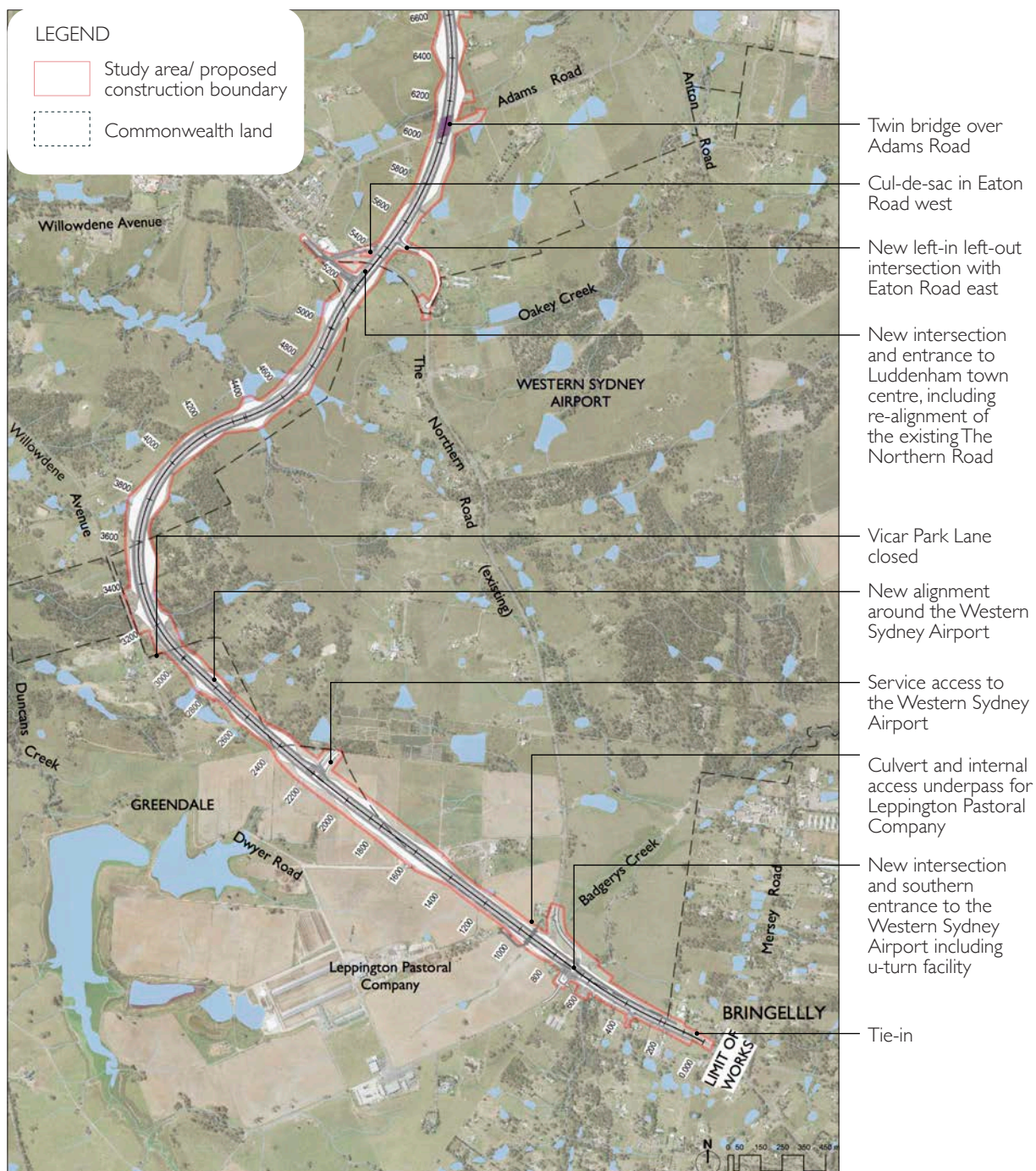


Figure 18: The proposed works - Mersey Road to Adams Road

PROJECT DESCRIPTION

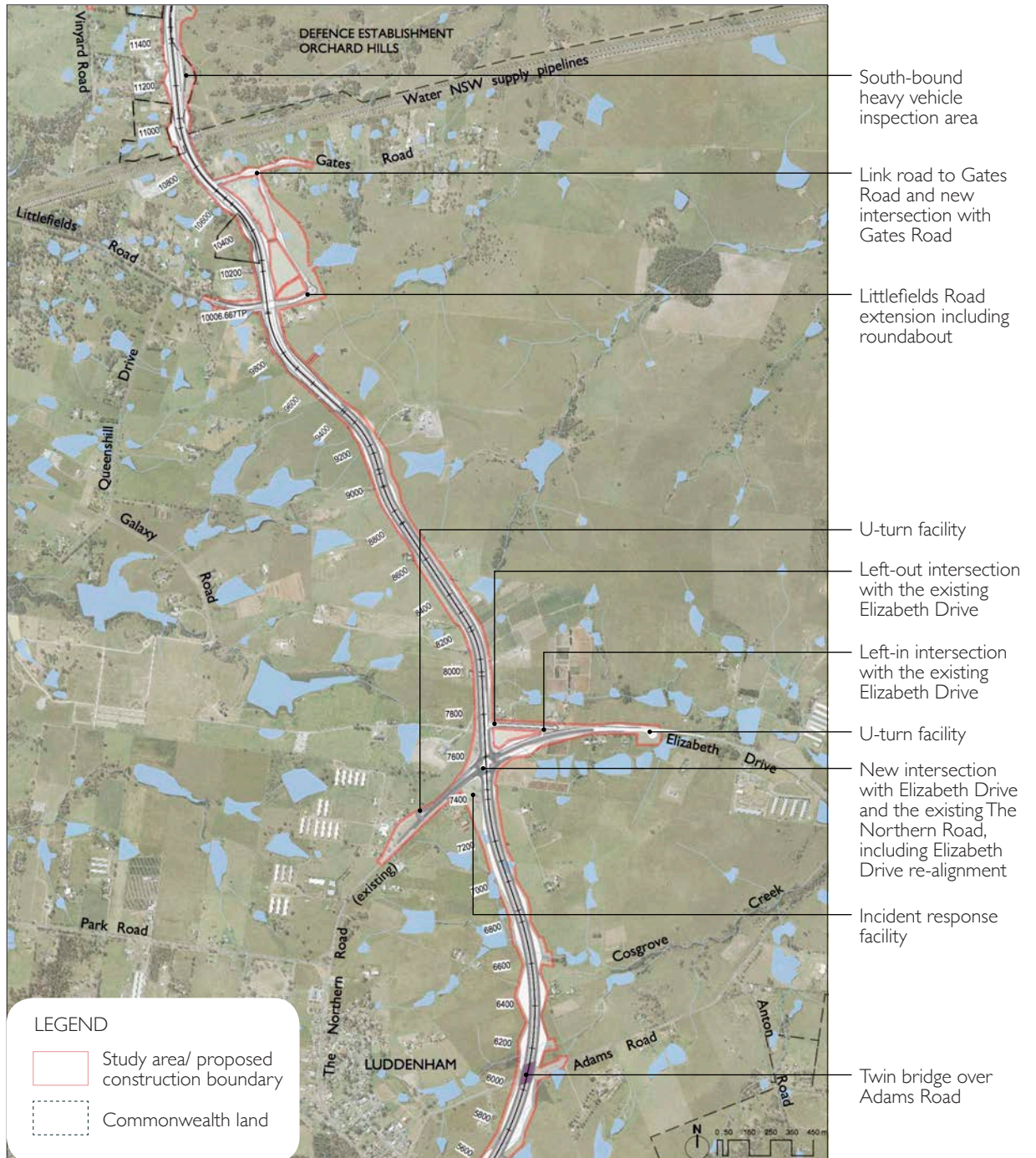


Figure 19: The proposed works - Adams Road to Water NSW supply pipelines

PROJECT DESCRIPTION

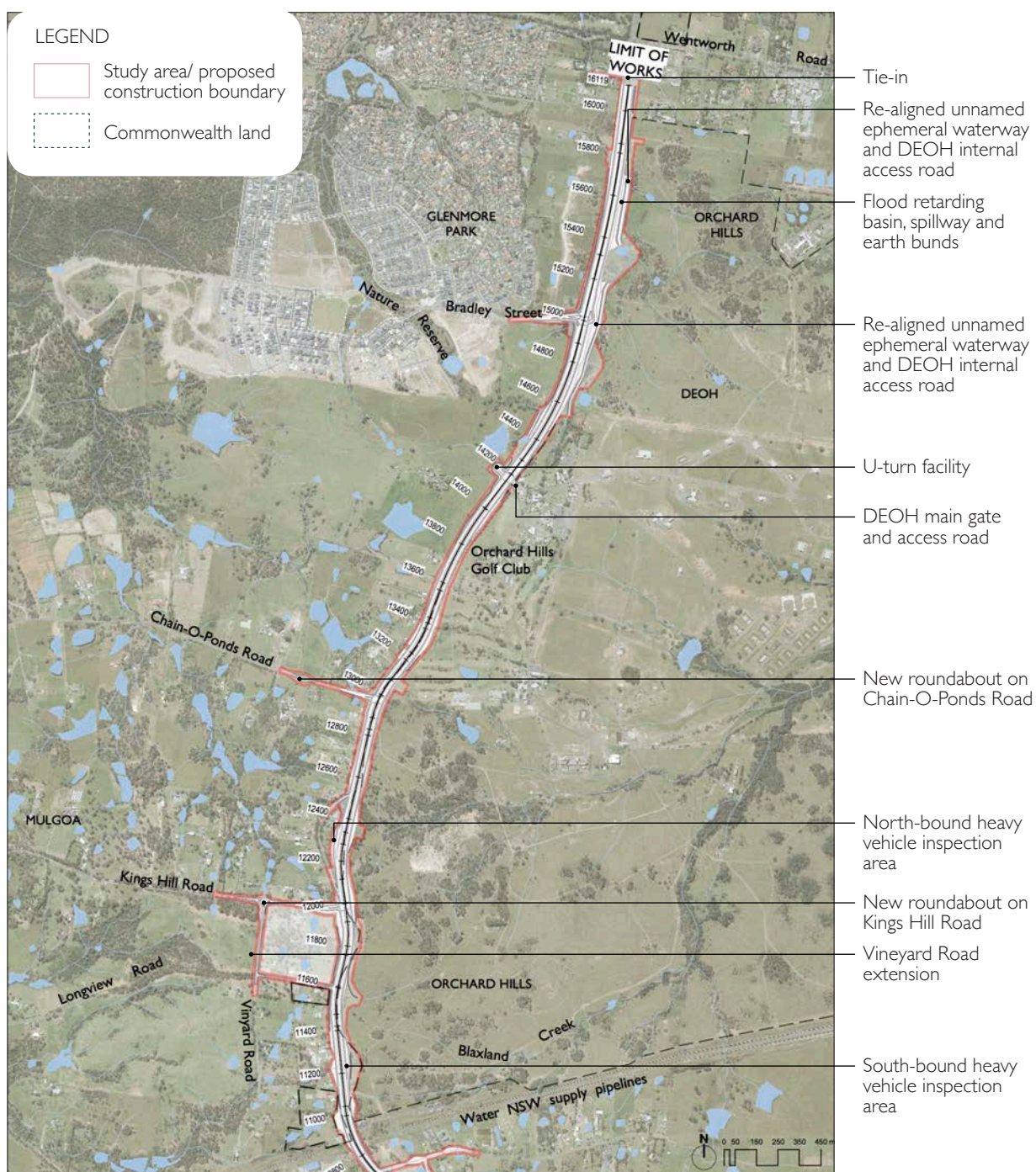


Figure 20: The proposed works - Water NSW supply pipelines to Glenmore Parkway

PROJECT DESCRIPTION

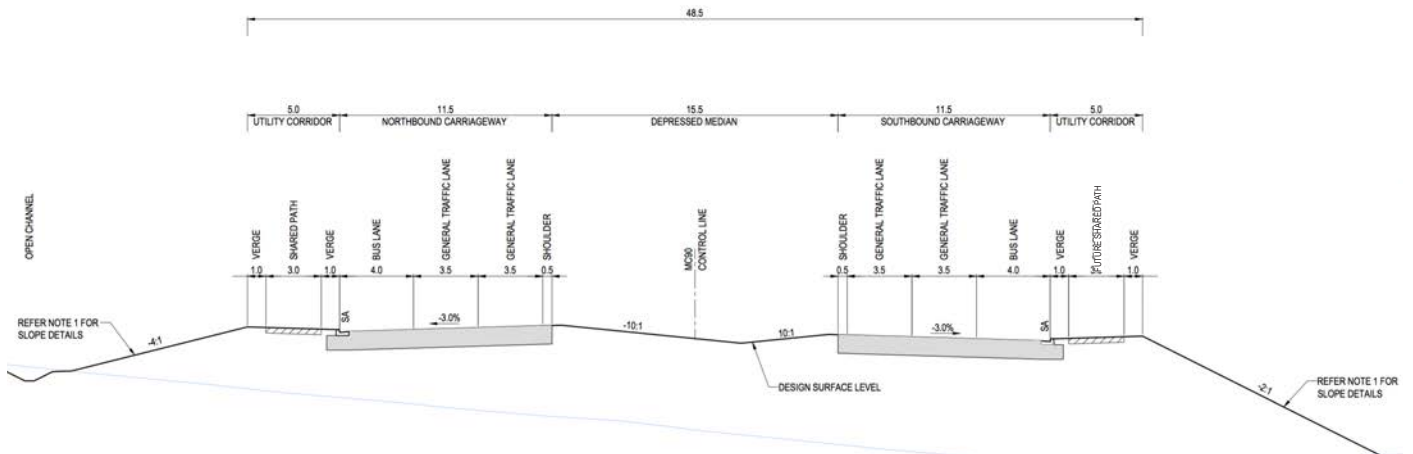
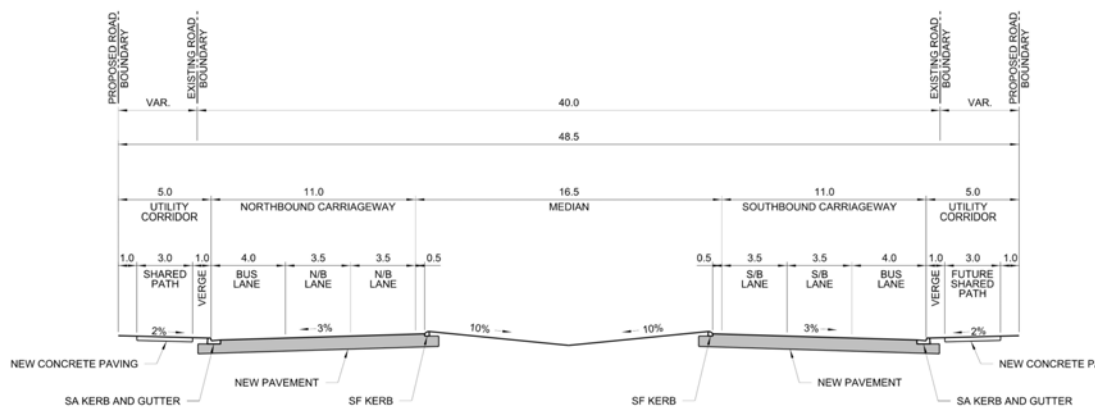


Figure 21: The proposed works - typical cross section between Mersey Road and Adams Road (source: Jacobs 2016)



The proposed works - typical cross section between Littlefields Road and Bradley Street (source: Jacobs 2016)

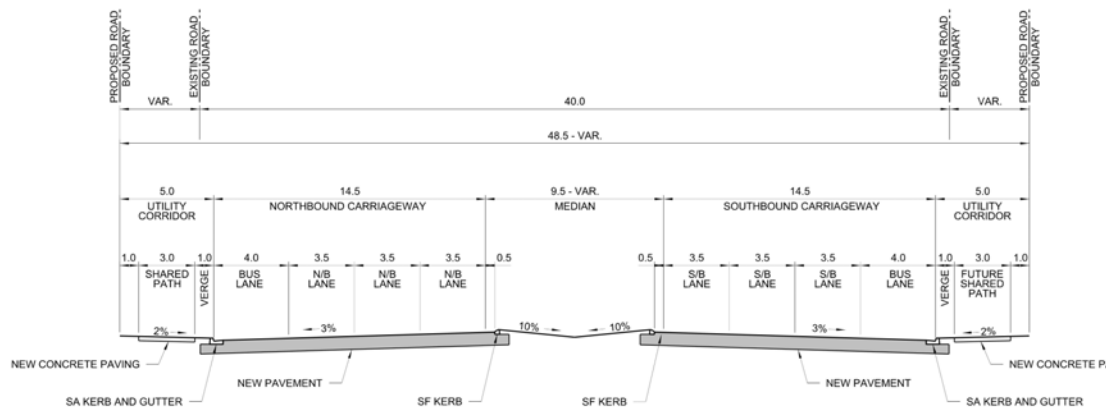


Figure 22: The proposed works - typical cross section between Bradley Street and Glenmore Parkway (source: Jacobs 2016)

PROJECT DESCRIPTION

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4. URBAN DESIGN OBJECTIVES

In any road upgrade, the experience of the road user and viewer is improved through careful consideration of all road design elements. They include cut and fill batters, walling, drainage structures, bridges, fences and barriers, planting and landscaped surfaces.

To guide the design of these elements urban design objectives are provided.

The objectives define the most important outcomes to be achieved as a result of the project, taking into account both the road corridor and its relationship with surrounding areas. Urban design objectives would be implemented in accordance with the performance themes of safety, cost effectiveness and sustainability as outlined in *Beyond the Pavement*.

4.1 URBAN DESIGN VISION FOR THE NORTHERN ROAD

The following vision statement articulates the desired outcome for The Northern Road within the study area.

The Northern Road will provide safe and efficient travel for motorists, public transport and active transport, both within, to and across the corridor. The planning and design of the road corridor will respond to the adjoining landscape and built context. Acknowledging likely future land use changes, the design for the proposed upgrade will enhance the contrast between future urban areas and areas retaining their rural land use. The latter include areas in Mulgoa and Orchard Hills known to possess significant scenic and landscape values. At the same time the proposed upgrade will provide an attractive experience on the approach to the Western Sydney Airport from the north and south that will assist in promoting a positive image for locals and visitors alike.

It is noted that the future character and quality of the experience of the road will be determined not only by the planning and design of future upgrades of the road, itself but substantially by the planning, design and development of land adjoining the corridor including the Western Sydney Airport. In that sense the vision relies on a commitment by the Commonwealth, State and Local Government agencies to address the issues raised in this technical paper; and to implement the urban design objectives, principles and strategies set out in this section.

URBAN DESIGN OBJECTIVES

4.2 URBAN DESIGN OBJECTIVES AND PRINCIPLES

The urban design objectives and principles for the project have been developed based on:

- **The Brief**
The brief for the project seeks to develop and present an integrated engineering and urban design outcome that:
 - Fits sensitively into the built, natural and community environments through which they pass, is well designed and contributes to the character and functioning of the area
 - Contributes to the accessibility and connectivity of people within regions and communities
 - Contributes to the overall quality of the public domain for the community and all road users.
- **The South Western Sydney Urban Design Strategy**
The SWSUDS provides guidance in respect of the desired outcomes for the road network of the area.
- **The Northern Road Corridor Plan of Management (CPoM) Narellan to Bringelly**
The *Northern Road CPoM* provided design objectives and principles for the sections of The Northern Road south of Bringelly Road. Consistent with the corridor approach to the design of the road network promoted by the SWSUDS, these objectives and principles are of relevance to achieve a consistent corridor outcome.
- **The Northern Road upgrade 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**
Beyond the Pavement is the overarching Roads and Maritime policy guiding urban design on all its projects. It outlines nine design principles to achieve an integrated engineering and urban design outcome for all Roads and Maritime projects.

The following four overarching urban design objectives have been adopted:

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

The following pages provide the more detailed urban design principles for each of the four objectives.

URBAN DESIGN OBJECTIVES

Objective 1: *Protect and enhance existing views, character and cultural values of the corridor.*

VIEWS AND VISTAS

- Provide an interesting driver experience by drawing on existing vistas and views to create contrast between open and enclosed sections of the route
- Maximise opportunities to enhance the driver experience through views into the surrounding landscape to foster a sense of place and local connection. In particular, maximise and enhance opportunities for views of the Blue Mountains and the Prospect Ridge
- Retain existing views beyond the road corridor, especially views to the Blue Mountains and panoramic views from the Luddenham Plateau, to establish a sense of place for the journey along The Northern Road.

LANDSCAPE CHARACTER

- Retain and reinforce the diverse character of the route, including the distinction between the rural north and west and future residential employment lands in the east and south, taking advantage of rural lands to provide an attractive gateway to and from the WSPGA and the Western Sydney Airport.
- Maintain, reinforce and integrate the diversity of landscape types and characters into the design of the road corridor, including the distinction between woodlands, open pastures and small rural holdings as well as future employment and airport lands
- Maintain and enhance the landscape experience of the drive
- Screen future industrial areas from the corridor to maintain the landscape experience and scenic values of the route and use vegetation to frame views of the rural landscape
- Enhance intersections as key landscape nodes that build on the current landscape character and provide an attractive landscape along the route
- Integrate and enhance - and where required reinstate - existing indigenous vegetation communities, to enhance the sense of place, maximise integration with the existing landscape setting, restore ecological values and assist in biodiversity protection and recovery
- Strengthen riparian corridors and creeks through regenerative planting and design creek crossing to enable future pedestrian/ cycle links along creeks and across the corridor, to assist with the establishment of an interconnected network of open space consistent with the Sydney Green Grid.

CULTURAL VALUES

- Recognise and protect the character of the Luddenham town centre
- Retain and protect existing heritage and scenic values of the area
- At entrances to the Luddenham town centre, provide feature planting that is consistent with the character of the town.

URBAN DESIGN OBJECTIVES

Objective 2: *Provide a flowing road alignment that is responsive to, and integrated with the natural and built landscape.*

LANDSCAPE AND VEGETATION

- Prioritise the replanting of EEC where these have been removed or where the *Biodiversity Assessment Report* (Appendix I of the EIS) identifies the need to enhance corridors
- Reduce median widths to create wider areas for new trees and other vegetation along the edges of the corridor while maintaining opportunities for vegetation in the median
- Enhance the scenic and landscape values of Orchard Hills with new trees to complement existing woodlands
- Devise a landscape strategy that is consistent with the landscape character adjoining the road corridor, including existing uses and settlement patterns, and proposed future land uses
- Control the placement of utilities in the corridor. Locate utilities in a way that maximises vegetation opportunities, particularly at the interface with the Orchard Hills Scenic Landscape Area
- Use safety barriers to maximise areas available for new trees in medians, between carriageways and along utility corridors.

HYDROLOGY

- Protect creeks and creek banks by maximising tree retention and reinstatement at creek crossings
- Develop designs for creek and road crossings having consideration for the local hydrology and ecology of the area. In particular, ensure physical continuity of natural streams and maintain ecological links across the road corridor to protect and conserve the existing ecology and habitat
- Regenerate native vegetation around creek crossings to provide a landscape buffer and enhance creeks as ecological corridors
- Design stormwater management and water quality controls to protect receiving waterways and contribute to a positive landscape and visual outcome. Integrate natural materials to provide for habitat.

LANDSCAPE FIT

- Minimise the corridor footprint and the extent of cuttings and embankments on the outsides of the corridor by independently grading the carriageways, using the median to mitigate level changes
- Design major formations like embankments and mounding to mirror the natural topography of the landscape as much as possible and to create a seamless fit with the existing setting. Design embankments to maintain the sense of an open and expansive landscape with uninterrupted views for both motorists and people in surrounding areas
- Minimise the footprint and scale of the road, intersections, overhead structures and associated fill embankments to reflect the gently undulating rural setting.

STRUCTURES

- Where required, design structures including retaining walls and embankments to reflect and integrate with the adjoining largely rural setting and to maintain the open landscape character
- Design drainage structures as landscape elements to enhance and complement the rural landscape interface and incorporate water sensitive urban design (WSUD) to treat stormwater before entering creeks or permanent water bodies.

URBAN DESIGN OBJECTIVES

Objective 3: *Facilitate the provision of good urban design outcomes for areas adjoining the road.*

COMMUNITIES

- Protect the amenity of surrounding communities, in particular the rural town of Luddenham, rural residential areas and farms
- Design intersections to provide attractive and inviting entrances to Luddenham
- Minimise lighting and signage as much as possible to reflect the predominantly rural character of the area to the west of the corridor. Ensure all lighting and signage is unobtrusive in the landscape, including at night.

ACCESS TO PUBLIC TRANSPORT AND OPPORTUNITIES FOR ACTIVE TRANSPORT

- Retain and maximise the accessibility and connectivity of adjoining existing and future communities for all users including motorists, public transport users, cyclists and pedestrians. Maximise the safety, convenience and ease of access through direct routes and connections
- Ensure ease of access to bus stops, including from the local street network and across the road corridor from both existing and future destinations such as residential centres and employment areas
- Provide a high level of amenity at bus stops including protection from sun, wind and rain, as well as lighting for orientation and safety
- Maximise opportunities for active transport connections. In particular, provide opportunities for pedestrian and bicycle access from The Northern Road to public transport and future employment areas including the WSPGA and the Western Sydney Airport, to encourage greater active transport use.

ACCESS

- Maintain short- and medium-term access to lands within the Western Sydney Airport during construction
- Provide for access to all properties from and across the corridor, including access between farm lands bisected by the new alignment
- Maximise the visibility of paths and shared paths from adjoining areas for good surveillance, sight lines and ease of orientation
- Provide lighting to shared paths and footpaths, consistent with statutory requirements, to ensure paths are safe and attractive for use during the evening and night-time.

Objective 4: *Develop a simple and unified palette of elements and details that are attractive and easily maintained.*

- Use robust, high quality and durable materials that minimise opportunities for vandalism
- Provide simple finishes that remain subservient to the landscape
- Design bridges as structures to appear as simple and elegant structures of contemporary form and scale that complement the surrounding environment
- Design the soffit of bridges with a visually attractive form, particularly in areas that will be highly visible to motorists and the general public
- Generally limit road lighting to major intersections to reduce glare and retain the character of existing rural areas along the corridor.

URBAN DESIGN OBJECTIVES

4.2.1 Urban design principles for road design elements

Standard road elements may include road furniture (safety barriers, pedestrian and shared path fencing, bus stops, street lighting, signage), retaining walls, shared paths and bridges. Principles have been developed to guide the design development of standard road design elements, as described in the following section.

Pedestrian and shared paths

- Provide a planted verge of at least 0.8 metres for native grasses between the back of kerb and the path, to provide physical separation from the carriageway. Where the width of the planted verge would be narrower than 0.8 metres, replace the verge with additional paving to provide a wider (shared) path
- Maximise the visibility of paths and shared paths from adjoining areas for good passive surveillance, sight lines and ease of orientation
- Concrete to be broom finished. Use a mid grey colour to reduce glare. Use exposed aggregate thresholds with adequate tonal variation to alert cyclists to potential points of conflict such as upcoming intersections or bus stops
- Make provision for connections to future residential and employment areas in the SWPGA, WSPGA and the Western Sydney Airport.

Fencing

- Maintain a scale and rhythmic use of fencing elements consistent with surrounding land uses, for example, where the road adjoins rural properties, use visually open fences similar to existing fence styles
- Provide a cyclist safety rail on bridges and other areas as required - refer **Figure 24**.
- On bridges, provide transparent safety barriers and anti-throw screens to maximise opportunities for views - refer **Figure 24 and 25**.

Bus stops

- Provide sufficient area to accommodate bus stop infrastructure including bus shelters, signs and shared paths
- Ensure ease of access to bus stops, including from the local street network and across the road corridor
- Provide a high level of amenity at bus stops including protection from sun, wind and rain
- Ensure bus stop areas are well lit for orientation and safety
- Provide transparent sides on bus shelters for maximum passive surveillance and views of the road corridor and of approaching buses
- Provide textured ground surface finishes to differentiate the bus shelter zone, for example exposed aggregate concrete. Provide enough space for the shared path to continue through the bus stop zone.

Lighting fixtures

- Provide street lighting or adjustments to existing street lighting as required
- Provide street lighting along the full length of the project to light the carriageway and shared path
- Design or adjust existing and proposed street lighting in the vicinity of the Western Sydney Airport site to ensure lighting intensity, configuration and colour meets the relevant guidelines, including but not limited to:

URBAN DESIGN OBJECTIVES

- The *National Airports Safeguarding Framework Guideline E: Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports*
- *Regulation 94 of the Civil Aviation Regulations 1988*
- As much as possible design road lighting to reduce glare and retain the character of existing rural areas along the corridor while creating a safe place and meeting statutory requirements
- Use planting to minimise the potential for direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting (including lights from a passing vehicles) to adversely affect wildlife
- Where possible, use vegetation to provide visual buffers reducing the potential for glare and headlight disturbance to residents adjoining the corridor
- Light fixtures and fittings are to be of the standard adopted for other areas of the SWPGA and WSPGA.

Bridges

- Provide simple and elegant structures designed in accordance with the *Roads and Maritime Bridge Aesthetics Guidelines*
- Ensure a consistent geometry of all bridge elements.
- Minimise disturbance to creek beds and riparian zones including farm dams and remnant vegetation
- Use viaducts and spill-through abutments instead of reinforced retaining structures to support bridges to maximise openness and natural light levels beneath bridges, and to avoid a 'tunnel' effect - refer **Figure 25**
- Provide a separate bridge deck for each carriageway to maximise light access below the Adams Road bridge
- Provide cyclist safety barriers on bridge to separate shared paths from carriageways - refer **Figure 24**
- Ensure that a neat and simple transition is provided between the bridge rail and the road safety barrier - refer **Figure 24**
- Provide transparent throw screens and ensure that the throw-screen is well integrated with the bridge structure - refer **Figure 24** and **Figure 25**.

Drainage infrastructure

- Maximise "green" infrastructure over hard engineering solutions, including drainage structures and swales, to maintain and protect the rural landscape character and outlook
- Produce positive urban design outcomes and minimise impacts on the natural environment through WSUD treatments to stormwater before entering major creeks. Ensure that treatment systems and any proposed stormwater controls are consistent with the landscape and visual values of the area, provide a landscape buffer and enhance creeks as ecological corridors.
- Where hard engineering structures or surfaces can't be avoided, maximise the use of natural rock over concrete for improved visual integration with the adjoining rural landscape
- For creeks identified as important fish habitat design fish friendly crossings and provide light wells to culverts to maximise light access and to maximise the potential for creeks to continue to function as ecological links through covered sections.

Note: no permanent water quality or sedimentation basins are proposed.

URBAN DESIGN OBJECTIVES



Figure 23: Examples of neat and simple integrated safety barriers between the carriageway and the shared path. Transparent throw screens provide for views into surrounding areas (source: <http://www.noise-barriers.org/img/clear-sound-barrier.jpg>)

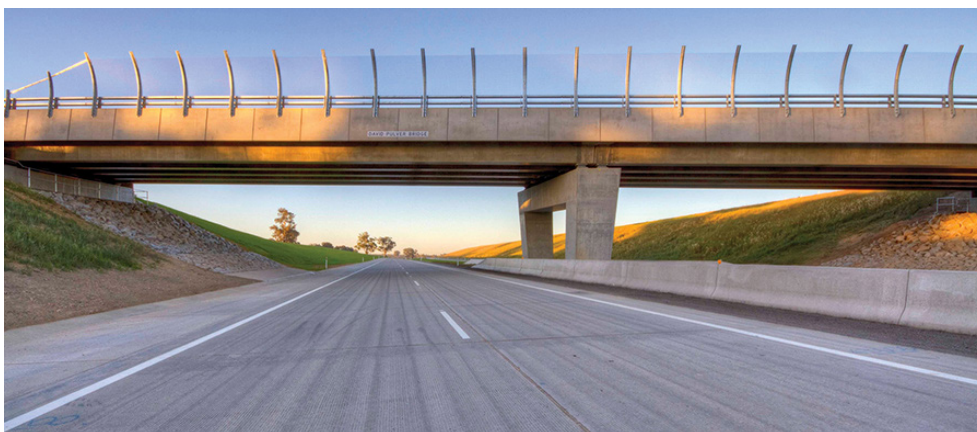


Figure 24: This bridge designed for the Hume Highway Duplication provides an example of visually transparent wire mesh throw screens, as well as of how the sense of openness under the bridge can be increased through the use spill-through abutments that avoid a 'tunnel feel'. It further illustrates an example of a simple and bold pier design (source: <http://www.rms.nsw.gov.au/projects/planning-principles/centre-for-urban-design/achievements/images/hume-highway-duplication-2.jpg>)