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M12 Motorway

Strategic Route Options Analysis

Biodiversity working paper

November 2016

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Executive summary

The Australian and NSW governments are funding a 10 year, $3.6 billion road investment program for western Sydney. The Western Sydney Infrastructure Plan will deliver new and upgraded roads to support integrated transport in the region and capitalise on the economic benefits from developing the planned western Sydney airport at Badgerys Creek.

As part of the plan, Roads and Maritime Services (Roads and Maritime) is proposing to build a new M12 Motorway which will provide direct access to a western Sydney airport at Badgerys Creek and connect to Sydney's motorway network.

The proposal is for an east-west motorway about 14 kilometres long between the M7 Motorway and The Northern Road. This will provide increased road capacity in the Western Sydney Priority Growth Area (WSPGA) and reduce existing and predicted congestion and travel times. It would also improve the movement of freight in and through western Sydney.

Eco Logical Australia has been engaged to carry out biodiversity investigations for the M12 Motorway.

This working paper is intended to support a multi-criteria analysis process to identify the preferred route option. It provides an assessment of constraints in relation to the study area and impact of the shortlisted route options with regards to identified biodiversity values.

The shortlisted route options were developed with a suite of objectives taking into consideration the constraints identified from a preliminary constraints report and long list of route options assessment through the multi-criteria values process.

This paper uses a suite of biodiversity constraint criteria to assess each identified shortlisted route option. The criteria are based on the identified biodiversity values of the study area, particularly those identified that will be a key constraint to development of the M12 Motorway. The key criteria developed are:

- Area of threatened ecological communities – incorporating legislative status and mapped vegetation condition
- Area of priority conservation lands impacted
- Area of regional and bushland corridors impacted
- Number of threatened flora and fauna recorded.

This report used existing and available information / data to carry out the assessment and describe the biodiversity values and constraints for each corridor option. This included field investigations to validate biodiversity values. A comparative assessment summary was prepared to support the multi-criteria analysis process for selection of the preferred option to take forward for assessment in the next phase of work.

Of the corridor options assessed, modified pink and purple options have the greatest impact on biodiversity values, however, potential impact are greatest within the easternmost areas of the corridor options (Zone A and B), while areas to the west (in Zone C) generally exhibit the least impact. Corridor options including Zone A1 (modified aqua, modified blue, modified green and modified orange) impact the greatest on fragmenting regional bushland corridors within the Western Sydney Parklands with some potential clearance of threatened ecological communities. Corridor options that include Zone A3 (modified pink, modified purple, modified white and modified yellow) have the greatest overall impact on threatened ecological communities, including those listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act*.

Using the key biodiversity constraint criteria developed to assess the route options, any impact to the extent of threatened ecological communities will require offset. This includes some areas of priority conservation lands, including the Western Sydney Parklands which contain a biobank agreement site and associated regional habitat corridor linkages between areas of important habitat. These areas are associated with key biodiversity values such as consolidated habitat and the occurrence of threatened species.

Contents

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) has engaged Aurecon Australasia Pty Ltd to carry out a strategic route options analysis for the M12 Motorway between the M7 Motorway, Cecil Park and The Northern Road, Luddenham (the project).

1.1.1 Western Sydney Infrastructure Plan

The M12 Motorway forms part of the Western Sydney Infrastructure Plan (WSIP). The WSIP is a joint initiative of the Australian and NSW governments to fund a $3.6 billion road investment program for western Sydney. The WSIP will:

- Deliver major road infrastructure upgrades to support an integrated transport solution for the western Sydney region. Road upgrades will improve connections within western Sydney and benefit the region's growing population, by reducing travel times
- Support and capitalise on the economic benefits of developing the planned western Sydney airport at Badgerys Creek. The airport will be transformational for western Sydney and be a catalyst for investment, growth and job creation for decades to come. It will need to be supported by a quality surface transport network to ensure the efficient movement of people and freight
- Improve road transport capacity ahead of future traffic demand generated by planned residential and employment development in the Western Sydney Priority Growth Area (WSPGA) (formerly South West Sydney Growth Centre and part of the Broader Western Sydney Employment Area) and the South West Priority Land Release Area.

There are five main projects included in the WSIP. These are split into 10 stages ranging from early development to construction. The projects include the construction of new roads and significant upgrade of other roads, as follows:

- M12 Motorway between the M7 Motorway and The Northern Road generally along Elizabeth Drive option (the subject of this study)
- The Northern Road upgrade between Narellan and Penrith
- Bringelly Road upgrade between The Northern Road and Camden Valley Way
- Werrington Arterial Road Stage 1
- Additional local road upgrades near the planned western Sydney airport at Badgerys Creek, to be proposed and managed by local councils.

1.2 Need for the project

The M12 Motorway is required to support the opening of the planned western Sydney airport at Badgerys Creek. The M12 Motorway will be a four lane (facilitating a future six lane) motorway between the M7 Motorway and The Northern Road.

The Australian Government announced the site of the western Sydney airport in 2014. The environmental impact statement for the western Sydney airport has been prepared, and was placed on public display at the end of 2015. More than 5 000 submissions were received and the EIS is currently being updated and planned to be finalised in mid 2016. If the project is approved, construction is expected to begin in 2016, becoming operational in the mid 2020s.

The M12 Motorway is also required to cater for the increased traffic volumes from future development in areas surrounding the planned western Sydney airport, which are to be further developed into the Western Sydney Priority Growth Area. Other planned road upgrades in western Sydney would also cater for increased traffic volumes from these future developments.

1.3 Study area

The project is required to provide access to the planned western Sydney airport at Badgerys Creek, with the airport layout facilitating access from the north and Elizabeth Drive. As such, the study area for the project has been developed around Elizabeth Drive, connecting to The Northern Road and the rest of Sydney through the M7 Motorway (refer to Figure 1-1).

Elizabeth Drive is bounded to the north by the WSPGA and the suburbs of Mount Vernon and Cecil Park, and, to the south, by the planned western Sydney airport at Badgerys Creek, the WSPGA and the Western Sydney Parklands.

The topography in and around the study area is rolling hills and small valleys between generally north–south ridge lines. In the east and west of the study area, topography is gently undulating, flattening out in the middle of the study area, where it passes through the floodplains associated with Cosgroves Creek, Oaky Creek, Badgerys Creek, South Creek and Kemps Creek. There are also numerous farm dams in the area.

The study area is predominantly semi-rural and includes residential, agricultural, recreational, commercial and industrial land uses.

The main population centres are the suburbs of Kemps Creek, Mount Vernon and Horsley Park.

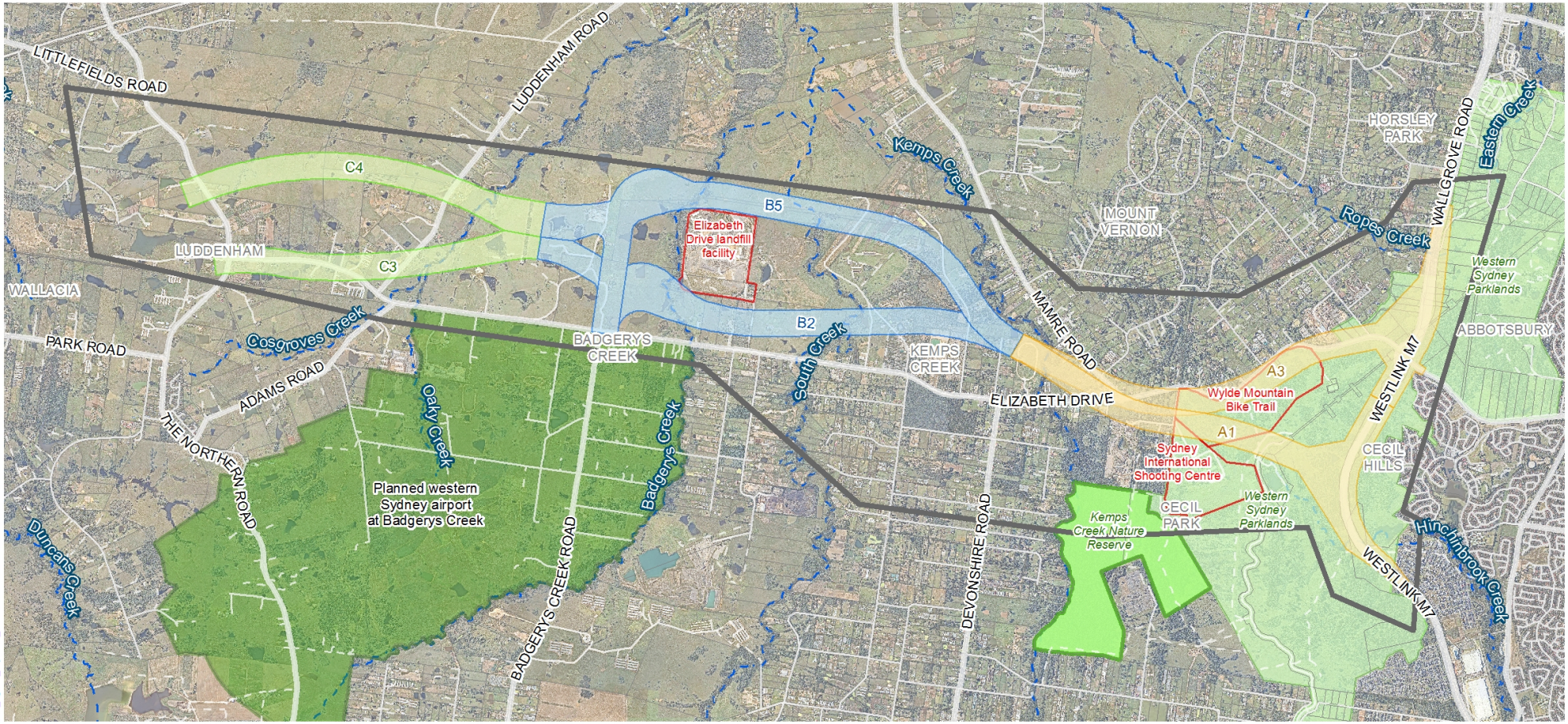
Agricultural land uses include poultry farming, farms producing tomatoes and cucumbers, commercial operations producing Christmas trees and Andreasens Green Wholesale Nurseries.

Recreational and community facilities include schools, Kemps Creek Sporting and Bowling Club, the Western Sydney Parklands (including the Wylde Mountain Bike Trail), Kemps Creek Nature Reserve and the Sydney International Shooting Centre.

Commercial uses are mainly associated with the Kemps Creek village including service stations, food stores and hardware/ maintenance shops.

Industrial uses include the Elizabeth Drive landfill and quarry sites.

There are a number of transport and utilities infrastructure through the study area including the M7 Motorway, Elizabeth Drive, major electrical infrastructure and the Sydney Water Upper Canal system.



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Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis

FIGURE 1.1: M12 Motorway Shortlisted route options

1.4 Purpose and structure of the report

The purpose of this working paper is to identify the biodiversity constraints to be considered to inform the development of the preferred option for the future development of the M12 Motorway project. It provides a comparative assessment of constraints in relation to the study area and impact of/on the shortlisted route options with regards to identified biodiversity values. The paper will consider the key ecological values existing within the study area.

Specifically, this report:

- Reviews the relevant, publicly available, background information applicable to the project from a biodiversity perspective, of the existing environment in the M12 Motorway study area
- Identifies the constraints in the study area based on available information
- Identifies key constraints, associated with the identified shortlisted route options based on available information.

The structure of the paper details:

- The methods used for the identification of the short list of corridor options and criteria developed for assessment of biodiversity constraint for each corridor option
- A description of the biodiversity values, risks and constraints for each corridor option
- A comparative, contextual analysis of each of the zones that make up the corridor options
- A series of maps of the biodiversity constraints for each corridor option.

2 Methodology

2.1 Overview

The biodiversity assessment is based on a desktop review of publicly available information and vegetation field validation. The assessment includes relevant information obtained from a review of databases and available literature and combines this with additional data to facilitate further investigation of environmental constraints and opportunities within the shortlisted route options identified.

2.1.1 Desktop assessment

The desktop assessment involved reviewing a range of available information including reports and databases to identify constraints across the whole of the M12 Motorway study area. The information source and its application to the assessment is shown in Table 2-1.

Table 2-1 Available information reviewed

Information source	Application
Threatened Species Records - Atlas of NSW Wildlife (Bionet) (OEH)	Atlas of NSW Wildlife (Bionet) search for threatened flora and fauna species recorded since 1 January 1980 within 5 kilometres of the identified study area
Matters of National Environmental Significance (MNES) – Protected Matters Search Tool (DotE)	EPBC Act protected matters search report using protected matters search tool for MNES identified within the study area
Vegetation Mapping - Native vegetation community mapping of the Cumberland Plain (OEH)	Identification of mapped threatened ecological communities (including Endangered as well as Critically Endangered Ecological Communities (EEC/CEEC)) (Western Sydney vegetation community mapping) or areas identified as core habitat that occurs within the study area
Western Sydney Priority Areas – Priority areas for conservation identified through the Cumberland Plain recovery plan (OEH)	Identification of lands identified for priority conservation in Western Sydney that occur within the study area
Cumberland subregion Biodiversity Investment Opportunities Map (BIO Map) (OEH)	Identification of lands forming regional biodiversity corridors between Priority Conservation Lands occurring in the study area
Reserved lands - NSW NPWS Estate (OEH)	Identification of lands reserved for conservation (NSW National Parks and Wildlife Service (NPWS) Estate) occurring within the study area
Western Sydney Growth Centres non-certified lands (DPE)	Identification of “non-certified” lands occurring within the study area
Mapped Existing native vegetation (ENV) within the Western Sydney Growth Centres (DPE)	Identification of lands containing mapped ENV within the study area
Western Sydney Parklands Bushland corridors - Western Sydney Parklands Plan of Management 2020 (WSPT)	Identification of areas planned for management as bushland corridors within the Western Sydney Parklands in the study area
Western Sydney Parklands Biobanking agreement sites – digital mapped data	Identification of designated biobanking offset sites
Western Sydney Parklands on Bushland on ground works – digital mapped data	Identification of areas of bushland rehabilitation within Western Sydney Parklands
Background documents and reports relevant to the M12 Motorway study area and as provided by Roads and Maritime	Review of information

2.2 Assessment of the shortlisted route options

The methodology adopted for the shortlisted route option assessment is summarised below:

- Review and refinement of the study area biodiversity constraints, including collation of additional information and update of spatial mapping where available. A summary of the biodiversity values of the study area and therefore constraints is provided in Section 3.
- refinement of vegetation mapping using latest available aerial photography
- Identify relevant key issues, risk and opportunities associated with constraints and assess each option against these. A spatial analysis was carried out to intersect each corridor option with each of the identified constraints.
- targeted field validation of relevant key issues
- Refine the list of constraints for relevance to the short list of corridor options. Where a biodiversity constraint was not specifically relevant to any corridor option, it was not carried forward to the comparative analysis.
- Development of criteria that allow assessment of the relative performance and differentiation between short list options. The criteria identified to allow a comparative analysis are based on the identified key constraints existing within each corridor option.

Further details are provided in Section 4 of this report.

2.2.1 Comparative analysis of shortlisted route options

The comparative analysis focused on potential impact to identified biodiversity values within each corridor option. Each corridor option is 300 metres wide and included interchanges which were included in the analysis. This results in overestimation of the potential impact, providing a worst case scenario. There will be flexibility for mitigating or avoidance of impact to biodiversity through the footprint design process and interchange design.

A statistical analysis was carried out on spatial data of the biodiversity constraints for each corridor option (including interchanges) and tabulated.

The comparative analysis involved:

- Calculation of the area of validated vegetation (broken down by threatened vegetation community type within the bounds of each corridor option)
- Identification of the priority conservation lands within each corridor option and calculation of the area of mapped land within the corridor
- Calculation of the area of non-certified lands in the South West Growth Centre (now part of the Western Sydney Priority Growth Area) as part of the biocertification order for SEPP (Sydney Region Growth Centres) 2006, within the corridor options
- Identification of the number of recorded threatened species (where existing information is available) within each corridor option
- Calculation of the area of land identified as regional corridors within each corridor option
- Calculation of the area of land identified for management as bushland corridors within the Western Sydney Parklands within each corridor option
- Identification and calculation of the areas of land identified for conservation as biobank sites within the Western Sydney Parkland within each corridor option.

2.3 Field investigations

Field investigations were carried out on 22 and 23 March 2016 by two Eco Logical Australia ecologists for a total of 16 hours per person. A number of private properties were surveyed on 22 March 2016 and Western Sydney Parklands Trust land was surveyed on 23 March 2016 (Figure 2-1).

The purpose of the field validation was to validate vegetation communities and their condition against mapped vegetation (NPWS 2002) and identify significant habitat features within the accessible areas of the shortlisted route options. An assessment was also made on whether the vegetation community met Critically Endangered or Endangered criteria under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act).

The random meander method (Cropper 1993) was used to confirm the type and boundaries of vegetation communities and species assemblages within the study area. Boundaries of existing vegetation communities that differed from available vegetation mapping were modified.

Each site was traversed slowly on foot, with all visible flora species identified. Each traverse included an assessment of all vegetation communities and their condition, floristic structure and the presence of any hollow bearing trees.

The survey of Western Sydney Parklands Trust land concentrated on 3 key areas of vegetation:

- Area near the Sydney International Shooting Centre
- Area near Elizabeth Drive
- Area on the corner of Wallgrove Road and Elizabeth Drive.

No targeted flora or fauna surveys were conducted. Notes on dominant flora species within inaccessible properties were taken from inside the vehicle while driving past. These notes were compared with the scientific committee final determinations for any threatened ecological communities likely to be present.

No threatened flora or fauna species were observed during the field investigations. Updated mapping, vegetation community definitions, status and key habitat features were incorporated into the assessment and discussion in section 5.

2.3.1 Weather

Temperatures were warm to hot during both field survey days with light showers on 22 March 2016. Cloud cover fluctuated throughout both days.

2.3.2 Limitations

- Field validation was limited to those properties that were available for access on 22 and 23 March 2016
- Some species such as ground orchids would not be visible in autumn; therefore the survey would have underestimated the relative importance of sites where these species are potentially present
- Some properties were not accessible at all and assumptions have been made based on previous broad scale regional vegetation mapping and recent high resolution aerial imagery
- For sites that were visible from public roads but not accessible, notes on the dominant flora species visible while driving were taken. For these areas, no information was gathered about ground flora or site condition.

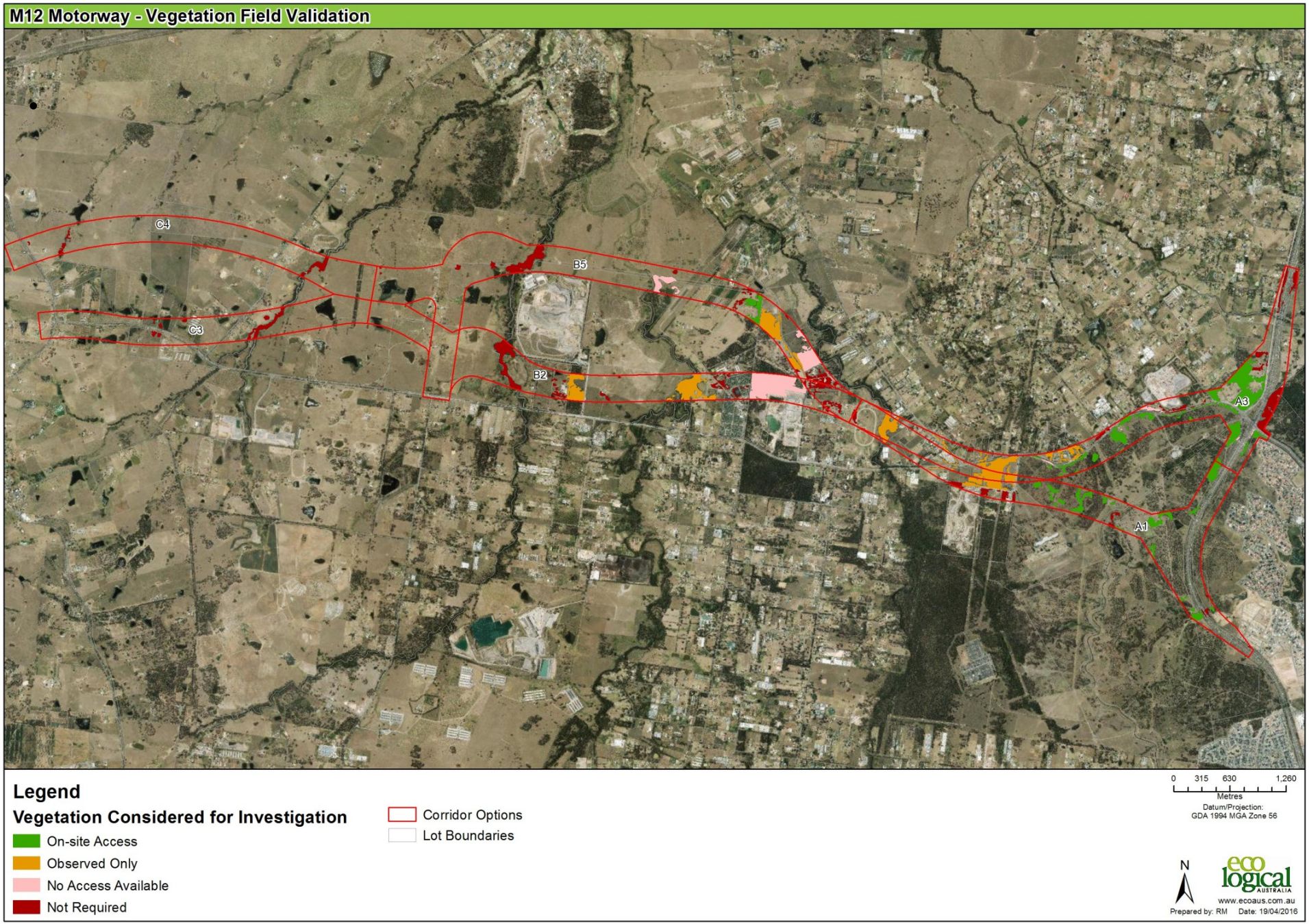


Figure 2-1 Field validation access

3 Existing environment

3.1 Biodiversity constraints

The key biodiversity constraints identified across the Study Area are shown in Figure 3-1. These are broadly areas of threatened vegetation in varying condition which provide significant habitat for a number of threatened flora and fauna species. The key constraints are made up of:

- Seven threatened ecological communities listed on the *NSW Threatened Species Conservation Act* 1995 (TSC Act) as Vulnerable Ecological Communities (VEC), Endangered Ecological Communities (EEC) or Critically Endangered Ecological Communities (CEEC). The communities are:
  - Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (VEC)
  - Castlereagh Swamp Woodland (EEC)
  - Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion (EEC)
  - Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)
  - Moist Shale Woodland in the Sydney Basin Bioregion (EEC)
  - River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (EEC)
  - Shale Gravel Transition Forest in the Sydney Basin Bioregion (CEEC)
- Four vegetation communities with the potential to meet criteria under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The communities are:
  - Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion (EEC)
  - Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion (CEEC)
  - Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CEEC)
  - Western Sydney Dry Rainforest and Moist Woodland on Shale (CEEC)
- The study area includes 30 threatened fauna species that have either been recorded in the study area or are known to occur. Threatened fauna species of concern include:
  - Varied Sittella (vulnerable – TSC Act) – one record in the north of the study area to the east of The Northern Road, one recorded along Elizabeth Drive, three records to the west of Kemps Creek Nature Reserve and two records along M7 Motorway at intersection with Elizabeth Drive
  - Microbats – (*Mormopterus norfolkensis* and *Scoteanax ruepellii)* (both vulnerable – TSC Act) – there are eight records within the study area, mainly in and around the Western Sydney Parklands
  - Cumberland Plain Land Snail (endangered – TSC Act) – there are 49 records within the study area, mainly occurring within CPW associated with Kemps Creek Nature Reserves and the Western Sydney Parklands, as well as within the Cooks River Castlereagh Ironbark Forest south of Elizabeth Drive next to Bill Anderson Park
  - Grey-headed Flying-fox (vulnerable in TSC Act and EPBC Act) – there is one record at Kemps Creek Nature Reserve. This is a broad ranging species that could occur across the study area, most likely in the more vegetated eastern half
- The study area includes 11 threatened flora species that have either been recorded in or are known to occur. Threatened flora species likely to occur are:
  - *Dillwynia tenuifolia* – TSC Act listed Endangered population (Kemps Creek) occurring mainly in Cooks River Castlereagh Ironbark Forest (EEC) south of Elizabeth Drive next to Bill Anderson Park (bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street)

- *Acacia pubescens* – there are seven records within the study area, all near the Kemps Creek Public School and Bill Anderson Park
- *Grevillea juniperina subsp. juniperina* – there is one record near Bill Anderson Park
- *Grevillea parviflora subsp. parviflora* – there are 12 records all concentrated at Kemps Creek in Cooks River Castlereagh Ironbark Forest (EEC) south of Elizabeth Drive in the vicinity of Bill Anderson Park
- *Persoonia nutans* – there are eight records, mostly near Kemps Creek and one record along South Creek to the north of Elizabeth Drive
- *Pimelea spicata* – there are two records near Luddenham Road / Elizabeth Drive intersection and near the end of Brolen Way
- *Pultenaea parviflora* – there are 15 records concentrated around Kemps Creek Creek in the Cooks River Castlereagh Ironbark Forest (EEC) mainly south of Elizabeth Drive in the vicinity of Bill Anderson Park, and one record on Elizabeth Drive towards the western end of the study area.

A desktop assessment based on known habitat values of the study area of likelihood of occurrence was made for all 41 threatened flora and fauna species. There are also a number of other threatened species that have the potential to occur in the study area. The assessment is documented in Appendix A.

It is important to note that some of the areas identified have not been field validated and in those sites that were validated, the occurrence, extent and the condition of some of the threatened ecological communities was updated and opportunistic species searches were undertaken. While some fauna habitat was identified during investigations, primarily with in Western Sydney Parklands, no threatened flora or fauna species were observed. Areas that have been field validated are shown in Figure 2-1.

The area to the south of Elizabeth Drive is within the South West Priority Growth Area. This area includes land containing habitat that has been identified for conservation and vegetation retention as part of the bio-certification order for the State Environmental Planning Policy (SEPP) (Sydney Region Growth Centres) 2006. This area includes existing native vegetation (ENV) on non-certified land.

Kemps Creek Nature Reserve occurs in the south of the study area and is adjacent to the Western Sydney Parklands.

The study area also includes four areas identified as a “priority for conservation” as part of the Cumberland Plain Recovery Plan. One of these areas includes Kemps Creek Nature Reserve. However, the majority of the areas identified include a mix of tenure (both public and privately owned), including parts of the Western Sydney Parklands. These lands are identified as core biodiversity areas and priorities for investment to be secured for biodiversity conservation and protection as an offset to impact in the Cumberland Plain.

There are also a number of regional habitat corridors, mostly associated with the riparian areas of the rivers and creeks that cross the area, and provide significant habitat connectivity across the broader region. These habitat corridors include South Creek, Badgerys Creek, Oaky Creek and Cosgroves Creek. Many of the corridors including riparian areas include threatened vegetation and potential fish habitat.

The Western Sydney Parklands, at the eastern end of the site also allows for important regional habitat connectivity. The Parklands Plan of Management has identified areas for management as bushland corridors within the Abbotsbury, Cecil Park North, Cowpasture and Cecil Park precincts. Bush regeneration operations are either underway or planned for these areas to contribute to the regional biodiversity connectivity of western Sydney (WSPT 2010).

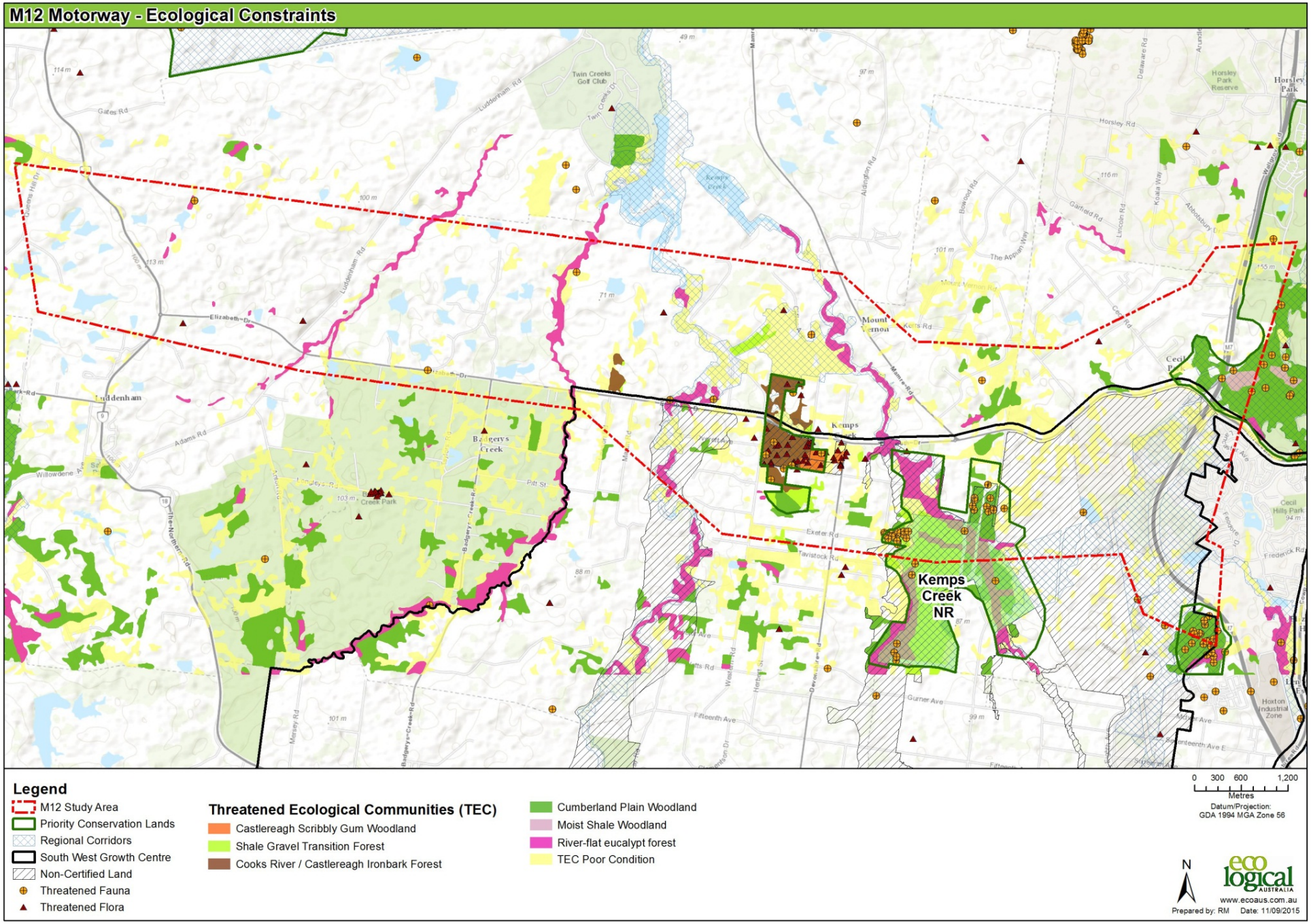


Figure 3-1 M12 Motorway study area biodiversity constraints

4 Shortlisted route options

4.1 Introduction

In February 2016, the eight shortlisted route options for the M12 Motorway were placed on public display. These consisted of two corridor options in zones A to C, and one option in Zone D (that is, D1 is common to all route options). Each route option consists of a corridor 300 metres wide. The options were:

Route option	Zone A	Zone B	Zone C	Zone D
Aqua (4)	A1	B2	C1	D1
Blue (5)	A1	B2	C2	D1
Green (16)	A1	B5	C1	D1
Orange (17)	A1	B5	C2	D1
Pink (18)	A3	B2	C1	D1
Purple (19)	A3	B2	C2	D1
White (20)	A3	B5	C1	D1
Yellow (21)	A3	B5	C2	D1

While these were the options that went to the value management workshop, last minute refinements to the shortlisted route options in Zone C and D due to community feedback and further work on interfacing with other transport projects in the area resulted in a change to the options.

This resulted in a change in Zone C, through the modification of C1 and C2 to C3 and C4. Zone D was also removed from the project.

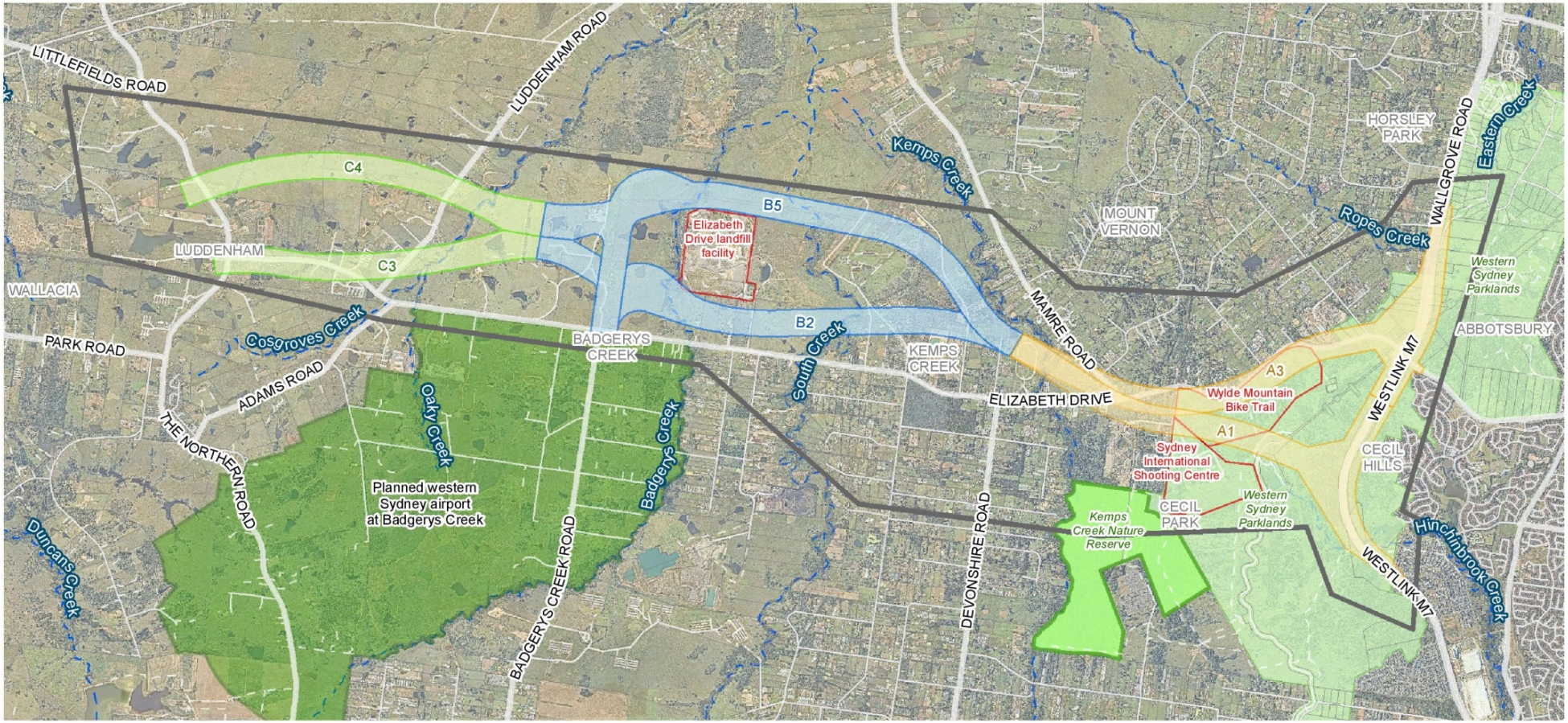
Due to this change in the shortlisted route options, this report assesses the modified shortlisted route options.

4.2 Modified shortlisted options

There are eight shortlisted route options and their zone corridor option components are identified in Table 4-1 and Figure 4-1. Each route option consists of a corridor 300 metres wide. Table 4-2 further details the modified route options.

Table 4-1: Shortlisted route options

Route option	Zone A	Zone B	Zone C
Modified Aqua	A1	B2	C3
Modified Blue	A1	B2	C4
Modified Green	A1	B5	C3
Modified Orange	A1	B5	C4
Modified Pink	A3	B2	C3
Modified Purple	A3	B2	C4
Modified White	A3	B5	C3
Modified Yellow	A3	B5	C4



Legend

- M12 study area
- western Sydney airport at Badgerys Creek
- Notable facilities
- Creek
- Nature Reserve
- Western Sydney Parklands

Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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M12 Strategic Route Options Analysis

FIGURE 4.1: M12 Motorway Shortlisted route options

Table 4-2 Short listed route options

Route option	Description
Modified Aqua option	The modified aqua option is 15 kilometres long. It connects to the M7 Motorway more than one kilometre south of the Elizabeth Drive interchange at a new interchange location. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) in a north-westerly direction before crossing Elizabeth Drive near the existing Mamre Road intersection. It passes through a number of commercial properties fronting Elizabeth Drive and Mamre Road, including the Hi-Quality Group property and Kemps Creek Sporting and Bowling Club. The option then travels around the north of the Kemps Creek village north of Elizabeth Drive, crossing Kemps Creek and passing through rural agricultural and residential properties. It also passes through some larger businesses including a quarry site and Andreasens Nursery. It crosses South Creek and skirts to the south of the landfill site and crosses Badgerys Creek before connecting to the planned western Sydney airport site through an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 700 metres away. The option then crosses Cosgroves and Oaky creeks near the confluence of the creeks, before crossing Luddenham Road just north of the intersection with Elizabeth Drive and south of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Model Park in Luddenham. The option connects to Elizabeth Drive via ramps, with Elizabeth Drive upgraded to a principal arterial road, and connects with The Northern Road.
Modified Blue option	The modified blue option is 15 kilometres long. It connects to the M7 Motorway more than one kilometre south of the Elizabeth Drive interchange at a new interchange location. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) in a north-westerly direction before crossing Elizabeth Drive near the existing Mamre Road intersection. It passes through a number of commercial properties fronting Elizabeth Drive and Mamre Road, including the Hi-Quality Group property and Kemps Creek Sporting and Bowling Club. The option then skirts around the north of Kemps Creek village north of Elizabeth Drive, crossing Kemps Creek and passing through rural agricultural and residential properties. It also passes through some larger businesses including a quarry site and Andreasens Nursery. It crosses South Creek and skirts to the south of the landfill site and crosses Badgerys Creek before connecting to the planned western Sydney airport site through an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 700 metres away. The option crosses Cosgroves Creek and passes through rural and agricultural properties before crossing Luddenham Road about 1.2 kilometres north of the intersection with Elizabeth Drive and north of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Luddenham Raceway. The option connects to The Northern Road about 900 metres north of the existing Elizabeth Drive roundabout.
Modified Green option	The modified green option is 16 kilometres long. It connects to the M7 Motorway more than one kilometre south of the Elizabeth Drive interchange at a new interchange location. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) in a north-westerly direction before crossing Elizabeth Drive near the existing Mamre Road intersection. It passes through a number of commercial properties fronting Elizabeth Drive and Mamre Road, including the Hi-Quality Group property and Kemps Creek Sporting and Bowling Club.

Route option	Description
	The option then crosses Kemps Creek and travels north-west, parallel to Clifton Avenue, before heading west and passing through the former Fleurs radio telescope site and crossing South Creek. It passes to the north of the landfill site, crossing Badgerys Creek before connecting to the planned western Sydney airport site via an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 1750 metres away. The option then crosses Cosgroves and Oaky creeks near the confluence of the creeks, before crossing Luddenham Road just north of the intersection with Elizabeth Drive and south of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Model Park. The option connects to Elizabeth Drive via ramps, with Elizabeth Drive upgraded to a principal arterial road, and connects with The Northern Road.
Modified Orange option	The modified orange option is 16 kilometres long. It connects to the M7 Motorway more than one kilometre south of the Elizabeth Drive interchange at a new interchange location. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) in a north-westerly direction before crossing Elizabeth Drive near the existing Mamre Road intersection. It passes through a number of commercial properties fronting Elizabeth Drive and Mamre Road, including the Hi-Quality Group property and Kemps Creek Sporting and Bowling Club. The option then crosses Kemps Creek and travels north-west, parallel to Clifton Avenue, before heading west and passing through the former Fleurs radio telescope site and crossing South Creek. It passes to the north of the landfill site, crossing Badgerys Creek before connecting to the planned western Sydney airport site via an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 1750 metres away. The option then crosses Cosgroves Creek and passes through rural and agricultural properties before crossing Luddenham Road about 1.2 kilometres north of the intersection with Elizabeth Drive and north of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Luddenham Raceway. The option connects to The Northern Road about 900 metres north of the existing Elizabeth Drive roundabout.
Modified Pink option	The modified pink option is about 16 kilometres long. It connects to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. The option generally follows the Elizabeth Drive alignment to the Mamre Road intersection. The alignment is on a more direct route than Elizabeth Drive to meet current design standards and to avoid the steep topography to the north of Elizabeth Drive. As this option would be built in the existing Elizabeth Drive corridor as much as possible, Elizabeth Drive would need to be reconstructed around the motorway. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) and a number of commercial properties fronting Elizabeth Drive or Mamre Road including the Hi-Quality Group property and CSR Brickworks. Around the existing intersection with Mamre Road, it travels north-west, crossing Kemps Creek. The option then travels around the north of Kemps Creek village north of Elizabeth Drive, passing through rural agricultural and residential properties. It also passes through some larger businesses including a quarry site and Andreasens Nursery. It crosses South Creek and travels to the south of the landfill site and crosses Badgerys Creek. It then connects to the planned western Sydney airport site through an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 700 metres away.

Route option	Description
	The option then crosses Cosgroves and Oaky creeks near the confluence of the creeks, before crossing Luddenham Road just north of the intersection with Elizabeth Drive and south of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Model Park. The option connects to Elizabeth Drive via ramps, with Elizabeth Drive upgraded to a principal arterial road, and connects with The Northern Road.
Modified Purple option	The modified purple option is about 16 kilometres long. It connects to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. The option generally follows the Elizabeth Drive alignment to the Mamre Road intersection. The alignment is on a more direct route than Elizabeth Drive to meet current design standards and to avoid the steep topography to the north of Elizabeth Drive. As this option would be built in the existing Elizabeth Drive corridor as much as possible, Elizabeth Drive would need to be reconstructed around the motorway. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) and a number of commercial properties fronting Elizabeth Drive or Mamre Road, including the Hi-Quality Group property and CSR Brickworks. Around the existing intersection with Mamre Road, it traverses north-west, crossing Kemps Creek. The option then travels around the north of Kemps Creek village north of Elizabeth Drive, passing through rural agricultural and residential properties. It also passes through some larger businesses including a quarry site and Andreasens Nursery. It crosses South Creek, skirting south of the landfill site and crossing Badgerys Creek. It then connects to the planned western Sydney airport site through an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 700 metres away. The option then crosses Cosgroves Creek and passes through rural and agricultural properties before crossing Luddenham Road about 1.2 kilometres north of the intersection with Elizabeth Drive and north of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Luddenham Raceway. The option connects to The Northern Road about 900 metres north of the existing Elizabeth Drive roundabout.
Modified White option	The modified white option is about 17 kilometres long. It connects to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. The option generally follows the Elizabeth Drive alignment to the Mamre Road intersection. The alignment is on a more direct route than Elizabeth Drive to meet current design standards and to avoid the steep topography to the north of Elizabeth Drive. As this option would be built in the existing Elizabeth Drive corridor as much as possible, Elizabeth Drive would need to be reconstructed around the motorway. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) and a number of commercial properties fronting Elizabeth Drive or Mamre Road including the Hi-Quality Group property and CSR Brickworks. Around the existing intersection with Mamre Road, it traverses north-west, crossing Kemps Creek. The option then traverses north-west, parallel to Clifton Avenue, before heading west and passing through the former Fleurs radio telescope site and crossing South Creek. It passes to the north of the landfill site, crossing Badgerys Creek before connecting to the planned western Sydney airport site via an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 1750 metres away. The option then crosses Cosgroves and Oaky creeks near the confluence of the creeks, before crossing Luddenham Road just north of the intersection with Elizabeth Drive and south of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Model Park.

Route option	Description
	The option connects to Elizabeth Drive via ramps, with Elizabeth Drive upgraded to a principal arterial road, and connects with The Northern Road.
Modified Yellow option	The modified yellow option is about 16 kilometres long. It connects to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. The option generally follows the Elizabeth Drive alignment to the Mamre Road intersection. This alignment is on a more direct route than Elizabeth Drive to meet current design standards and to avoid the steep topography to the north of Elizabeth Drive. As this option would be built in the existing Elizabeth Drive corridor as much as possible, Elizabeth Drive would need to be reconstructed around the motorway. The option passes through Western Sydney Parklands (including a section of the Wylde Mountain Bike Trail) as well as a number of commercial properties fronting onto Elizabeth Drive or Mamre Road including the Hi-Quality Group property and the CSR Brickworks. Around the existing intersection with Mamre Road, it traverses north-west, crossing Kemps Creek. The option then travels north-west, parallel to Clifton Avenue, before heading west and passing through the former Fleurs radio telescope site and crossing South Creek. It passes to the north of the landfill site, crossing Badgerys Creek before connecting to the planned western Sydney airport site via an interchange. The distance between the option and Elizabeth Drive in this area varies; at its furthest, the corridor is 1750 metres away. The option then crosses Cosgroves Creek and passes through rural and agricultural properties before crossing Luddenham Road about 1.2 kilometres north of the intersection with Elizabeth Drive and north of Blackford Hill. It passes through rural residential, agricultural and other uses such as the Luddenham Raceway. The option connects to The Northern Road about 900 metres north of the existing Elizabeth Drive roundabout.

5 Assessment of shortlisted route options

The following sections identify the existing biodiversity features that occur within each corridor option. The key issues and risks for each corridor option are identified as well as any opportunities for mitigation of potential impact on significant biodiversity. Figures of the biodiversity values and constraints are illustrated for each zone in Appendix B.

Field validation confirmed areas where vegetation is likely to meet the criteria for Critically Endangered under the EPBC Act. The area of vegetation meeting or potentially meeting the criteria has been included within each corridor option.

5.1 Zone A

5.1.1 Corridor option A1

About 26 hectares of threatened vegetation (EEC or CEEC - TSC Act) occurs throughout corridor option A1 in varying condition, of which, after site validation, up to 5 hectares meets Critically Endangered criteria under the EPBC Act. Table 5-1 shows the breakdown of this threatened vegetation.

Table 5-1 Significant vegetation within corridor option A1

Vegetation community	Status (TSC Act)	Good condition^	Poor condition^^	Total	Status (EPBC Act)*
Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	2.3	18.2	20.5	4.6
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	3.5	2	5.5	-
Total		**5.8**	**20.2**	**26**	**4.6**

* area meeting criteria listed as Critically Endangered under the EPBC Act

^Vegetation mapped as having a relatively intact native tree canopy, midstorey or understory

^^Vegetation mapped with <10% canopy cover, in areas in rural or urban influence and land use

EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

The majority of the extant native vegetation across this zone has been field validated, is in poor condition and does not meet the Critically Endangered criteria under the EPBC Act. The areas of vegetation within the Western Sydney Parklands are undergoing current management, but also include poor understory, the majority of which is made up of exotic species. Fauna habitat in this area includes a number of old dead trees (stags) with hollows.

Corridor option A1 passes through areas of the Western Sydney Priority Growth Area at its north eastern extent, including about 134 hectares of land classified as non-certified lands as part of the biocertification order for SEPP (Sydney Region Growth Centres) 2006.

Option A1 passes more than about four hectares identified as priority conservation lands (PCL) as part of the Cumberland Plain Recovery Plan.

The corridor option crosses two identified regional corridors that link priority conservation lands. The option will potentially impact 56 hectares of mapped lands within these corridors. All of this land is identified for management as bushland corridor within Western Sydney Parkland, which will effectively be fragmented into two separate areas by the corridor option, as it passes through the centre of this area. The area of impact would be similar to that in corridor option A3 but this fragmentation would have a greater impact.

The corridor option also potentially impact on 55 hectares of land which have included active bush regeneration activities since 1997 to support the enhancement of the identified bushland corridor within WSP.

This corridor option potentially passes over about six hectares of the M7 biobanking agreement site (ID number 119). Also, the very south eastern end of this option is immediately adjacent to the Cecil Park South-East biobanking agreement (ID number 70) made under the *Threatened Species Conservation Act* for Western Sydney Parklands Trust. 'BioBanking' is designed to address the loss of biodiversity values from habitat degradation. BioBanking enables 'biodiversity credits' to be generated by landowners and developers who commit to enhance and protect biodiversity values on their land through a biobanking agreement. More than 400 biobanking credits were created (since 2010) and just under 300 credits sold (WSPT, 2010).

5.1.2 Corridor option A3

About 51 hectares of threatened vegetation (EEC or CEEC - TSC Act) occurs throughout corridor option A3 in varying condition, of which, after site validation, up to 31 hectares meets Critically Endangered criteria under the EPBC Act. Table 5-2 shows the breakdown of this threatened vegetation.

Table 5-2 Significant vegetation within corridor option A3

Vegetation community	Status (TSC Act)	Good condition^	Poor condition ^^	Total	Status (EPBC Act)*
Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	21.2	23.2	44.3	29.0
Moist Shale Woodland in the Sydney Basin Bioregion	EEC	1.5	0.2	1.7	1.6
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	3.8	0.6	4.4	-
Total		**26.5**	**24**	**50.5**	**30.6**

* area meeting criteria listed as Critically Endangered under the EPBC Act

^Vegetation mapped as having a relatively intact native tree canopy, midstorey or understory

^^Vegetation mapped with <10% canopy cover, in areas in rural or urban influence and land use

EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

The extant native vegetation across this option is in varying condition with a large proportion meeting the Critically Endangered criteria under the EPBC Act. The majority of the vegetation in this option has been field validated. Some areas of vegetation within the Western Sydney Parklands are undergoing current management. The area of native vegetation located at the corner of Wallgrove Road and Elizabeth Drive is an area of very good condition, intact native habitat. Fauna habitat areas to the south of Elizabeth Drive within the zone include a number of large remnant native trees including hollows.

Corridor option A3 includes one threatened fauna species that has either been previously recorded within its extent or is known to occur in the immediate vicinity:

- Varied Sittella – in the Western Sydney Parklands to the east of the option in the vicinity of the M7 Motorway.

Corridor option A3 passes through areas of the Western Sydney Priority Growth Area at its north eastern extent, including about 67 hectares of land classified as non-certified lands as part of the biocertification order for SEPP (Sydney Region Growth Centres) 2006.

Option A3 passes over about 38 hectares identified as priority conservation lands (PCL) as part of the Cumberland Plain Recovery Plan.

The corridor option crosses two identified regional corridors that are either contained within or link priority conservation lands. The option will potentially impact 28 hectares of mapped lands within these corridors. The majority of this land is identified for management as bushland corridor within Western Sydney Parkland. This corridor option will impact at the edge of the Western Sydney Parkland bushland corridor, expanding an existing barrier in the vicinity of Elizabeth Drive, rather than severing consolidated areas of bushland corridor.

The corridor option also potentially impact on 36 hectares of land which have included active bush regeneration activities since 1997 to support the enhancement of the identified bushland corridor within Western Sydney Parklands.

The corridor option potentially impact on about three hectares of the M7 Motorway biobanking agreement site (ID number 119).

5.2 Zone B

5.2.1 Corridor option B2

About 34 hectares of threatened vegetation (EEC or CEEC - TSC Act) occurs throughout corridor option B2 in varying condition, of which, after site validation, up to 23 hectares may meet Critically Endangered or Endangered criteria under the EPBC Act. Table 5-3 shows the breakdown of this threatened vegetation.

Table 5-3 Significant vegetation within corridor option B2

Vegetation community	Status (TSC Act)	Good condition^	Poor condition ^^	Total	Status (EPBC Act)*
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	VEC	-	11.2	11.2	11.2
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion	EEC	5.2	-	5.2	5.2
Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	-	0.3	0.3	0.3
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	4.9	6.1	11.1	-
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion	CEEC	0.2	6	6.2	6.2
Total		**10.4**	**23.7**	**34.1**	**23.0**

* area potentially meeting criteria listed as Critically Endangered or Endangered under the EPBC Act

^Vegetation mapped as having a relatively intact native tree canopy, midstorey or understory

^^Vegetation mapped with <10% canopy cover, in areas in rural or urban influence and land use

EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

About half of the existing native vegetation within Corridor option B2 has been field validated.

The corridor includes one threatened flora species that has been previously recorded at two sites within the corridor:

- *Dillwynia tenuifolia* – adjacent to identified priority conservation lands

Option B2 passes over about four hectares identified as priority conservation lands (PCL) as part of the Cumberland Plain Recovery Plan.

The corridor option crosses two identified regional corridors that link priority conservation lands, primarily associated with drainage lines. The option will potentially impact 38 hectares of mapped land within these corridors. Any impact on native vegetation within these regional corridors should be avoided or minimised where possible.

5.2.2 Corridor option B5

About 30 hectares of threatened vegetation (EEC or CEEC - TSC Act) occurs throughout corridor option B5 in varying condition, of which, after site validation, up to 21 hectares may meet Critically Endangered or Endangered criteria under the EPBC Act. Table 5-4 shows the breakdown of this threatened vegetation.

Table 5-4 Significant vegetation within corridor option B5

Vegetation community	Status (TSC Act)	Good condition^	Poor condition ^^	Total	Status (EPBC Act)*
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	VEC	-	8.2	8.2	6.7
Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	-	6.7	6.7	6.5
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	3.9	3	6.9	-
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion	CEEC	-	7.7	7.7	7.7
Total		**3.9**	**25.6**	**29.5**	**20.9**

* area potentially meeting criteria listed as Critically Endangered under the EPBC Act

^Vegetation mapped as having a relatively intact native tree canopy, midstorey or understory

^^Vegetation mapped with <10% canopy cover, in areas in rural or urban influence and land use

EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

About half of the existing native vegetation within Corridor option B2 has been field validated.

The corridor includes one threatened flora species that has been previously recorded in two locations within the regional corridor to the east and to the west of Clifton Ave:

- *Dillwynia tenuifolia*

The corridor option includes two migratory bird species that have either been previously recorded within its extent or are known to occur in the immediate vicinity:

- White-bellied Sea-Eagle
- Cattle Egret

The corridor option crosses two identified regional corridors that link priority conservation lands primarily associated with drainage lines. The option will potentially impact 38 hectares of mapped land within these corridors. Any impact on native vegetation within these regional corridors should be avoided or minimised where possible.

5.3 Zone C

5.3.1 Corridor option C3

About four hectares of threatened vegetation (EEC - TSC Act) occurs throughout corridor option C3 in good condition. This vegetation type is not listed under the EPBC Act. Table 5-5 shows the breakdown of this threatened vegetation.

Table 5-5 Significant vegetation within corridor option C3

Vegetation community	Status (TSC Act)	Good condition^	Poor condition ^^	Total
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	3.6	-	3.6
Total		**3.6**	**-**	**3.6**

^Vegetation mapped as having a relatively intact native tree canopy, midstorey or understory

^^Vegetation mapped with <10% canopy cover, in areas in rural or urban influence and land use

EEC – Endangered Ecological Community

Vegetation within this corridor option has not been field validated.

The corridor option includes three threatened flora species that have been previously recorded within the corridor:

- *Dillwynia tenuifolia* – to the west of Luddenham Road
- *Pimelea spicata* - to the west of Luddenham Road
- *Pultenaea parviflora* – to the south of Elizabeth Drive

5.3.2 Corridor option C4

About three hectares of threatened vegetation (EEC or CEEC - TSC Act) occurs throughout corridor option C4 in varying condition. This vegetation type is either not listed or is not consistent with the Critically Endangered criteria under the EPBC Act. Table 5-6 shows the breakdown of this threatened vegetation.

Table 5-6 Significant vegetation within corridor option C4

Vegetation community	Status (TSC Act)	Good condition^	Poor condition ^^	Total
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	2.5	-	2.5
Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	-	0.1	0.1
Total		**2.5**	**0.1**	**2.6**

^Vegetation mapped as having a relatively intact native tree canopy, midstorey or understory

^^Vegetation mapped with <10% canopy cover, in areas in rural or urban influence and land use

EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

Vegetation within this corridor option has not been field validated.

No threatened flora or fauna species have been recorded or are known to occur in the corridor option.

5.4 Key issues and risks

The major constraints within the corridor options are the areas of threatened vegetation (EECs and CEECs) which provide significant habitat for threatened flora and fauna species. All of the corridor options also cross a number of watercourses which include riparian and fish habitat, as well as regional habitat connectivity across the landscape. Where possible, any crossing of watercourses should avoid or minimise impact to existing riparian vegetation by bridging.

All options pass through the Cumberland Plain, where the vegetation is a fragmented fraction of what was originally present. However, it is not possible for the options to completely avoid impact upon remnant vegetation, with some corridor options impacting more than others (Zone A3 and Zone B2). Consequently, the easternmost corridor options (Zone A3 and Zone B2) contain the majority of threatened vegetation communities and habitat for threatened species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) or NSW *Threatened Species Conservation Act* 1995 (TSC Act). Corridor options within Zone C contain the lesser extent of habitat for threatened species listed under NSW *Threatened Species Conservation Act* 1995 (TSC Act) and no threatened ecological communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Any impact on existing biodiversity values should be minimised where possible through design of the corridor and interchanges. It is anticipated that due to the extent of biodiversity values within the Study Area, it is likely that unavoidable impact will occur. This will require offset by securing areas with biodiversity values for protection in other areas. Minimising impact on key biodiversity constraints, will reduce the amount of offset required to be secured.

While impact on identified priority conservation lands (PCL) should be avoided where possible, if this cannot be avoided, impact to the edges of these lands (as is the case for both corridor options A1 and A3) is preferable to cutting through the middle of these lands. Impact at the edges will minimise habitat fragmentation of these lands which have been identified by OEH as areas of core biodiversity investment opportunity in the Cumberland Plain. These lands make up some of the remaining large, consolidated areas of high biodiversity value within the fragmented landscape of Western Sydney.

It is preferable to also avoid impact to areas of vegetation on lands that have been identified as regional corridors. These vegetated corridors have been identified as opportunities to maintain regional habitat connectivity across the landscape and link areas of large

consolidated areas of core habitat, such as priority conservation lands. This is particularly the case within the Western Sydney Parklands, where areas have been identified for management as bushland corridors to assist in maintaining habitat connectivity both within the Parklands as well as to adjoining lands with biodiversity values. As noted for priority conservation lands, impact at the edges of regional corridors will minimise habitat severance. This is the case for option A3 as it would expand an existing barrier, whereas corridor option A1 severs the regional corridor; particularly in the Cecil Park and Cowpasture Precincts which have a history of bushland restoration and management for biodiversity enhancement.

In addition, as part of the enhancement of biodiversity within the Western Sydney Parklands, a number of biobanking agreements have been made under the *Threatened Species Conservation* Act for Western Sydney Parklands Trust. Part of one of these biobank agreements, adjacent to the M7 in the Cecil Park Precinct, falls within both corridor options A1 and A3 (Corridor option A1 impacting on the greater area of the site). Any impact or incursion into this site should be minimised.

It will also be desirable to consider options to facilitate ecological connectivity (fauna culverts, rope bridges, etc), particularly if impact on PCL or regional corridors cannot be minimised, and in association with riparian corridors.

5.4.1 Criteria for comparative analysis

Threatened Ecological Communities

A major constraint within the area is the presence of threatened ecological communities (TEC) which are listed as Vulnerable (VEC), Endangered (EEC) or Critically Endangered (CEEC). The area contains TECs listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) or NSW *Threatened Species Conservation Act* 1995 (TSC Act). While impact to TECs are unavoidable for all options due to the spatial extent of TECs across the study area, it is preferred that impacts are minimised wherever possible. Therefore, to aid in comparison of each corridor option, three metrics have been identified in relation to TECs occurring in the area. The metrics are:

- Total area of TECs (ha)
- Area of mapped TECs in good condition (ha)
- Area of mapped TECs meeting or potentially meeting the criteria, listed under the EPBC Act (ha).

The greater the area recorded for each metric, the greater the impact on TECs, the majority of which occur towards the eastern parts of the corridor options in Zones A3 and B2.

Priority Conservation Areas

The areas identified as priority conservation lands (PCL) have been identified as having larger, consolidated, viable areas of significant habitat within the Cumberland Plain, containing a large proportion of threatened vegetation communities. Where these consolidated areas are fragmented by barriers such as major infrastructure, the biodiversity value of the consolidated area decreases. As such, it is preferable for options to avoid or minimise impact to PCLs. To aid in comparison of each corridor option, the area of PCLs impacted has been considered. The greater the area of these lands potentially impacted by the corridor option, the greater the constraint. Specifically, the metrics used are:

- Total area of PCLs affected (ha)
- Number of PCLs fragmented.

Regional corridors

Regional biodiversity corridors are linear areas that link core areas identified as priority conservation lands and play a crucial role in maintaining connections between animal and plant populations that would otherwise be isolated and at greater risk of local extinction. They provide strategic locations for protection and enhancement of native habitat which results in the greatest benefit to achieve better biodiversity outcomes across the landscape. Where these regional corridors are fragmented by barriers such as major infrastructure, there is a greater risk of regional fragmentation and isolation of core areas of biodiversity. Therefore, it is preferable for options to avoid or minimise impact to the identified regional corridors.

All options potentially impact the same number of regional corridors (4); however, there is a distinction in the bushland corridor within Western Sydney Parklands (in Zone A), between expansion of an existing barrier (corridor option A3) or severing (corridor option A1) the regional corridor and subsequently, the area of bushland corridor potentially impacted.

A comparison of each corridor option has been carried out by identifying the area of regional corridor impacted. This criterion is related to the broader connectivity values of the identified PCLs. The metrics used are:

- Total area of regional corridors affected (ha)
- Total area of bushland corridor within Western Sydney Parklands affected (ha).

Western Sydney Priority Growth Area

Areas of non-certified land within the South West Growth Centre (now part of the Western Sydney Priority Growth Area) have been identified for conservation and vegetation retention as part of the biocertification order for SEPP (Sydney Region Growth Centres) 2006. The key impact associated with this metric is clearance of any area of mapped Existing Native Vegetation (ENV) under the SEPP. The corridors will not impact on any areas of mapped ENV, therefore, the metric used for the comparison of each option relates to land with the potential for conservation management. For this assessment, the metric used is:

- Area of non-certified land impacted.

Threatened species

A number of threatened species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or NSW *Threatened Species Conservation Act 1995* (TSC Act) have been recorded across the area. The metrics used for comparison of each option are:

- Number of threatened flora species
- Number of threatened fauna species.

It is important to note that some of the areas identified have not been field validated and in those sites that were validated, opportunistic species searches were undertaken. No threatened species were observed during site inspections.

Threatened species information is based on observations previously recorded within the footprint for each option. Consequently there is the potential that additional threatened species, or their habitat, may be present.

5.5 Comparative analysis of shortlisted route options

A summary of the comparative analysis is shown in Table 5-7 below. The purpose of this summary is to provide an overview at a glance of the performance of each route option relative to other route options. Raw values from the GIS analysis are used to populate each cell, there has been no ranking or weighting applied to either criteria or route option.

Coloured cells identify the greatest impact or comparatively worst performers for that criterion (red) and the lowest impact or comparatively best case (green) for each criterion for each route option.

Table 5-7 Summary comparative assessment

Criteria	Route options							
	Modified Aqua	Modified Blue	Modified Green	Modified Orange	Modified Pink	Modified Purple	Modified White	Modified Yellow
Total area of TECs (ha)	63.7	62.7	59.1	58.1	88.2	87.2	83.6	82.6
TECs in good condition (ha)	19.8	18.7	13.3	12.2	40.5	39.4	34	32.9
TECs potentially EPBC (ha)	27.6	27.6	25.5	25.5	53.6	53.6	51.5	51.5
Area of PCLs (ha)	8	8	4	4	42	42	38	38
No. of PCLs fragmented	1	1	1	1	0	0	0	0
Area of Regional Corridors (ha)	90	90	90	90	66	66	66	66
Area of Bushland Corridor in WSP (ha)	55	55	55	55	36	36	36	36
Non Certified Land (ha)	134	134	134	134	67	67	67	67
Threatened Flora Species	4	1	4	1	4	1	4	1
Threatened Fauna Species	0	0	2	2	1	1	3	3

Red cells = greatest impact, Green cells = lowest impact

5.5.1 Discussion

The comparative analysis summary of the key identified constraints for the shortlisted route options shown in Table 5-7 provides an overview of potential impact to the biodiversity values occurring within each option. All criteria and constraints were weighted equally to provide a raw value of impact on each criterion for all corridor options for comparison. The greater the numeric value recorded under each criterion, the greater the level of impact for the corridor option.

Alignments of corridor options attempted to minimise potential impact on threatened ecological communities (TEC) by avoidance of areas of large consolidated patches of native vegetation where possible; however, there will be an overall potential impact on TECs across the options ranging from 58 hectares to 88 hectares over a range of vegetation conditions. This is equivalent to 7% to about 13% of the total area of mapped TECs across the study area. The range across the total amount of TECs potentially impacted by corridor options varies by 30 hectares. Modified pink and modified purple options (which include corridor option A3) include the greatest potential impact on the total area of TECs and modified orange route option (including corridor option A1) impact the least.

The modified pink and modified purple options have the greatest direct impact on identified priority conservation lands (PCL) in total area affected. Modified green and modified orange options impact the least total area across the PCLs; the impact occurring within the eastern parts of the corridor options only.

Modified aqua, modified blue, modified green and modified orange, which include Corridor option A1, have the greatest impact including the severance of a regional corridor. Modified pink, modified purple, modified white and modified yellow route options, which include Corridor option A3 in the east, will not sever, but will affect the edge of a regional corridor by increasing an existing barrier. Zone C to the west, does not have any impact on regional corridors.

The greatest potential impact on areas planned for management as bushland corridors within Western Sydney Parklands occur in modified aqua, modified blue, modified green and modified orange route options. All corridor options also have a potential impact on a biobanking agreement site, however modified aqua, modified blue, modified green and modified orange route options include the larger of the potential impact in Corridor option A1.

Generally, modified pink route option (closely followed by modified purple route option) has the greatest overall impact on biodiversity values, but route options including Corridor option A1 (modified aqua, modified blue, modified green and modified orange route options) impact the greatest on the Western Sydney Parklands.

5.5.2 Information gaps

Some of the areas of mapped native vegetation within the corridors were not able to be accessed for field validation. Further targeted field validation of identified TECs and their condition in these areas where information is still lacking will be beneficial to further assessment.

After this assessment, a refinement of the assessment of potential habitat offset requirements for either a refined worst case scenario or identified preferred corridor can be carried out to refine the type and quantity of offset required.

6 Conclusion and recommendations

The option analysis summarises the comparative distribution of the biodiversity constraints across each of the corridor options to contribute to the multi-criteria analysis in the selection of the preferred route.

The assessment primarily showed a variation in the amount of biodiversity constraint across each option, with no single corridor option clearly showing least or most constraint across all ecological values.

A key criterion for biodiversity constraint for the corridor options is the amount of threatened ecological communities (TEC) being impacted by each option. All corridor options will impact on TECs to some extent and may require consideration of the development of a biodiversity offset, depending on the approval pathway used.

Other key constraint criteria such as areas of priority conservation lands (PCL) and associated regional biodiversity corridor linkages between them are effectively subsets of TECs that are associated with biodiversity values such as consolidation of habitat and occurrence of threatened species. Any impact on native vegetation in these areas should be avoided where possible and limited to the edges of these lands.

Of the route options assessed, modified pink and purple options have the greatest impact on TECs, however, potential impact are greatest within the easternmost areas of the route options (Zone A and B), while areas to the west (in Zone C) generally exhibit the least impact. Key potential impact include areas of TECs in good condition within Corridor option A3 and the biobanking agreement site which occurs within both Corridor options A1 and A3.

Supporting biodiversity mechanisms, such as the areas to be managed as bushland corridors within the Western Sydney Parklands to enhance habitat values for biodiversity across western Sydney, are also a key constraint for the study area, particularly around the proposed M7 Motorway interchange. Where possible, minimising impact to all biodiversity corridors through carriageway and interchange design (such as bridges or viaducts over waterways or sensitive areas) should be carried out, as well as incorporating opportunities for the enhancement of an east west habitat corridor through incorporation of appropriate planting in combination with associated development such as walking and cycle paths along the selected route.

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Appendix A Threatened species likelihood of occurrence

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database records, suitable habitat within the study area and professional judgement. The terms for likelihood of occurrence are defined below:

- "known" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species.

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Fauna					
Anthochaera phrygia	Regent Honeyeater	E4A	E	Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana (*River Oak).	Potential
Apus pacificus	Fork-tailed Swift	P	C,J,K, Mar	Riparian woodland., swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	Potential
Ardea ibis	Cattle Egret	P	C,J, Mar	Grasslands, wooded lands and terrestrial wetlands.	Known
Callocephalon fimbriatum	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E2,V		Forest and woodland, urban fringes.	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Tall mountain forests and woodlands in summer; in winter, may occur at lower altitudes in open eucalypt forests and woodlands, and urban areas.	Potential
Chthonicola sagittata	Speckled Warbler	V		*Eucalyptus*-dominated communities with a grassy understorey and sparse shrub layer, often on rocky ridges or in gullies.	Likely
Daphoenositta chrysoptera	Varied Sittella	V		Inhabits eucalypt forests and woodlands, mallee and *Acacia* woodland.	Known
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Unlikely
Ephippiorhynchus asiaticus	Black-necked Stork	E1		In NSW, floodplain wetlands of the major coastal rivers are key habitat.	Unlikely

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
				Also minor floodplains, coastal sandplain wetlands and estuaries.	
Falco subniger	Black Falcon	V		Woodland, shrubland and grassland, especially riparian woodland and agricultural land. Often associated with streams or wetlands.	Unlikely
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Tall (greater than 20m) moist habitats.	Potential
Gallinago hardwickii	Latham's Snipe	P	C,J,R, Mar	Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grasslands or heathlands.	Potential
Glossopsitta pusilla	Little Lorikeet	V		Dry, open eucalypt forests and woodlands, including remnant woodland patches and roadside vegetation.	Likely
Haliaeetus leucogaster	White-bellied Sea-Eagle	P	C	Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	Likely
Hieraaetus morphnoides	Little Eagle	V		Open eucalypt forest, woodland or open woodland, including sheoak or *Acacia* woodlands and riparian woodlands of interior NSW.	Known
Lathamus discolor	Swift Parrot	E1	E	Box-ironbark forests and woodlands.	Known
Limosa limosa	Black-tailed Godwit	V	C,J,K	Usually sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found around muddy lakes and swamps.	Potential
Litoria aurea	Green and Golden Bell Frog	E1	V	Marshes, dams and stream-sides, particularly those containing Typha spp. (bullrushes) or *Eleocharis* spp. (spikerushes). Some populations occur in highly disturbed areas.	Potential
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas.	Unlikely
Meridolum corneovirens	Cumberland Plain Land Snail	E1		Primarily inhabits Cumberland Plain Woodland. Also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest.	Known
Merops ornatus	Rainbow Bee-eater	P	J	Open forests and woodlands, shrublands, farmland, areas of human habitation, inland and coastal sand dune systems, heathland, sedgeland, vine forest and vine thicket.	Likely
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Rainforest, wet and dry sclerophyll forest, monsoon forest, open	Likely

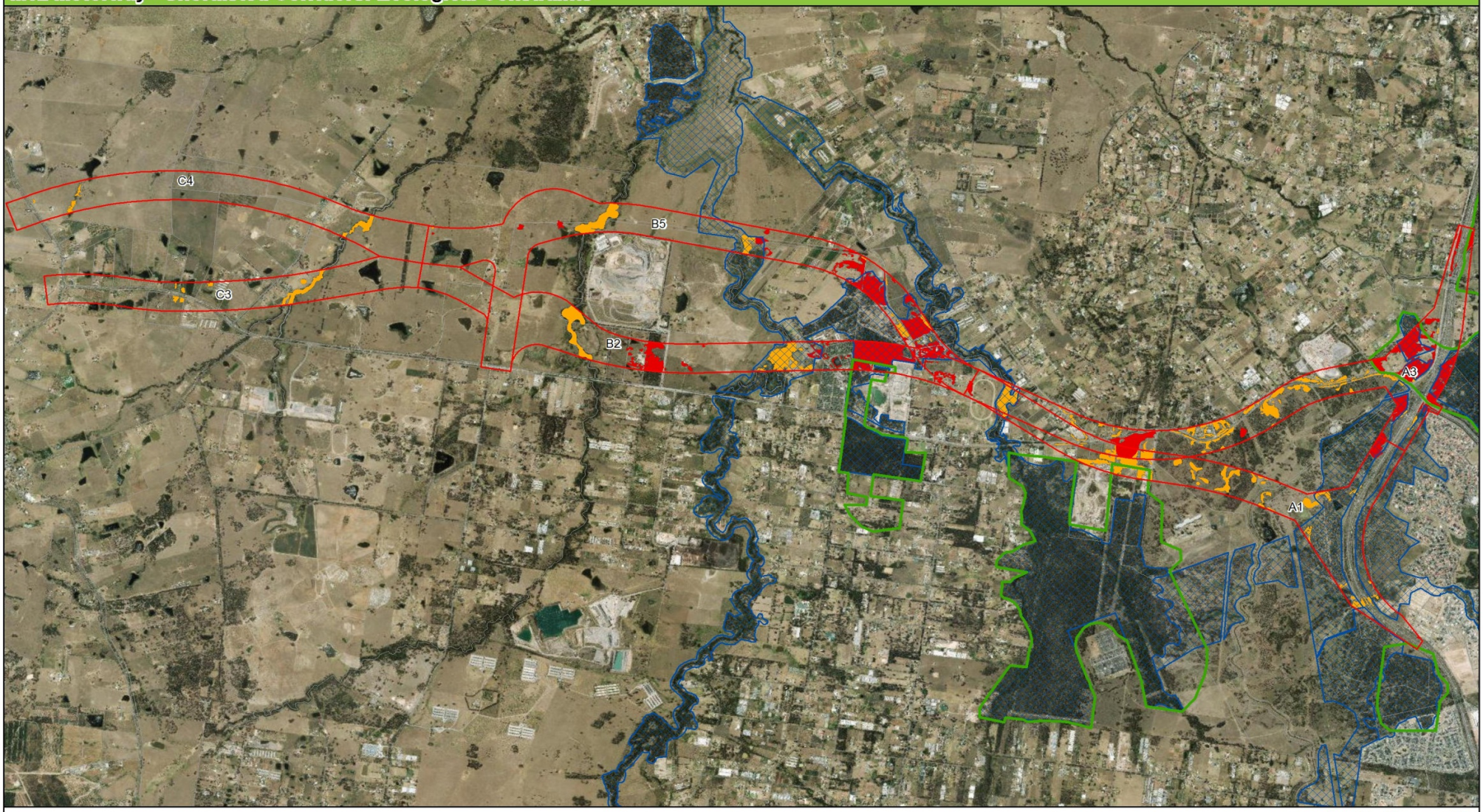
Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
				woodland, paperbark forests and open grassland.	
Mormopterus norfolkensis	Eastern Freetail-bat	V		Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Known
Myotis macropus	Southern Myotis	V		Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m.	Likely
Petroica phoenicea	Flame Robin	V		Breeds in upland tall moist eucalypt forests and woodlands. In winter uses dry forests, open woodlands, heathlands, pastures and native grasslands. Occasionally occurs in temperate rainforest, herbfields, heathlands, shrublands and sedgelands at high altitudes.	Likely
Phascolarctos cinereus	Koala, Hawks Nest and Tea Gardens population	E2,V	V	Eucalypt forest and woodland communities, including coastal forests, rainforest, riparian areas, swamp sclerophyll forests, heathland and shrubland.	No
Phascolarctos cinereus	Koala in the Pittwater Local Government Area	E2,V	V	Eucalypt forests and woodlands. Key likely habitats within Pittwater Council are: Swamp Mahogany Forest, ecotone between Spotted Gum Forest & Hawkesbury Sandstone Open-Forest, Northern form of Coastal Sandstone Woodland at Whale Beach, Red Bloodwood - Scribbly Gum Woodland, Bilgola Plateau Forest and the Grey Ironbark - Grey Gum form of the Newport Bangalay Woodland.	No
Phascolarctos cinereus	Koala	V	V	Eucalypt woodlands and forests.	Potential
Plegadis falcinellus	Glossy Ibis	P	C	Edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. Occasionally estuaries, deltas, saltmarshes and coastal lagoons.	Likely
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Known
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Woodland, moist and dry eucalypt forest and rainforest.	Known
Stagonopleura guttata	Diamond Firetail	V		Grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland, secondary derived grassland, riparian areas and lightly wooded farmland.	Likely

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Tringa nebularia	Common Greenshank	P	C,J,K	Terrestrial wetlands (swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans, saltflats, sewage farms and saltworks dams, inundated rice crops and bores) and sheltered coastal habitats (mudflats, saltmarsh, mangroves, embayments, harbours, river estuaries, deltas, lagoons, tidal pools, rock-flats and rock platforms).	Potential
Flora					
Acacia pubescens	Downy Wattle	V	V	Open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones.	Known
Cynanchum elegans	White-flowered Wax Plant	E1	E	Dry rainforest; littoral rainforest; *Leptospermum laevigatum-Banksia integrifolia subsp. integrifolia* (Coastal Tea-tree– Coastal Banksia) coastal scrub; *Eucalyptus tereticornis* (Forest Red Gum) or *Corymbia maculata* (Spotted Gum) open forest and woodland; and *Melaleuca armillaris* (Bracelet Honeymyrtle) scrub.	Potential
Dillwynia tenuifolia	Dillwynia tenuifolia, Kemps Creek	E2,V		Transition from Castlereagh Ironbark Forest to Castlereagh Scribbly Gum Woodland.	Known
Dillwynia tenuifolia	Dillwynia tenuifolia Sieber ex D.C. in the Baulkham Hills local government area	E2,V		Vegetation similar to Cumberland Plain Woodland, on Wianamatta Shale soils.	No
Dillwynia tenuifolia		V		Scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest, transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland, and disturbed escarpment woodland on Narrabeen sandstone.	Known
Eucalyptus benthamii	Camden White Gum	V	V	Occurs in open forest. Requires a combination of deep alluvial sands and a flooding regime.	Unlikely
Eucalyptus scoparia	Wallangarra White Gum	E1	V	Open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes. Natural distribution is in northern NSW,	No

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V		Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest, on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium.	Known
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	Heath and shrubby woodland to open forest on sandy or light clay soils usually over thin shales.	Known
Marsdenia viridiflora subsp. *viridiflora*	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		Vine thickets and open shale woodland.	Potential
Persoonia nutans	Nodding Geebung	E1	E	Northern populations: sclerophyll forest and woodland (Agnes Banks Woodland, Castlereagh Scribbly Gum Woodland and Cooks River / Castlereagh Ironbark Forest) on aeolian and alluvial sediments. Southern populations: tertiary alluvium, shale sandstone transition communities and Cooks River / Castlereagh Ironbark Forest.	Known
Pimelea spicata	Spiked Rice-flower	E1	E	Well-structured clay soils. *Eucalyptus moluccana* (Grey Box) communities and in areas of ironbark on the Cumberland Plain. Coast Banksia open woodland or coastal grassland in the Illawarra.	Known
Pultenaea parviflora		E1	V	Dry sclerophyll forest, especially Castlereagh Ironbark Forest, Shale Gravel Transition Forest and transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Known

Appendix B Corridor option constraints

M12 Motorway - Shortlisted Corridors: Ecological Constraints



Legend

Threatened Ecological Communities (TECs)

- TSC Act
- TSC and EPBC Act

- Corridor Options
- Lot Boundaries

- Priority Growth Area Non-Certified Land
- Priority Conservation Lands
- Regional Corridors

0 315 630 1,260
Metres

Datum/Projection:
GDA 1994 MGA Zone 56

N

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Figure 1

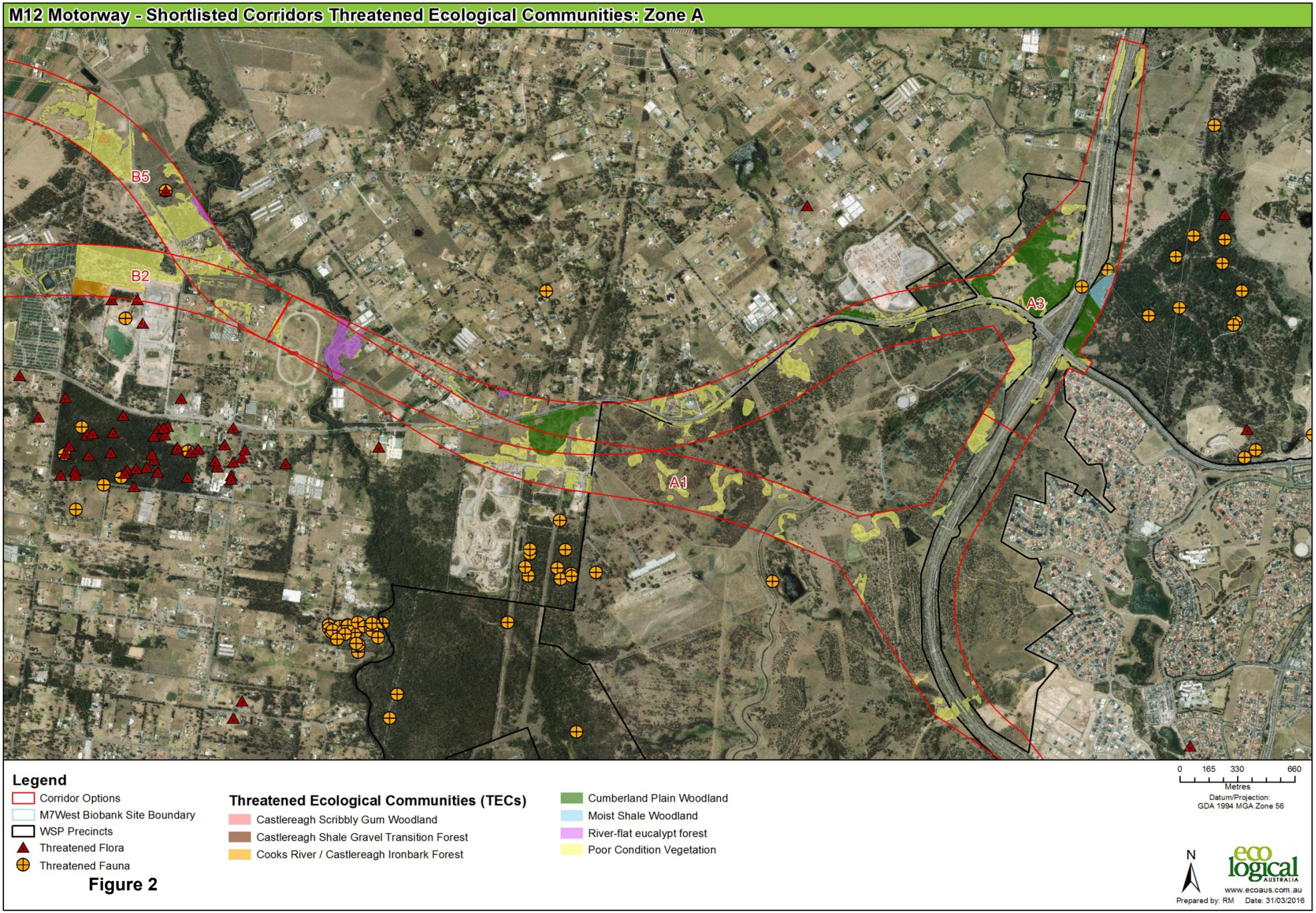
M12 Motorway - Shortlisted Corridors Threatened Ecological Communities: Zone A
B5
B2
A3
A1
Legend
Corridor Options
M7West Biobank Site Boundary
WSP Precincts
Threatened Flora
Threatened Fauna
Threatened Ecological Communities (TECs)
Castlereagh Scribbly Gum Woodland
Castlereagh Shale Gravel Transition Forest
Cooks River / Castlereagh Ironbark Forest
Cumberland Plain Woodland
Moist Shale Woodland
River-flat eucalypt forest
Poor Condition Vegetation
0 165 330 660
Metres
Datum/Projection:
GDA 1994 MGA Zone 56
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Figure 2

M12 Motorway - Shortlisted Corridors Threatened Ecological Communities: Zone B

Legend

- Corridor Options
- Threatened Flora
- Threatened Fauna

Threatened Ecological Communities (TECs)

- Castlereagh Scribbly Gum Woodland
- Castlereagh Shale Gravel Transition Forest
- Cooks River / Castlereagh Ironbark Forest
- Cumberland Plain Woodland
- Moist Shale Woodland
- River-flat eucalypt forest
- Poor Condition TECs

0 140 280 560
Metres
Datum/Projection:
GDA 1994 MGA Zone 56

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Figure 3

M12 Motorway - Shortlisted Corridors Threatened Ecological Communities: Zone C

Legend

- Corridor Options
- Threatened Flora
- Threatened Fauna

Threatened Ecological Communities (TECs)

- Castlereagh Scribbly Gum Woodland
- Castlereagh Shale Gravel Transition Forest
- Cooks River / Castlereagh Ironbark Forest
- Cumberland Plain Woodland
- Moist Shale Woodland
- River-flat eucalypt forest
- Poor Condition TECs

0 115 230 460
Metres
Datum/Projection:
GDA 1994 MGA Zone 56

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Figure 4

rms.nsw.gov.au/projects/sydney-west/m12-motorway/index.html

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