Appendix F Biodiversity assessment

Roads and Maritime Services

The Northern Road / Bringelly Road Grade Separated Interchange

Biodiversity impact assessment

November 2015

Table of contents

1. Introduction....1
   - 1.1 Overview....1
   - 1.2 Proposal outline....1
   - 1.3 Biodiversity certified areas....2
   - 1.4 Purpose of this report....3
   - 1.5 Report structure....3
   - 1.6 Terms and definitions....4
2. Legislative context....7
   - 2.1 NSW State legislation....7
   - 2.2 Commonwealth legislation....10
3. Methodology....13
   - 3.1 Desktop assessment....13
   - 3.2 Field survey....14
   - 3.3 Assessment of likelihood of occurrence....19
4. Existing environment....21
   - 4.1 Landscape context....21
   - 4.2 Flora....23
   - 4.3 Fauna....35
   - 4.4 Conservation significance....41
5. Assessment of impacts....45
   - 5.1 Introduction....45
   - 5.2 Construction impacts....45
   - 5.3 Operation impacts....50
   - 5.4 Key threatening processes....50
   - 5.5 Impacts on threatened biota and MNES within certified land....53
   - 5.6 Impacts on threatened biota and MNES within non-certified land....54
6. Management of impacts....55
   - 6.1 Avoiding and minimising impacts during design....55
   - 6.2 Mitigating impacts....55
   - 6.3 Offsetting impacts....58
7. Conclusion....59
8. References....61

Table index

Table 3.1 Condition thresholds for Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (taken from TSSC, 2008) 15

Table 3.2 Staff qualifications 18

Table 3.3 Key to likelihood of occurrence for threatened species 19

Table 4.1 Declared noxious weeds recorded in the study area 23

Table 4.2 Native vegetation in the proposal site 25

Table 4.3 Vegetation within the study area 26

Table 4.4 Fauna habitats present within the study area 36

Table 5.1 Key threatening processes of relevance to the proposal 51

Table 6.1 Environmental safeguards (construction) 55

Table 6.2 Environmental safeguards (operation) 58

Figure index

Figure 1.1 Proposal location and key features 5

Figure 4.1 Vegetation, threatened species and hollow-bearing trees 22

Appendices

Appendix A Likelihood of occurrence of threatened and migratory species within the study area

Appendix B Survey results

Appendix C Assessment of significance

1. Introduction

1.1 Overview

Roads and Maritime Services (Roads and Maritime) is proposing a new grade separated interchange at The Northern Road and Bringelly Road, Bringelly (referred to as 'the proposal' for the purposes of this report). The proposal is located within the Western Sydney Priority Growth Area and South West Land Release Area (formerly known as the South West Growth Centre), about 45 km south-west of the Sydney central business district and 12 km west of Liverpool (refer to Figure 1.1).

The proposal would tie into The Northern Road Upgrade Stage 2A (Peter Brock Drive to Belmore Road) to the south, The Northern Road Upgrade Stage 2C (Thames Road to Mersey Road) to the north, and the Bringelly Road Upgrade Stage 2 (King Street to The Northern Road) to the east.

This report has been prepared by GHD as part of the environmental assessment of the project. Roads and Maritime is the proponent of the proposal, and an environmental assessment in the form of a review of environmental factors (REF) is being prepared by GHD in accordance with the requirements of Part 5 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act).

This report assesses and documents the potential biodiversity impacts of the proposal. It assesses the potential for impacts on ecological values, with particular emphasis on threatened ecological communities, populations and species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and *Fisheries Management Act 1994* (FM Act), and Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Mitigation measures to ameliorate potential impacts of the proposal are included in section 6.2 of this report.

1.2 Proposal outline

The grade separated interchange, which would involve The Northern Road passing under Bringelly Road, would be located about 300 m east of the existing intersection of The Northern Road, Bringelly Road and Greendale Road. The proposal also involves modifications to the existing intersection. The key features of the proposal are shown in Figure 1.1 and include:

- Widening and upgrading about 400 m of Bringelly Road, between Kelvin Park Drive and Greendale Road, to provide:
  - Two 3.5 m wide traffic lanes in each direction between Kelvin Park Drive and The Northern Road/Bringelly Road interchange, with wide central medians to allow for a future third traffic lane in each direction
  - Two 3.5 m wide traffic lanes in each direction on the western side of the interchange, transitioning to one lane in each direction to tie in to the existing intersection and Greendale Road
  - Two metre wide shoulders in each direction
- Constructing a new section of The Northern Road, to the east of the existing alignment, between about 200 m south of Robinson Road and the southern abutment of the bridge over Thompsons Creek. The new section, which would pass beneath Bringelly Road, would be about one kilometre long and about 50 m wide (including embankments), and would include:
  - Two 3.5 m wide traffic lanes in each direction

  - Four metre wide shoulders connecting to the on and off ramps of the interchange, allowing for the future provision of bus lanes
  - An underpass about 60 m long beneath the upgraded section of Bringelly Road
  - 2.5 m wide shoulders along The Northern Road under the interchange for a length of about one kilometre
  - A wide central median to allow construction of a future third traffic lane in each direction
- Providing a new signalised intersection on Bringelly Road over The Northern Road, with turning movements provided in all directions
- Providing dual right turn movements in all directions to and from The Northern Road and Bringelly Road, and dedicated left turn lanes in all directions
- Providing bus service facilities by:
  - Retaining the bus stops on the existing The Northern Road
  - Relocating bus stops on Bringelly Road to suit the interchange
  - Providing two new bus stops on The Northern Road northbound and southbound interchange on ramps
  - Providing a bus only lane for buses travelling north and south along The Northern Road at the traffic lights on Bringelly Road
- Providing three metre wide shared paths for pedestrians and cyclists
- Providing a new road connection between Robinson Road and The Northern Road via an extension of the realigned Belmore Road intersection, and building a cul-de-sac at the western end of Robinson Road
- Converting the existing section of The Northern Road (to the west of the new section) to a 'no through road', by providing cul-de-sacs at both the northern (at Thames Road) and southern ends (near Robinson Road).

It is anticipated that construction of the proposal would commence in late 2016 / early 2017 and would be open to traffic by the end of 2019.

1.3 Biodiversity certified areas

The vast majority of the proposal site falls within the biodiversity certified areas of the South West Growth Centre (SWGC). Biodiversity certification or 'Biocertification' was granted for the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 under the TSC Act. This certification allows for a streamlined biodiversity assessment process by identifying and protecting high conservation value areas at a landscape scale while also identifying suitable areas for development. The legislative implications of this certification are discussed in section 2.1.2. Within this assessment, biocertified lands are referred to simply as 'certified' lands, and non-biocertified lands as 'non-certified' lands. Offsets are required for impacts on existing native vegetation within non-certified lands under the Biodiversity Certification Order for the Sydney Region Growth Centres (Minister for the Environment, 2007) (see section 2.1.2).

1.4 Purpose of this report

This report has been prepared with reference to Roads and Maritime's *Environmental Assessment Practice Note: Biodiversity Assessment EIA-N06* (RMS, 2012). The aims and scope of this report are to:

- Outline the methods used for the biodiversity assessment
- Describe the existing environment of the study area, including the results of the desktop assessment and site surveys
- Identify the presence or likely presence of threatened species, populations and ecological communities and their habitats listed under the TSC Act and FM Act
- Assess the potential for any MNES listed under the EPBC Act to occur within the site and/or to be affected by the proposal
- Identify the potential impacts of the proposal on threatened biota and their habitats, with a particular focus impacts in non-certified land
- Recommend mitigation and environmental management measures to avoid or minimise adverse impacts on threatened biota and biodiversity values, in accordance with Roads and Maritime's *Biodiversity Guidelines* (RTA, 2011)
- Assess the likely significance of impacts on threatened biota listed under the TSC Act and EPBC Act within non-certified land that would be affected by the proposal
- Assess the requirement for a biodiversity offset in accordance with the relevant biodiversity measures in the biodiversity certification order and the *Guideline for biodiversity offsets* (RTA, 2011).

As noted above, the majority of the proposal site is located in certified lands. In relation to Part 5 activities undertaken on biodiversity certified land, sections 126I(4) and (5) of the TSC Act provide that:

- activities are taken to be not likely to significantly affect any threatened species, population or ecological community
- a determining authority is not required to consider the effect on biodiversity values of the activity (despite section 111 of the EP&A Act).

While the determining authority is not required to consider the effect the activity will have on certified land, it is described here to provide context to the proposal and to impacts on non-certified land. In addition, while impacts are not taken to be significant, the proposal will impact the environment, and a description of the environment assists with the preparation of mitigation measures, such as for threatened species that would be impacted.

1.5 Report structure

The report comprises the following sections:

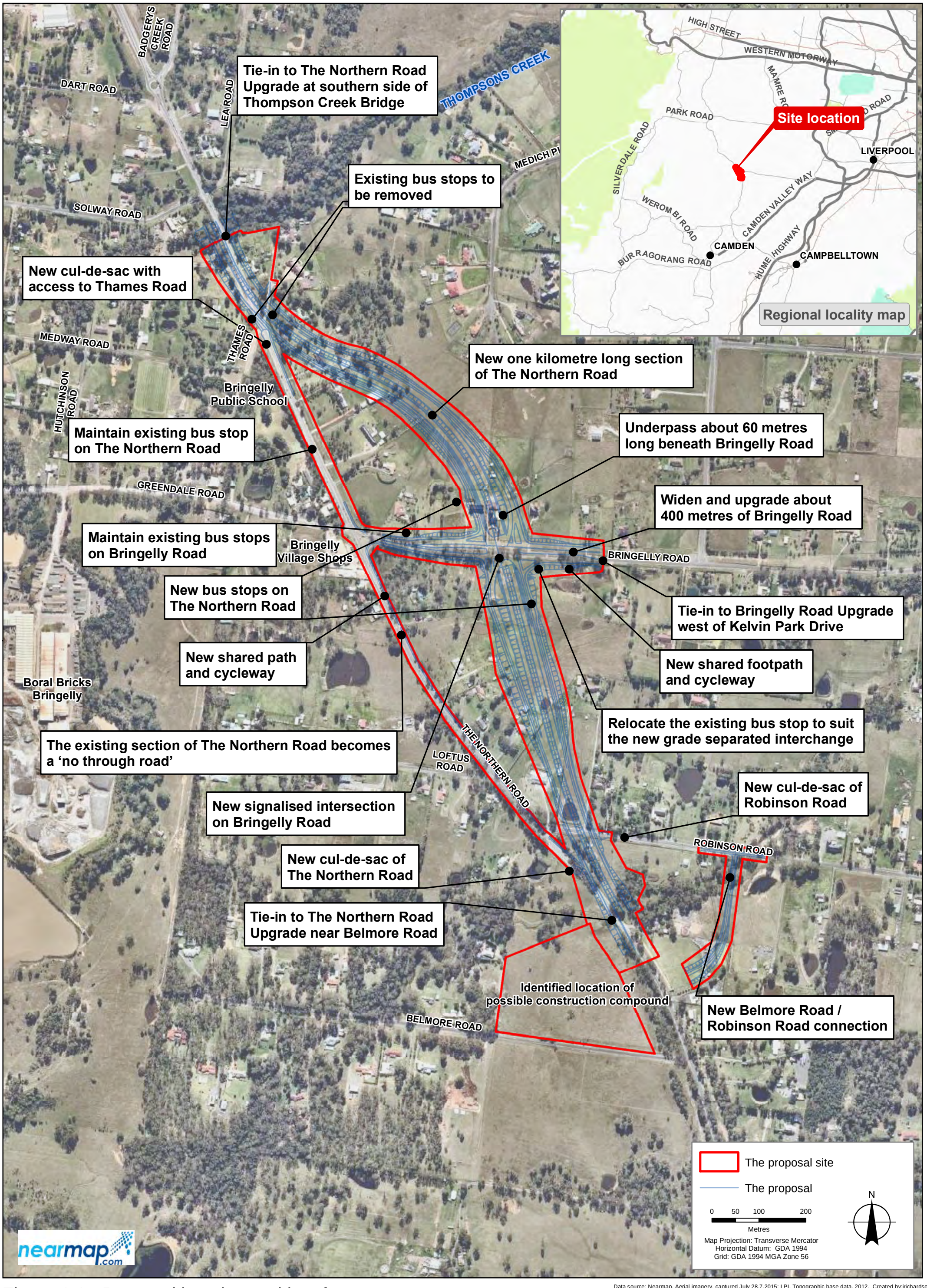
- **Section 1 – Introduction:** provides a background to the proposal and the scope of this report.
- **Section 2 – Legislative context:** summarises the legislation of relevance to this report.
- **Section 3 – Methodology:** describes the desktop and field methods used for this assessment.
- **Section 4 – Existing environment:** describes the existing environment of the study area.

- **Section 5 – Assessment of impacts:** assesses the potential impacts of the proposal during construction and operation on biodiversity values.
- **Section 6 – Management of impacts:** discusses measures to avoid and minimise impacts. Offset requirements are also discussed.
- **Section 7 – Conclusion:** concluding statements with regards to the impacts of the proposal on biodiversity values, and mitigation measures recommended to minimise the impacts on flora and fauna.

1.6 Terms and definitions

The following terms are used in this report:

- Proposal: the proposal as described in section 1.2
- Proposal site: the area where direct impacts would occur as a result of the proposal
- Study area: the proposal site and adjacent areas of vegetation and aquatic habitats that may be indirectly impacted by the proposal. For the purposes of this report, the study area is taken to be a 100 m radius of the proposal site
- Locality: the area within a 10 km radius of the proposal site
- Certified areas: areas within the SWGC subject to Biocertification (see section 2.1.2)
- Non-certified areas: areas within the SWGC precinct which are not subject to Biocertification (see section 2.1.2). In the study area this generally includes riparian corridors, as shown on Figure 4.1.



N:\AU\Sydney\Projects\21\24664\GIS\Maps\Deliverables\21_24664_Z008_ProposalLocation_KeyFeatures.mxd

Figure 1.1 Proposal location and key features

Data source: Nearmap, Aerial imagery, captured July 28.7.2015; LPI, Topographic base data, 2012. Created by:jrichardson

2. Legislative context

2.1 NSW State legislation

2.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act forms the legal and policy platform for proposal assessment and approval in NSW and aims to, amongst other things, 'encourage the proper management, development and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EP&A Act and the Environmental Planning and Assessment Regulation 2000.

The proposal, as an activity that does not require consent, is to be determined under Part 5 of the EP&A Act and Roads and Maritime is the 'determining authority' for the purposes of the Act. Under section 111(1) of the EP&A Act, determining authorities must 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'. This report addresses the ecological components of the environment to assist Roads and Maritime to address the requirements of section 111 of the EP&A Act.

In addition, section 111(4) of the EP&A Act states that the determining authority must consider the effect of an activity on:

- 'Critical habitat' (as defined under the TSC Act and FM Act)
- Species, populations or ecological communities, or their habitats (as listed under the TSC Act and FM Act) and whether there is likely to be a 'significant effect' on those species, populations or ecological communities.
- Other protected fauna or protected native plants listed under the *National Parks and Wildlife Act 1974*.

Section 5A of the EP&A Act lists seven factors that must be taken into account when determining the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the TSC Act and the FM Act. The 'seven-part test' is used to assist in the determination of whether a proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a species impact statement (SIS) is required. Seven-part tests are only required for threatened biota likely to be affected within the non-certified areas of the study area (see section 2.1.2).

2.1.2 State Environment Planning Policy (Sydney Region Growth Centres) 2006

State Environmental Planning Policy (Sydney Regional Growth Centres) 2006 (the Growth Centres SEPP) is the legal instrument that establishes the planning rules and objectives for Sydney's Growth Centres. Consent authorities, such as local councils, must apply this policy when they make planning decisions about land within the Growth Centres areas. The study area is located within the SWGC.

The aims of the Growth Centres SEPP are (in conjunction with amendments to the regulations under the Act relating to precinct planning) to:

- Co-ordinate the release of land for residential, employment and other urban development in the North West and South West growth centres of the Sydney Region
- Enable the Minister from time to time to designate land in those growth centres as ready for release for development

- Provide for comprehensive planning
- Enable the establishment of vibrant, sustainable and liveable neighbourhoods that provide for community well-being and high quality local amenity
- Provide controls for the sustainability of land that have conservation value
- Provide for the orderly and economic delivery of infrastructure
- Provide development controls to protect the health of the waterways
- Protect and enhance land with natural and cultural heritage value
- Provide land use and development controls that will contribute to the conservation of biodiversity.

Biocertification

Under section 126G of the TSC Act, the Minister has applied the principle of Biodiversity Certification to the Growth Centres SEPP. Clause 18(2) of the *Threatened Species Conservation Amendment* (*Special Provisions*) *Act 2008* outlines that Biocertification applies to 'all development and activities that may be carried out under the Growth Centres SEPP, and, to all threatened species, populations and ecological communities.'

Biocertification removes the need to undertake threatened species assessments or prepare SIS for species and communities listed under the TSC Act. The proposal site is entirely located within land certified under the Growth Centres SEPP. Sections 126I(4) and (5) of the TSC Act provide that activities are taken to be not likely to significantly affect any threatened species, population or ecological community, and a determining authority is not required to consider the effect on biodiversity values of the activity (despite section 111 of the EP&A Act.

Non-certified land is located in close proximity to the proposal site at Thompsons Creek, and indirect impacts of the project are assessed at this location.

Biocertification does not apply to threatened biota listed under the FM Act. As such, there is a requirement to assess impacts with respect to this Act in both certified and non-certified land.

Non-certified areas

No non-certified land is located in the proposal site. The northern part of the study area intersects Thompsons Creek. Riparian areas to the north-east of The Northern Road at this location are within non-certified areas of the SWGC and contain River-flat Eucalypt Forest endangered ecological community (EEC). A portion of this community in the study area is identified as 'existing native vegetation' (ENV) under the SEPP Growth Centres (see below), however, this is located outside the proposal site (see Figure 4.1).

There would be no direct impacts on River-flat Eucalypt Forest EEC within this area of non-certified land, however indirect impacts may occur. While impacts would not be significant, an assessment of significance for this community has been completed as a precaution. The potential for impacts on threatened biota occurring within non-certified areas are discussed further in section 5.2.

Under the Biodiversity Certification Order for the Sydney Region Growth Centres, offsets are developed in accordance with the relevant biodiversity measures 10 and 11 outlined in Schedule 1 of the Biodiversity Certification Order (Minister for the Environment 2007). These are only required for clearing of vegetation mapped as ENV within non-certified lands. As there would be no direct impacts on ENV within non-certified lands, there is no requirement to offset the impacts of the proposal with regard to the relevant biodiversity measures in the biodiversity certification order (see section 6.3).

Commonwealth endorsement of Biocertification

On 28 February 2012, the Commonwealth Environment Minister approved all actions associated with development of the Sydney Growth Centres as described in the Sydney Growth Centres Strategic Assessment Program Report. This endorsement removes the requirement for site by site approvals under the EPBC Act as long as proposed actions are consistent with the endorsed Program. No approval under the EPBC Act is therefore required for impacts on threatened and migratory biota listed under the Act within certified areas.

There would be no significant impacts on potential habitat for MNES in non-certified areas within the proposal study area, and thus no assessments of significance pursuant to the significant impact guidelines (DotE 2013) have been prepared.

2.1.3 Threatened Species Conservation Act 1995

The TSC Act provides legal status for biota of conservation significance in NSW. The TSC Act aims to, amongst other things, 'conserve biological diversity and promote ecologically sustainable development'. It provides for:

- The listing of 'threatened species, populations and ecological communities', with endangered species, populations and communities listed under Schedule 1, 'critically endangered' species and communities listed under Schedule 1A, and vulnerable species and communities listed under Schedule 2
- The listing of 'Key Threatening Processes' under Schedule 3
- The preparation and implementation of Recovery Plans and Threat Abatement Plans
- Requirements or otherwise for the preparation of a SIS.

The TSC Act has been addressed in this assessment through:

- Desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality and hence could occur subject to the habitats present
- Targeted field surveys for listed threatened species, populations and ecological communities
- Identification, assessment and mapping of listed threatened communities and threatened species (or their habitat)
- Assessment of potential impacts on listed threatened species, populations and ecological communities, including identification of key threatening processes relevant to the proposal
- Identification of suitable impact mitigation and environmental management measures for listed threatened species, where required.

2.1.4 Fisheries Management Act 1994

The objects of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for:

- The listing of threatened species, populations and ecological communities, with endangered species, populations and communities listed under Schedule 4, critically endangered species and communities listed under Schedule 4A, vulnerable species and communities listed under Schedule 5
- The listing of 'Key Threatening Processes' under Schedule 6
- Diseases affecting fish and marine vegetation under Schedule 6B

- Noxious fish and noxious marine vegetation under Schedule 6C
- The preparation and implementation of Recovery Plans and Threat Abatement Plans
- Requirements or otherwise for the preparation of a SIS.

One of the objectives of the FM Act is to 'conserve key fish habitats ' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. To assist in the protection of key fish habitats, DPI has produced the *Policy and guidelines for fish habitat conservation and management* (2013 update). This policy applies to the following developments, works or activities, each of which can impact on key fish habitat:

- Dredging or reclamation
- Impeding fish passage
- Damaging marine vegetation
- De-snagging.

The FM Act has been addressed in this assessment through undertaking:

- A desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality of the proposal and hence could occur subject to the habitats present
- Assessment of aquatic habitats during terrestrial field surveys
- Assessment of potential impacts on aquatic habitats, including identification of key threatening processes of relevance to the proposal, impacts on key fish habitat and fish passage
- Assessment of the potential for impacts on listed threatened species, populations and ecological communities
- Identification of suitable impact mitigation and environmental management measures to avoid or mitigate impacts on the aquatic environment.

2.1.5 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act) provides for the declaration of noxious weeds by the Minister for Primary Industries. Noxious weeds may be considered noxious on a National, State, regional or local scale. All private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act. As such, if present, noxious weeds in the study area would need to be assessed and controlled.

A total of 12 noxious weeds were recorded in the study area. Legal requirements to minimise the potential for the introduction and/or spread of weeds as a result of the proposal are discussed in section 4.2.2.

2.2 Commonwealth legislation

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on ‘matters of national environmental significance’ undergo an assessment and approval process. Under the EPBC Act, an action includes a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that ‘has, will have or is likely to have a significant impact on a matter of national environmental significance’ is deemed

to be a ‘controlled action’ and may not be undertaken without prior approval from the Australian Minister for the Environment (the ‘Minister’).

The EPBC Act identifies MNES as:

- World heritage properties
- National heritage places
- Wetlands of international importance (Ramsar wetlands)
- Threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- A water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act has been addressed in this assessment through:

- Desktop review to determine the listed biodiversity matters that are predicted to occur within the locality of the proposal and hence could occur, subject to the habitats present
- Targeted field surveys for listed threatened biota and migratory species
- Assessment of potential impacts on MNES
- Identification of suitable impact mitigation and environmental management measures for threatened biota, where required.

Potential impacts on MNES is subject to an assessment of significance pursuant to the EPBC Act Significant Impact Guidelines (DotE 2013). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Minister. As described in section 2.1.2, the Australian Minister for the Environment approved all actions associated with development of the Sydney Growth Centres as described in the Sydney Growth Centres Strategic Assessment Program Report (NSW Department of Planning, 2010b). An assessment of the likely significance of impacts on threatened and migratory biota listed under the EPBC Act pursuant to the Significant Impact Guidelines (DotE 2013) is thus only required for impacts within non-certified land within the study area. When applying the Significant Impact Guidelines (DotE 2013), the proposal will not result in a significant impact on any EPBC Act listed threatened or migratory species or community within non-certified land. As such, no referral under the EPBC Act is required.

3. Methodology

3.1 Desktop assessment

3.1.1 Database searches

A desktop database review was undertaken to identify threatened flora and fauna species, populations and ecological communities (biota) listed under the TSC Act and FM Act, and MNES listed under the EPBC Act, that could be expected to occur in the locality, based on previous records, known distribution ranges, and habitats present. The database review assisted with focusing field survey techniques and effort. Biodiversity databases pertaining to the proposal site and locality (i.e. within a 10 km radius of the site) that were reviewed prior to conducting field investigations included:

- The NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife for records of threatened species listed under the TSC Act and EPBC Act which have been recorded within the locality (report generated on 22 June 2015) (OEH, 2015a)
- The NSW Department of Primary Industries (DPI) online protected species viewer for records of threatened aquatic species listed under the FM Act that have been recorded within the locality (DPI, 2015a) (database queried on 22 June 2015)
- The Australian Government Department of the Environment (DotE) Protected Matters Search Tool for Matters of National Environmental Significance (MNES) listed under the EPBC Act which may occur in the area (report generated on 22 June 2015) (DotE, 2015a)
- OEH threatened species profiles online database (OEH 2015b)
- DotE online species profiles and threats database (DotE 2015b).

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats at the proposal site. This was further refined following field surveys and assessment of habitats present (see section 3.3). The results of this assessment are presented in Appendix A.

3.1.2 Document review

Literature and resources reviewed for the preparation of this report has included the following key documents:

- *The Northern Road upgrade, Narellan to Bringelly* (SKM 2012)
- *Bringelly Road Upgrade Ecological Assessment* (PB 2011)
- Broad scale vegetation mapping the Cumberland Plain (NPWS 2002) to identify native vegetation types occurring within the study area and the likely presence of any threatened ecological communities
- Noxious weed declarations for Liverpool and Camden local government areas (LGAs) (DPI 2015b)
- Aerial photography of the proposal site.

3.2 Field survey

3.2.1 Survey methods

The primary aim of the survey was to ground-truth vegetation mapping within both non-certified and certified portions of the study area. Survey effort was determined by the fact that over 99 per cent of the proposal site is located in certified land (see section 2.1.2). Field surveys were conducted by two ecologists (Kirsten Crosby, Gary Leonard) on 1 and 2 July 2015 in certified and non-certified areas within the study area. Surveys were conducted during the day an in the evening. Weather was sunny and cool with some wind and no rain. Temperatures reached a high of 15.3 on the first day, falling to 2.6 overnight, and reaching 15.7 on the second day. Access was granted for most properties. Where access was not granted, ecologists viewed the property from either the road or an adjacent property.

The methodology for flora and fauna surveys is detailed below. The aims of the field survey were to:

- Verify vegetation types, condition and mapping within certified and non-certified land
- Identify fauna habitat types and specific features, in particular those of relevance for threatened species
- Identify the presence or likely presence of threatened species, populations and ecological communities and their habitats listed under TSC Act and FM Act within the study area that may be impacted by the proposal
- Identify the presence or likely presence of any threatened or migratory biota listed under the EPBC Act within the study area that may be impacted by the proposal.

A description of survey techniques is provided below.

3.2.2 Flora survey

The flora survey involved the following techniques, which are described below:

- Vegetation mapping and extrapolation of existing vegetation mapping
- Random meander surveys (as per Cropper, 1993)
- Targeted threatened flora surveys.

Vegetation mapping

Vegetation mapping by PB (2011) and SKM (2012) that covered the study area was ground-truthed. Vegetation communities were mapped using aerial photograph interpretation within a geographical information system (GIS) as guided by the field survey results. Vegetation mapping of the surrounding locality by NPWS (2002) was used as a baseline, although it is recognised that this mapping was developed at a coarse scale, therefore extensions of existing vegetation mapping into the study area were undertaken where appropriate.

Vegetation within the study area was assessed against identification criteria for State and Commonwealth listed threatened ecological communities (Critically Endangered Ecological Communities (CEECs) and Endangered Ecological Communities (EECs)). Vegetation and habitats were compared with descriptions provided in OEH (2015b) and DotE (2015a) profiles.

Cumberland Shale Plains Woodland survey

The diversity of native understorey species is key to determining whether vegetation is consistent with the EPBC Act listed Cumberland Shale Plains Woodlands and Shale-Gravel Transition Forest CEEC. The field surveys undertaken in areas of Cumberland Plain Woodland

collected floristic and structural vegetation data to determine which (if any) patches of this vegetation meet the condition criteria of the community as listed under the EPBC Act. Condition thresholds prepared for the community listed under the EPBC Act (TSSC 2008) are provided in Table 3.1. All areas of Cumberland Plain Woodland in the study area are consistent with the community as listed under the TSC Act.

Table 3.1 Condition thresholds for Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (taken from TSSC, 2008)

Category and rationale	Thresholds
A. Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW.	Minimum patch size is ≥ 0.5 ha; AND ≥ 50% of the perennial understorey vegetation cover is made up of native species.
OR	OR
B. Larger patches which are inherently valuable due to their rarity.	The patch size is ≥ 5 ha; AND ≥ 30% of the perennial understorey vegetation cover is made up of native species.
OR	OR
C. Patches with connectivity to other large native vegetation remnants in the landscape.	The patch size is ≥ 0.5 ha; AND ≥ 30% of the perennial understorey vegetation cover is made up of native species; AND The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥ 5 ha in area.
OR	OR
D. Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is ≥ 0.5 ha in size; AND ≥ 30% of the perennial understorey vegetation cover is made up of native species; AND The patch has at least one tree with hollows per hectare or at least one large tree (≥ 80 cm diameter at breast height) per hectare from the upper tree layer species outlined in the description and Appendix A of TSSC (2008).

Targeted threatened flora surveys

Targeted surveys were undertaken for threatened flora species which could potentially occur within the study area given known distributions, previous records in the study area and locality and habitat requirements for each species. Random meander surveys (as per Cropper, 1993) were undertaken throughout suitable habitat within the study area. Consideration was given to previous threatened species records within the locality and within close proximity to the study area (e.g. OEH, 2015a; SKM 2012; PB 2011) when identifying areas of potentially suitable habitat. The timing of field surveys was not ideal for identification of cryptic species such as *Pimelea spicata*, which is more visible during its spring flowering period and can be present as an underground tap root only. As such, the field survey aimed to identify areas of suitable habitat for cryptic species where necessary.

3.2.3 Fauna survey

Fauna habitat assessment

General fauna habitat assessments were undertaken throughout the study area, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, the density of understorey vegetation, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted.

Indicative habitat criteria for targeted threatened species (i.e. those determined as having the potential to occur within the study area following the desktop review) were identified prior to fieldwork. Fauna habitat assessments aimed to identify potential habitat for these species.

Habitat criteria were based on information provided in OEH and DotE threatened species profiles, field guides, and the knowledge and experience of GHD field ecologists. Habitat assessment assists in the compilation of a comprehensive list of threatened fauna species that are predicted within the vicinity of the study area, rather than relying solely on single event surveys that are subject to seasonal limitations and may only represent a snapshot of assemblages present.

Habitat assessments included active searches for:

- Trees with bird nests or other potential fauna roosts
- Tracks or animal remains
- Evidence of activity such as feeding scars, scratches and diggings
- Specific food trees and evidence of foraging
- Leaf litter and fallen timber suitable for gastropods and reptiles
- Potential habitat for the Cumberland Plain Land Snail (*Meridolum corneovirens*) in areas of River-flat Eucalypt Forest and Cumberland Plain Woodland
- Presence of potential habitat for frog species.

The locations and quantitative descriptions of significant habitat features were captured with a handheld GPS unit.

Hollow-bearing tree assessments

The locations of hollow-bearing trees within the study area were mapped. Counts and estimates of sizes of visible hollows were made, and hollows were checked for signs of use (e.g. visible chew marks, guano). Data collected included tree species, height, diameter at breast height, and number, size and location of hollows. The locations of hollow-bearing trees were captured with a handheld GPS unit.

Diurnal bird surveys

Diurnal bird surveys were performed in the early morning, targeting representative habitats within the study area. Habitats of particular interest included woodland, creeklines, dams and open paddocks. Area searches of at least 20 minutes duration were undertaken at a number of locations to compile a list of native birds present in each habitat type. Species were identified by sight and call. Incidental observations made outside the targeted survey period were also recorded.

Snail searches

Active searches for the Cumberland Plain Land Snail (*Meridolum corneovirens*) were undertaken in areas of suitable habitat, as defined in NSW NPWS (2000); namely areas that included Cumberland Plain Woodland and fringing areas between Cumberland Plain Woodland and River-flat Eucalypt Forest. Survey focussed on identifying the species sheltering under logs, debris, leaf and bark accumulations and under any man-made shelter resources such as rubbish, building materials etc. Empty snail shells were collected and any live snails were photographed for identification purposes.

Microchiropteran bat surveys

Microbat ultrasonic echolocation call recordings (Anabat^{TM} SD1 surveys) were undertaken using one unit on one night within the study area, to target both common and threatened species. Fixed recordings were undertaken from dusk until the following morning in a patch of Cumberland Plain Woodland along The Northern Road adjacent to an open area. *The Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay et al. 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for possible species (Pennay et al 2011; Churchill 2008; van Dyck and Strahan 2008) and records from the Atlas of NSW Wildlife (OEH 2015a).

Spotlighting and call playback

Spotlight searches, which included dedicated listening periods for fauna vocalisations, targeted areas with hollow-bearing trees for nocturnally active mammals, birds and frogs. Spotlighting was focussed on areas that contained native vegetation, in particular along The Northern Road and Bringelly Road.

Nocturnal call playback surveys were conducted for the Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*) and Masked Owl (*Tyto novaehollandiae*) where The Northern Road crosses Thompsons Creek. Surveys involved an initial listening period of five minutes, followed by call playing for five minutes, followed by a listening period of five minutes (undertaken separately for each species), with a final listening period of approximately 10 minutes. Calls were played through an iPhone connected to a 45-watt megaphone. Potential roost sites in the immediate area were scanned using spotlights following call playback.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. Survey effort was concentrated in areas that supported habitat resources, for instance fallen timber was scanned and/or turned for reptiles and mature trees and dams were scanned for roosting birds.

Aquatic habitat assessment

Rapid aquatic habitat assessments were undertaken where the proposal is located near waterways. The presence of instream or riparian vegetation was recorded. Areas of potential fish refuge (snags, undercut banks) were noted. Assessment of potential habitat for threatened species was based on habitat assessments undertaken during field surveys and published habitat preferences of threatened biota. Key fish habitat was identified according to the following classifications as detailed in DPI (2013):

- Type 1 – highly sensitive fish habitat (includes freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or three metres in length, or native aquatic plants; known or expected protected or threatened fish habitat; and areas of critical habitat)

- Type 2 – moderately sensitive key fish habitat (freshwater habitats other than those defined in Type 1)
- Type 3 – minimally sensitive key fish habitat (ephemeral aquatic habitat not supporting native aquatic or wetland vegetation)
- Not key fish habitat (includes first and second order streams on gaining streams, canals, and urban drains and dams).

3.2.4 Survey effort considerations

The study area is located almost entirely within certified land and encroaches only a very small area of non-certified land at its north-eastern extent (Figure 4.1). Few stands of intact native vegetation would be impacted by the proposal. As such, the survey focussed on habitat assessment, with no trapping, detailed vegetation surveys (eg plot/transects in accordance with the BioBanking Assessment Methodology) or aquatic surveys considered necessary.

The survey built on previous information collected during detailed investigations undertaken by PB (2011) and SKM (2012) for the upgrades of The Northern Road and Bringelly Road, both of which encompassed the proposal site. The results of these surveys have been considered in this current study.

It is likely that some species that occur in the proposal site were not detected during the current or previous surveys. GHD surveys were conducted in winter. Weather was sunny and cool with some wind and no rain. Species not detected may include annual, ephemeral or cryptic flora species; fauna that are less active during colder months (eg frogs which call in specific seasons or weather conditions, and microchiropteran bats); and mobile or transient fauna in general. To make an assessment of their likelihood of occurring within the proposal site the habitat assessment identified habitat resources for such species. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the ecological values within the proposal site. This information was used to predict potential impacts of the proposal on ecological values.

3.2.5 Staff qualifications

Qualifications of staff that undertook field surveys and prepared this report are provided in Table 3.2 Flora and fauna surveys were conducted under a Section 132C scientific licence (SL100146) issued under the NSW *National Parks and Wildlife Act 1974* and complied with GHD's animal ethics permit requirements.

Table 3.2 Staff qualifications

Name	Position/Role	Qualifications	Years' Experience
Kirsten Crosby	Senior Ecologist / site surveys, reporting	BSc, PhD (Zoology) NSW BioBanking Assessor Accreditation (number 160)	10+ years
Gary Leonard	Senior Ecologist / site surveys, reporting	Horticulture Certificate, National Diploma of Horticulture	40+ years
Malith Weerakoon	Graduate Ecologist / desktop assessment, data processing.	BSc, MPhil. (Zoology)	2+ years
Jayne Tipping	Principal Ecologist/technical review	BSc (Ecology), MEnvLaw	20+ years

3.3 Assessment of likelihood of occurrence

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats contained within the study area. Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles (DotE 2015b, OEH 2015b), recovery plans, journal articles, and the field staffs' knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality since 1990, species distribution and habitat preferences, and the suitability of potential habitat present in the study area. The results of this assessment are provided in Appendix A.

Table 3.3 provides a key to the likelihood of occurrence in the study area of threatened biota known or likely to occur in the locality.

Table 3.3 Key to likelihood of occurrence for threatened species

Likelihood	Definition
Likely	Species previously recorded within a 10 km radius of the study area and suitable habitat occurs within the study area.
Possible	Species previously recorded within a 10 km radius of the study area but only marginal suitable habitat recorded, OR Species not previously recorded within a 10 km radius of the study area, but the study area is within the species known distribution and suitable habitat occurs within the study area.
Unlikely	Species previously recorded within a 10 km radius of the study area but no suitable habitat recorded.
Nil	Species not previously recorded within a 10 km radius of the study area, suitable habitat not recorded within study area, and/or study area outside species known distribution.

4. Existing environment

4.1 Landscape context

4.1.1 Site location and key features

The study area is located in south-west Sydney in the Liverpool and Camden LGAs. The study area is comprised of rural-residential properties and portions of land adjacent to existing roads. The study area falls within the SWGC, and is located predominantly within certified lands (see Figure 4.1). The majority of land in the study area has been previously cleared for agricultural or residential use, although small stands of native vegetation persist as fragmented patches within this modified landscape. Thompsons Creek is located at the northern end of the study area, and runs from the south-west to the north-east across The Northern Road. This creek flows into South Creek approximately three kilometres north-east of the site. A number of small drainage lines are also present that drain to South Creek.

4.1.2 Geology, soils and topography

The geological series sheet for the site (Penrith 1:100,000 scale, Sheet No. 9030) indicates that the site is underlain by Bringelly Shale comprising shale, carbonaceous claystone, laminite and rare coal. Quaternary aged alluvial deposits comprising quartz and lithic fluvial sand, silt and clay are located at Thompsons Creek.

The soil landscape series sheets (Penrith 1:100,000 scale, Sheet No. 9030 and Wollongong-Port Hacking 1:100,000 scale, Sheet No. 9029-9129) indicates the site is primarily underlain by the Blacktown residual soil unit. The alluvial areas associated Thompsons Creek are underlain by the South Creek fluvial soil landscape.

The Blacktown residual soil landscape typically comprises of clayey soils over gently undulating crests. The soil unit can have moderately reactive, highly plastic subsoils and poor drainage.

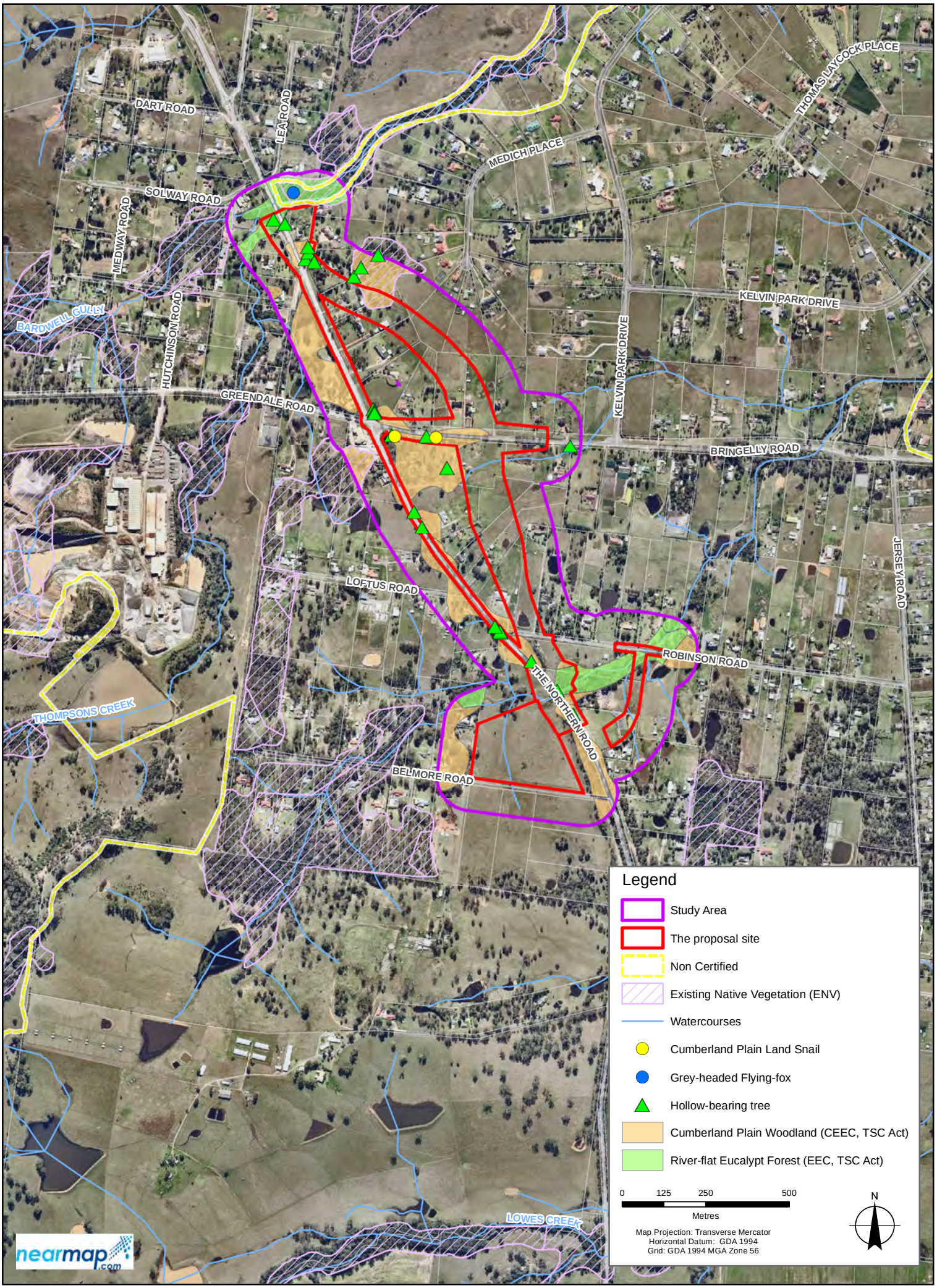
The South Creek fluvial soil comprises floodplains and drainage depressions of very deep layered clays and sands. These fluvial soils are prone to erosion and frequent flooding.

4.1.3 Vegetation

Native vegetation occurs mainly as small, isolated patches of remnant and regenerating vegetation. Narrow linear patches of riparian vegetation follow Thompsons Creek and the unnamed creek at the southern end of the study area. Vegetation mapping of the Cumberland Plain (NPWS 2002) identified the following native vegetation types in the study area:

- Cumberland Shale Plains Woodland
- Cumberland Shale Hills Woodland
- Alluvial Forest.

Many of the patches in the study area are mapped as having less than 10 per cent cover (NPWS 2002), suggesting they are in low condition.



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Data source: Nearmap, Aerial Imagery, Extracted 23 July 2015; LPI, Topographic base map, 2012. Created by:MWeerakoon

Figure 4.1
Vegetation, threatened species and hollow-bearing trees

4.2 Flora

4.2.1 Flora species

A total of 225 species of flora were recorded within the study area, comprising 124 species that are native to the Liverpool and Camden LGAs and 101 species that are either exotic or are native species but not endemic to the LGAs (ie planted natives). The Poaceae (grasses, 33 species), Myrtaceae (trees or shrubs, 29 species), and Fabaceae (trees or shrubs, 18 species) were the most diverse families recorded. No threatened plant species native to the LGAs were recorded within the study area (see section 4.4.3).

The full list of flora species recorded is presented in Appendix B. Species recorded are discussed below in relation to the vegetation communities occurring within the study area. Noxious weeds recorded in the study area are discussed in Section 4.2.2

4.2.2 Noxious weeds

The NW Act provides for the declaration of noxious weeds in LGAs. Landowners and occupiers must control noxious weeds according to the control category specified in the Act. Public authorities must control noxious weeds according to the control category to the extent necessary to prevent their spread to adjoining land. The study area contains 12 species declared as noxious weeds in the Liverpool and Camden LGAs as shown in Table 4.1.

Table 4.1 Declared noxious weeds recorded in the study area

Scientific name	Common name	Control category	Legal requirements
Asparagus aethiopicus	Ground Asparagus	4	The plant must not be sold, propagated or knowingly distributed
Asparagus asparagoides	Bridal Creeper	4	The plant must not be sold, propagated or knowingly distributed
Bryophyllum species	Mother-of-millions	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Cestrum parqui	Green Cestrum	3	The plant must be fully and continuously suppressed and destroyed
Gleditsia triacanthos	Honey Locust	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed
Lantana camara	Lantana	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Ligustrum lucidum	Broad-leaved Privet	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Ligustrum sinense	Narrow-leaved Privet	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Lycium ferocissimum	African Boxthorn	4	The plant must not be sold, propagated or knowingly distributed

Scientific name	Common name	Control category	Legal requirements
Olea europaea subsp. *cuspidata*	African Olive	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Rubus fruticosus species aggregate	Blackberry	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Senecio madagascariensis	Fireweed	4	The plant must not be sold, propagated or knowingly distributed

4.2.3 Vegetation communities

Vegetation within the study area has been modified by historic and ongoing clearing for development and agriculture. Native vegetation occurs in isolated patches of remnant or remnant and regenerating trees, often concentrated in roadside reserves or along waterways throughout the study area. There are no large continuous tracts of vegetation within the study area. The study area is intersected by a series of main roads (Bringelly Road and The Northern Road) which have all contributed to the existing fragmented nature of vegetation within the locality.

All native vegetation types in the study area are commensurate with threatened ecological communities (TECs). These comprise:

- Cumberland Plain Woodland (mapped as Shale Plains Woodland)
  - Listed as the CEEC *Cumberland Plain Woodland in the Sydney Basin Bioregion* under the TSC Act. Cumberland Plain Woodland is located in scattered patches and as linear roadside strips within certified lands in the study area. One patch meets the definition of existing native vegetation (ENV) under the Biocertification Order (Minister for the Environment 2007) (refer to section 2.1.2) and is mapped on such in the Growth Centres Conservation Plan (Growth Centres Commission 2007).
  - No patches of this vegetation in the study area meet the condition criteria for the form of the CEEC listed under the EPBC Act (*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*) (refer to Table 3.1).
- River-flat Eucalypt Forest
  - Listed as the endangered ecological community (EEC) *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* under the TSC Act. River-flat Eucalypt Forest is located along a small creek in the southern portion of the study area and along Thompsons Creek in the north of the study area. A small portion of River-flat Eucalypt Forest in the study area at Thompsons Creek is located in non-certified land. A part of this vegetation along Thompsons Creek is also classified and mapped as ENV under the Biocertification Order (Minister for the Environment 2007); however, this is not located in the proposal site and would not be impacted by the proposal.

Native vegetation in the proposal site is summarised in Table 4.2.

The majority of the proposal site comprises non native vegetation communities:

- Exotic grassland and gardens
- Aquatic plants in dams.

Table 4.2 Native vegetation in the proposal site

Vegetation type	Conservation status/classification	Proposal site (certified land) (ha)
Cumberland Plain Woodland	Listed under the TSC Act as the critically endangered ecological community Cumberland Plain Woodland in the Sydney Basin Bioregion	3.30
River-flat Eucalypt Forest	Listed under the TSC Act as the critically endangered ecological community River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.96
Total native vegetation		**4.26**
Total area		**39.06**

Vegetation in the study area is described in more detail in Table 4.3. Native vegetation within the study area is mapped on Figure 4.1.

Table 4.3 Vegetation within the study area

Vegetation Community	Conservation status*	Location	Description
Certified land	-	-	-

Vegetation Community	Conservation status*	Location	Description
Cumberland Plain Woodland (Shale Plains Woodland)	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC – TSC Act form of the community	Northern section of the study area, to the east of The Northern Road	Woodland vegetation associated with flat and gently undulating areas. Canopy is about 20 m in height, with a foliage projective cover of about 15-20%. Mid-storey species are sparse to absent and the groundcover consists of a mixture of indigenous and exotic grasses and forbs. Most trees in this patch appear to be of the same age class (±25 years). The canopy species composition is almost monotypic, consisting of Forest Red Gum (*Eucalyptus tereticornis*), with a few Grey Box (*Eucalyptus moluccana*). The most common mid-storey species is the exotic African Olive *(Olea europaea* subsp*. cuspidata*), with occasional individuals of Native Blackthorn (*Bursaria spinosa*) and Parramatta Wattle (*Acacia parramattensis*). Small clumps of Lantana (*Lantana camara*) and Purpletop (*Verbena bonariensis*) occur. The only climbing species recorded is the exotic Moth Vine (*Araujia sericifera*). The understorey consists of a dense sward of Panic Veldtgrass (*Ehrharta erecta*), with occasional patches of Weeping Grass (*Microlaena stipoides*) and, along vegetation edges, Kangaroo Grass (*Themeda australis*). Small patches of native forbs occur where the grass cover is not so dense. Species include Kidney Weed (*Dichondra repens*), Variable Glycine (*Glycine tabacina*) and Whiteroot (*Pratia purpurascens*). This patch is mapped as ENV as per the Biodiversity Certification Order (Minister for the Environment 2007) (see Figure 4.1). As this is located in certified land it has already been offset. 

Vegetation Community	Conservation status*	Location	Description
Cumberland Plain Woodland (Shale Plains Woodland)	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC – TSC Act form of the community	Corner of The Northern Road and Bringelly Road	Woodland vegetation associated with flat and gently undulating areas. Canopy height is about 12- 20 m in height, with a foliage projective cover of about <15%. Regeneration is taking place at this location, although tree cover is sparse. Most trees in this patch appear to be of the same age class (±25 years). Mid-storey species are sparse to absent, although some dense patches of African Olive *(Olea europaea* subsp*. cuspidata*) occur, especially at the base of mature trees. The groundcover consists of a mixture of indigenous and exotic grasses and forbs. The most common canopy species is Grey Box (*Eucalyptus moluccana*), with occasional specimens of Forest Red Gum (*Eucalyptus tereticornis*). Die-back is extensive in the Grey Boxes. A small patch of self-recruiting Wallangarra White Gums (*Eucalyptus scoparia*) is also present. This threatened species is endemic to a small area in north-east NSW and SE Queensland, but is a common garden plant in the Sydney area (see section 4.4.3). The most common mid-storey species is the exotic African Olive *(Olea europaea* subsp*. cuspidata*), which forms a dense hedge around the northern and western edges of this patch, as well as occurring in several dense patches throughout the site. Native mid-storey species include Native Blackthorn (*Bursaria spinosa*), Sickle Wattle (*Acacia falcata*), Parramatta Wattle (*Acacia parramattensi)s* and Eucalypt seedlings. Native groundcover and small shrub species include *Dillwynia sieberi, Bossiaea prostrata, Dichondra repens, Astroloma humifusum* and *Leucopogon juniperinus*. Native grasses are also common. Species include Weeping Grass (*Microlaena stipoides*), Kangaroo Grass (*Themeda australis*), Western Rat's Tail (*Sporobolus creber*), Three-Awn Speargrass (*Aristida vagans*) and Forest Hedgehog Grass (*Echinopogon ovatus*). 

Vegetation Community	Conservation status*	Location	Description
Cumberland Plain Woodland (Shale Plains Woodland)	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC – TSC Act form of the community	Road Reserve, western end of Bringelly Road and northern end of proposal site, both sides of The Northern Road. Also, northern end of Bringelly school grounds	This vegetation mainly consists of single lines of mature trees, often with a mown grass groundcover. Grey Box (*Eucalyptus moluccana)* occurs in association with Forest Red Gum *(Eucalyptus tereticornis),* with occasional occurrences of Narrow-leaved Ironbark *(Eucalyptus crebra)* and Thin-leaved Stringybark *(Eucalyptus eugenioides)*. Near the creekline and on low-lying sites the vegetation intergrades with River-flat Eucalypt Forest. Groundcover mostly consists of exotic grasses, especially Kikuyu (*Pennisetum clandestinum*) and Paspalum (*Paspalum dilatatum*). In some locations weed species, especially Mother of Millions *(Bryophyllum delagoense),* African Olive and Lantana are common. The small patch at the northern end of Bringelly school is included although it appears to be a planted artefact. All trees are approximately 15 to 25 years old and include, apart from Grey Box and Forest Red Gum, a number of Narrow-leaved Ironbark (*Eucalyptus crebra*). Groundcover is sparse to absent, with occasional individuals of Saloop (*Einadia hastata*) and Forest Nightshade (*Solanum prinophyllum*). The most commonly occurring groundcover is the invasive Wandering Jew (*Tradescantia fluminensis*). 

Vegetation Community	Conservation status*	Location	Description
River-flat Eucalypt Forest	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC – TSC Act	Occurs as a narrow band at the southern end of the study area, crossing The Northern Road and continuing north-east to cross Robinson Road	Woodland vegetation associated with creeklines and watercourses within the study area. Canopy vegetation varies from 12-20 m in height, with a foliage projective cover of 20- 40%. This vegetation type generally supports an intact canopy layer; however, the understorey generally includes a number of exotic shrub, forb and grass species. The canopy includes a mixture of Cabbage Gum (*Eucalyptus amplifolia*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Grey Box (*Eucalyptus moluccana*), Swamp Oak (*Casuarina glauca*), Rough-barked Apple (*Angophora floribunda*) and Broad-leaved Apple (*Angophora subvelutina*). The midstorey includes juvenile Swamp Oak (*Casuarina glauca*) and Eucalypt species as well as Native Blackthorn (*Bursaria spinosa*), *Melaleuca decora*, Prickly-leaved Tea Tree (*Melaleuca styphelioides*), Parramatta Wattle (*Acacia parramattensis*) and Snow in Summer (*Melaleuca linariifolia*). The invasive species African Olive and Privet (*Ligustrum sinense* and *L. lucidum*) are also common. Native understorey species include Lesser Joyweed (*Alternanthera denticulata*), Blue Trumpet (*Brunoniella australis*), Rock Fern (*Cheilanthes sieberi*), Native Wandering Jew (*Commelina cyanea*), Wiry Panic (*Entolasia stricta*), *Juncus continuus*, Forest Nightshade (*Solanum prinophyllum*), and Ivy-leaved Violet (*Viola hederacea*). Emergent Cumbungi (*Typha* spp). is present where the un-named creek crosses Robinson Road, and the daisy *Leptinella longipes* is also present in the creek at this location. Exotic species present include Madeira Vine (*Anredera cordifolia*), Moth Vine (*Araujia sericifera*), Bridal Creeper (*Asparagus asparagoides*), Praire Grass (*Bromus catharticus*), Rhodes Grass (*Chloris gayana*), Blackberry (*Rubus fruiticosus* sp. agg.), Panic Veldtgrass (*Ehrharta erecta*), African Lovegrass (*Eragrostis curvula*), African Boxthorn (*Lycium ferocissimum*), Curled Dock (*Rumex crispus*), Fireweed (*Senecio madagascariensis*) and Wandering Jew (*Tradescantia fluminensis*). 

Vegetation Community	Conservation status*	Location	Description
Exotic grassland	Non-native	Dominant vegetation type in the study area	This is a highly modified exotic vegetation type comprising a mixture of exotic grasses and some pasture species. Occasional paddock trees or shrubs are present. The grass layer is between 0.2 – 1.2 m in height, depending on grazing pressure or other influences. 

Vegetation Community	Conservation status*	Location	Description
Garden	Non-native	Located patchily throughout the study area in residential areas	This is a highly modified vegetation type and comprises various planted native, exotic and horticultural cultivar species within gardens in private residential land. Generally restricted to the front portion of most properties, and ranges from well-maintained areas to over-grown areas that have become infested with weed species in addition to the primarily exotic garden species. The non-endemic threatened species *Eucalyptus scoparia* is a common planted specimen within some gardens (see section 4.4.3). Numbers of remnant trees also occur, including several over-mature specimens of *Angophora* and *Eucalyptus*. 

Vegetation Community	Conservation status*	Location	Description
Aquatic plants in dams	Non-native	Located patchily throughout the study area.	There are no extensive patches of aquatic vegetation in any of the ponds and dams surveyed, and generally there are usually no more than three species in each dam. Cumbungi *(Typha orientalis)* and Common Weed (*Phragmites australis)* are the most common aquatic species. Scattered occurrences of Curly Pondweed (*Potamogeton crispus*), Water Peppers (*Persicaria* spp.) and *Ludwigia peploides* subsp. *montevidensis* were also recorded. One dam was almost entirely covered with Duckweed (*Azolla filiculoides* var. *rubra*) (see photo). 
Non-certified land	-	-	-

Vegetation Community	Conservation status*	Location	Description
River-flat Eucalypt Forest	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC – TSC Act	Occurs as a narrow band along Thompsons Creek in the northern end of the study area	Woodland vegetation associated with creeklines and watercourses within the study area. Canopy vegetation varies from 12-20 m in height, with a foliage projective cover of 20- 40%. This vegetation type generally supports an intact canopy layer; however, the understorey generally includes a number of exotic shrub, forb and grass species. The canopy includes a mixture of Cabbage Gum (*Eucalyptus amplifolia*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Grey Box (*Eucalyptus moluccana*), Swamp Oak (*Casuarina glauca*), Rough-barked Apple (*Angophora floribunda*) and Broad-leaved Apple (*Angophora subvelutina*). The midstorey includes juvenile Swamp Oak (*Casuarina glauca*) and Eucalypt species as well as Native Blackthorn (*Bursaria spinosa*), *Melaleuca decora*, Prickly-leaved Tea Tree (*Melaleuca styphelioides*), Parramatta Wattle (*Acacia parramattensis*) and Snow in Summer (*Melaleuca linariifolia*). The invasive species African Olive and Privet (*Ligustrum sinense* and *L. lucidum*) are also common. Native understorey species include Lesser Joyweed (*Alternanthera denticulata*), Blue Trumpet (*Brunoniella australis*), Rock Fern (*Cheilanthes sieberi*), Native Wandering Jew (*Commelina cyanea*), Wiry Panic (*Entolasia stricta*), *Juncus continuus*, Forest Nightshade (*Solanum prinophyllum*), and Ivy-leaved Violet (*Viola hederacea*). Exotic species present include Madeira Vine (*Anredera cordifolia*), Moth Vine (*Araujia sericifera*), Bridal Creeper (*Asparagus asparagoides*), Praire Grass (*Bromus catharticus*), Rhodes Grass (*Chloris gayana*), Blackberry (*Rubus fruiticosus* sp. agg.), Panic Veldtgrass (*Ehrharta erecta*), African Lovegrass (*Eragrostis curvula*), African Boxthorn (*Lycium ferocissimum*), Curled Dock (*Rumex crispus*), Fireweed (*Senecio madagascariensis*) and Wandering Jew (*Tradescantia fluminensis*). Parts of this community along Thompsons Creek are mapped as ENV (Minister for the Environment 2007). No stand of this community mapped as ENV are located within the proposal site. 

4.3 Fauna

4.3.1 Fauna species

A total of 35 species of native fauna were recorded across the study area during the recent surveys (within both certified and non-certified lands), comprising 26 bird species, four mammal species, one reptile species, two frog species, and two snail species (see Appendix B). A further 81 fauna species have been recorded by PB (2011) and SKM (2012) in a wider investigation area, including the study area. Fauna observed were mostly common and widespread species, capable of persisting in highly fragmented, semi-urban habitats such as those within the study area.

Two threatened fauna species were recorded during the surveys, the Cumberland Plain Land Snail (*Meridolum corneovirens*) and the Grey-headed Flying-fox (*Pteropus poliocephalus*) (refer to Figure 4.1). The Cumberland Plain Land Snail was recorded in certified land in the proposal site and the Grey-headed Flying-fox in non-certified land within the study area (adjacent to the proposal site).

A number of threatened microbats and the Varied Sittella (*Daphoenositta chrysoptera*) have previously been recorded in the wider area (PB 2011) and these species are also likely to occur in the study area, at least on occasion. No habitat for threatened species listed under the FM Act is present. One migratory species listed under the EPBC Act, the Cattle Egret (*Ardea ibis*), was recorded in paddocks in the study area during recent surveys. Two additional migratory species have been previously recorded in the wider area (PB 2011) (see Appendix B).

Threatened and migratory species are discussed in more detail in section 4.4.4 and Appendix A.

Four exotic species were recorded during the survey. These included the Common Myna (*Sturnus tristis*), Common Starling (*Sturnus vulgaris*), Eurasian Blackbird (*Turdus merula*) and European Rabbit (*Oryctolagus cuniculus*). Various additional introduced species are also likely to occur in the area.

The fauna species that were recorded, habitat associations and additional species of fauna that may occur based on the habitats present are described below.

4.3.2 Fauna habitats

Fauna habitat is patchy throughout the study area due to past disturbance, residential subdivision and grazing, and many of the remaining patches have poor quality lower strata and limited microhabitat availability. The more intact remnants provide potential habitat for a variety of fauna and the creeklines and associated tributaries provide habitat for birds, microbats and amphibians. Exotic gardens and pasture are also present. A description of fauna habitats in provided in Table 4.4.

Table 4.4 Fauna habitats present within the study area

Fauna habitats in the study area	
Grassland	**-**
Description	The majority of the proposal site contains exotic grassland (pasture). These areas would have historically supported native woodland vegetation but have been extensively modified by clearing and agriculture. Exotic grassland contains few habitat resources of relevance to most native species due to low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species. Occasional paddock trees and shrubs also occur in these areas. Regrowth trees and shrubs would provide some foraging resources for native woodland birds. Some isolated hollow-bearing paddock trees are present which provide nesting opportunities for various bird species. These are of less value for less mobile species that need some cover and for species that do not nest in isolated trees (such as arboreal mammals).
Typical fauna species	Bird species commonly recorded in this habitat type included the Magpie-lark (*Grallina cyanoleuca*), Australian Magpie (*Cracticus tibicen*), Australian Raven (*Corvus coronoides*), and Welcome Swallow (*Hirundo neoxema*). A range of raptors, including the threatened Little Eagle (*Hieraaetus morphnoides*) may forage on occasion in these areas. The migratory Cattle Egret (*Ardea ibis*) was observed with a number of cattle. Bats typical of open agricultural land such as the White-striped Freetail Bat (*Tadarida australis*) and the threatened Eastern Bentwing Bat (*Miniopterus schriebersii*) are likely to forage for insects above the grassland. Grassland areas also provide habitat for a range of reptile species, including snakes and small lizards, as well as various frogs. The Wrinkled Toadlet (*Uperoleia rugosa*) was heard calling from soaks in some paddocks.  **Exotic grassland**
Cumberland Plain Woodland	**-**

Fauna habitats in the study area	
Description	Native woodland at the proposal site occurs as both small, isolated patches of vegetation and as linear strips along roadsides, and provides shelter, foraging and breeding resources for a range of fauna species. There is limited connectivity within the proposal site, although some small patches connect to larger patches outside the study area. There are roads, residences, agriculture and industry throughout the proposal site and associated noise and light disturbance and barriers to fauna movement. Grazing and the presence of exotic pest fauna would further reduce the value of habitats for native fauna. The proposal site contains only a moderate number of pre-European occupation age trees and associated habitat resources such as tree-hollows and stags. These trees include hollows with a range of sizes, orientations and landscape positions and both living and dead trees. *Eucalyptus* species provide foraging and shelter resources for a range of birds and mammals. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias and Native Blackthorn would help provide year-round foraging resources for a range of native birds, bats and mammals. Much of the shrub and ground layer vegetation and habitat features of the woodland and forest in the proposal site have been removed and 'cleaned up' for grazing. Woodland at the proposal site generally contains low quantities of woody debris and leaf litter, although some patches have higher quantities of these resources. Fallen timber and leaf litter provides shelter habitat for small lizards, snakes, small mammals and snails.
Typical fauna species	Aggressive honeyeater species including Noisy Miner (*Manorina melanocephala*), Bell Miner (*Manorina melanophrys*) and Noisy Friarbird (*Philemon corniculatus*) were recorded foraging in woodland areas. The Eastern Rosella (*Platycercus eximius*) and Galah (*Eolophus roseicapillus*) were also observed. Small and gregarious flocking bird species such as the Grey Fantail (*Rhipidura albiscapa*) and Superb Fairy-wren (*Malurus superbus*) were recorded foraging in the shrubby midstorey where this was present. Hollow-bearing trees provide nesting habitat for species such as the Galah (*Eolophus roseicapilla*), Eastern Rosella (*Platycercus eximius*) and Common Brush-tailed Possum (*Trichosurus vulpecula*). A range of microbat species are likely to occur at the proposal site. A species of forest bat (*Vulturnus* sp.) was recorded using call echolocation analysis. Other bats that are likely to occur include the threatened East Coast Freetail Bat (*Mormopterus (Micronomus) norfolkensis*). Hollow trees at the proposal site may provide roosting habitat for these species. The Cumberland Plain Land Snail (*Meridolum corneovirens*) and Common Southern Carnivorous Snail (*Austrorhytida capillacea*) were recorded where deep litter occurred at the base of trees. Dark-flecked Garden Sunskinks (*Lampropholis delicata*) were also observed in the leaf litter.
	
Patch of Cumberland Plain Woodland	**Linear roadside patch Cumberland Plain Woodland**
River-flat Eucalypt Forest	**-**

Fauna habitats in the study area	
Description	River-flat Eucalypt Forest occurs in narrow strips along Thompsons Creek at the northern end of the proposal site and a small creek line at the southern end of the proposal site that runs between The Northern Road and Robinson Road. A closed woodland or forest of eucalypts with Swamp Oak (*Casuarina glauca)* present along the margins of these creeks. A range of paperbarks (*Melaleuca* spp.) are also present. Understorey vegetation includes rushes and sedges. At Robinson Road, the canopy trees are more widely spaced over a grazed understory. Eucalyptus and other species provide foraging and shelter resources for a range of birds and mammals. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias and paperbarks would help provide year-round foraging resources for a range of native birds, bats and mammals. Some large, hollow-bearing trees were recorded near the creek. This vegetation occurs within thin and fragmented riparian corridors, and thus provides habitat for species that are mobile and able to utilise smaller, isolated fragments. Species that require larger, more intact stands of woodland/forest vegetation are unlikely to occur. Riparian corridors provide potential movement corridors and the denser vegetation present provides refuge for smaller woodland birds, although not those that require more extensive tracts of habitat.
Typical fauna species recorded	Dense vegetation along the creek provides foraging and shelter habitat for small woodland birds such as the Yellow Thornbill (*Acanthiza nana*) and Superb Fairy-wren (*Malurus superbus*). A range of other woodland birds are also likely to utilise the riparian corridor, potentially including threatened species such as the Varied Sittella (*Daphoenositta chrysoptera*). The Common Brush-tailed Possum (*Trichosurus vulpecula*) was recorded foraging next to a large, hollow-bearing tree south of the bridge. Microbats are likely to forage along the creek, particularly the threatened Large-footed Myotis (*Myotis macropus*) that forages over water. This species would also forage at nearby dams. No roosting bats or evidence of past roosting activity (eg bat guano) were observed under the bridge or in the culvert, however bats may roost on occasion at these locations. The Grey-headed Flying-fox (*Pteropus poliocephaus*) was heard calling from the vicinity of Thompsons Creek, and is likely to forage on eucalypts in this area when flowering. A range of common frogs, such as the Striped Marsh Frog (*Limnodynastes perroni*), and reptiles, such as the Eastern Water Skink (*Eulamprus quoyii*), are likely to occur along the creek.  **Riparian forest along Thompsons Creek**
Aquatic creek habitat	***-***

Fauna habitats in the study area	
Description	Thompsons Creek is located at the northern end of the study area. In the study area, the creek is about two metres wide and about 20 cm deep. Banks vary in height, ranging from about 50 cm to two metres tall. Creek substrate is silt and sand, with large pieces of cement present under the bridge on The Northern Road, probably to act as scour protection. Water was flowing at the time of survey, with creek depth about 20 cm under the bridge. No oil sheen or odours were noticed. Some woody debris is present both upstream and downstream of the bridge. No emergent aquatic vegetation is present in the study area. Riparian vegetation includes a variety of eucalypts and other shrubs and trees. A small un-named creek is present at the southern end of the study area. This creek drains an open paddock on the western side of The Northern Road and is fringed by riparian vegetation on the eastern side of The Northern Road. It runs through a culvert under The Northern Road. No flow was observed at the time of the survey, with a large still pool present on the eastern side of The Northern Road. The creek is about two metres wide and banks are up to 50 cm high at this location. Creek substrate is silt and sand. No emergent aquatic vegetation or woody debris were observed. This un-named creek continues in a north-easterly direction and also crosses under the property fence and Robinson Road through small pipes. The creek is very narrow (about 50 cm wide) and shallow (less than 5 cm deep) on the southern side of Robinson Road. Creek banks at this location are vegetated with grass. Some *Typha* spp. and aquatic herbs are present on the southern side of the road. On the northern side of Robinson Road the creek drains into a dam where a large stand of emergent *Typha* spp. is present. The creeks provide habitat for native fish and aquatic invertebrates and potential breeding habitat for a number of common frogs such as the Striped Marsh Frog (*Limnodynastes perroni*). No suitable habitat for creek dependent threatened frogs is present, as these are generally associated with clear, rocky streams located on sandstone substrates higher in the catchment. Native fish species tolerant of disturbance such as the Firetail Gudgeon (*Hypseleotris galii*) are likely to occur. The noxious fish Eastern Gambusia (*Gambusia holbrooki*) and Common Carp (*Cyprinus carpio*) are also likely to be present. Thompsons Creek is mapped as Key Fish Habitat (DPI 2007) and is considered to be Type 2 (moderately sensitive) key fish habitat as it is likely to support aquatic vegetation and native fish species. The unnamed creek in the south is considered to be a Class 3 (minimal fish habitat) waterway. No habitat for threatened fish is present in Thompsons Creek or the southern creek, as they are located at a low height above sea level and are not near an estuary.  **Un-named creek at southern end of study area (The Northern Road)**

Fauna habitats in the study area	
 **Un-named creek at southern end of study area (Robinson Road)**	-
Farm dams	**-**
Description	There are a number of farm dams at the proposal site. Some dams contain emergent and aquatic vegetation, providing habitat for a range of fauna species including frogs and water birds. Some dams are used by cattle and have minimal fringing vegetation limiting their value for native fauna. No important breeding habitat for wetland birds is present, due to the small size of the dams present and the limited aquatic vegetation present.
Typical fauna species recorded	Ducks and herons were observed at farm dams, including the Pacific Black Duck (*Anas superciliosa*), Purple Swamphen (*Porphyrio porphyrio*), Eurasian Coot (*Fulica atra*) and White-necked Heron (*Ardea pacifica*). The Common Eastern Froglet (*Crinia signifera*) was heard calling at a number of dams. Various other common frog species are also likely to occur. Eastern Snake-necked Turtles (*Chelodinia longicolllis*) and Red-bellied Black-Snakes (*Pseudechis porphyriacus*) are likely to occur at dams in the study area.  **Farm dam in open paddock, showing limited value for fauna**

4.4 Conservation significance

4.4.1 Overview

Based on the desktop assessment, the following threatened biota and MNES are known or predicted to occur in the locality (including within certified and non-certified lands):

- 18 threatened ecological communities (TECs)
- 25 threatened flora species
- 51 threatened fauna species, comprising six frogs, 24 birds, three fish, three invertebrates, 14 mammals and one reptile
- Four endangered populations
- 14 migratory species.

Appendix A includes a summary of the habitat requirements of the threatened species, populations and migratory species identified in the desktop assessment, and an assessment of whether they are likely to occur in the study area, based on the habitats present. This list does not include marine species (such as turtles, sharks, whales, pelagic seabirds) which were highlighted by the database searches because the locality does not contain any marine habitats. All native vegetation in the study area is either Cumberland Plain Woodland CEEC or River-flat Eucalypt Forest EEC. No other TECs are relevant to the study area due to the wrong topography, geology, soils or vegetation, and are thus not included in Appendix A.

No Wetlands of International Significance (Ramsar sites) or Commonwealth Marine Areas were identified within the locality.

No World Heritage Properties, National Heritage Places or Wetlands of International Importance occur within the locality. The study area is not located near the Great Barrier Reef or a Commonwealth Marine Area. These MNES are not considered further in this report.

A discussion of threatened biota and migratory species that are present or are likely to occur in the study area is provided below.

4.4.2 Threatened ecological communities

The two native vegetation types in the study area are threatened ecological communities:

- Cumberland Plain Woodland CEEC:
  - Shale Plains Woodland is commensurate with Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC listed under the TSC Act. The Shale Plains Woodland occurs as remnant and regrowth moderate to low condition vegetation within the study area. All of this vegetation type is located within certified lands. No stands of Shale Plains Woodland meet the condition thresholds of the community as listed under the EPBC Act, as either the patch size is too small or the understory lacks the appropriate diversity of understory species.
  - A total of 3.30 ha of this vegetation type is present within certified land in the proposal site. None of this vegetation type is located within non-certified land.
- River-flat Eucalypt Forest EEC:
  - River-flat Eucalypt Forest is commensurate with River-flat Eucalypt Forest on Coastal Floodplains EEC listed under the TSC Act. River-flat Eucalypt Forest occurs along Thompsons Creek in the northern portion of the study area and along a small creek at the southern end of the study area. This vegetation type occurs in both certified and non-certified land.

– A total of 0.96 ha of this vegetation type is present within certified land in the proposal site. None of this vegetation type located within non-certified land is within the proposal site.

The distribution of these TECs is mapped on Figure 4.1.

4.4.3 Threatened flora species and populations

No threatened flora species or populations native to the Liverpool and Camden LGAs were recorded during the field surveys.

The Wallangara White Gum (*Eucalyptus scoparia*), listed as threatened under the TSC Act, is a planted tree in the study area. This species is native to the New England Tablelands and is not considered a threatened species for the purpose of this report.

One endangered flora population listed under the TSC Act has been recorded in close proximity to the study area: *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs. There are a number of records of this species near the proposal, including near the intersection of Loftus Road and The Northern Road (OEH 2015a). This species was recorded along Bringelly Road about two kilometres to the east of the study area by PB (2011). No threatened flora species or populations were recorded during surveys along The Northern Road by SKM (2012). No individuals of *Marsdenia viridiflora* subsp. *viridiflora* were recorded in the study area during the current field surveys despite targeted searches in areas of woodland that comprise potential habitat for this species. This species can be surveyed for year round.

Of the 22 threatened flora species previously recorded in the locality, the majority can be discounted as unlikely to occur in the study area or to be affected by the proposal. These species are unlikely to occur based on known geographic range, associated vegetation types, specific habitat requirements, previous records and the lack of evidence during field surveys, as described in Appendix A. There are a number of plant species associated with tertiary gravel habitats of the Castlereagh forests, or sandstone habitats of higher elevations which are present within the locality but can be reliably excluded from occurring in the Wianamatta Shale and alluvial habitats within the study area.

There is broadly suitable habitat in certified land in the study area for a number of threatened plant species that are known from the locality. These include species such as the Downy Wattle (*Acacia pubecens*), Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*), Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*), *Pultenaea parviflora* and Austral Toadflax (*Thesium australe*). These species are easily identifiable and do not require surveys at specific seasonal times, yet were not located within the study area despite targeted field surveys. These species are therefore not likely to occur in the study area. One species that does have the potential to occur in the study area is a cryptic species that is hard to locate: the endangered Spiked Rice-flower (*Pimelea spicata*). *Pimelea spicata* flowers sporadically and is difficult to detect when not flowering. No threatened flora species are likely to occur in non-certified land within the study area.

4.4.4 Threatened fauna species

Two threatened fauna species were recorded during the surveys:

- The Cumberland Plain Land Snail, listed as endangered under the TSC Act, was recorded in Cumberland Plain Woodland at the western end of Bringelly Road (within certified land). This species was recorded within and adjacent to the proposal site. This species has been previously recorded at this location (PB 2011). Habitat for this species occurs where deep leaf litter is present at the base of large old trees within patches of Cumberland Plain Woodland. This species is unlikely to occur within River-flat Eucalypt

Forest in non-certified land as this vegetation type is not the preferred habitat of the species.

- A Grey-headed Flying-fox, listed as vulnerable under the TSC Act and EPBC Act, was heard near Thompsons Creek (within non-certified land) during nocturnal surveys. This species could forage in eucalypts in River-flat Eucalypt Forest and Cumberland Plain Woodland vegetation in the study area and surrounds when these trees are in flower.

The likelihood of occurrence of threatened fauna species has been assessed in Appendix A based on habitat requirements, suitability of habitat in the study area, and existing records in the locality.

Seven threatened fauna species listed under the TSC Act are likely to occur on occasion within the study area (within both certified and non-certified lands) given the presence of suitable habitat and previous records within the locality. These include:

- Varied Sittella (*Daphoenositta chrysoptera*)
- Little Eagle (*Hieraaetus morphnoides*)
- Hollow-roosting microbats:
  - Eastern Freetail Bat (*Mormopterus norfolkensis*)
  - Greater Broad-nosed Bat (*Scoteanax rueppellii*)
  - Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Cave-breeding microbats:
  - Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
  - Large-footed Myotis (*Myotis macropus*).

The Varied Sittella is likely to forage along the riparian corridors in the study area. The presence of various aggressive honeyeaters and lack of large patches of remnant vegetation make it unlikely that this species would breed in the study area. The study area would make up a small proportion of the foraging range of this species. The Little Eagle is likely to forage regularly over open fields and woodland patches in the study area. No large raptor nests were observed, and it is unlikely to breed in the study area. The study area would comprise a small proportion of the home range of an individual of this species. A number of other small woodland birds may occur on occasion, however only limited suitable habitat is present, and/or only few records are known from the locality. None of these species are likely to rely on habitats present in the study area for their survival in the locality (see Appendix A).

Hollow-roosting microbats may roost and breed in the study area. A number of hollow-bearing trees were recorded, however the presence of parrots, cockatoos and starlings may limit breeding habitat for these microbat species. These microbats would forage in cleared and vegetated areas, including within the ecotone between cleared and vegetated areas, along the creek line and over farm dams. The study area would make up a very small proportion of the foraging range of these highly mobile species.

The Eastern Bent-wing Bat and Large-footed Myotis would forage within the study area. These species may also roost temporarily under the bridge over Thompsons Creek or in the culvert under The Northern Road on occasion. No breeding habitat for the Eastern Bent-wing Bat is present as this species breeds in large maternity caves. The Large-footed Myotis is unlikely to breed in the study area given the levels of disturbance at roosting locations, and lack of evidence of any roosting individuals.

No threatened terrestrial or arboreal mammals are likely to occur given the patchy nature of the vegetation and lack of connectivity. No habitat for threatened frogs, reptiles or fish is present. A summary of the likelihood of occurrence of threatened fauna species in the study area is provided in Appendix A.

4.4.5 Migratory species

The Cattle Egret (*Ardea ibis*) was recorded foraging in pasture areas in the study area. This is a highly mobile species and is highly unlikely to rely on habitats within the study area for any part of its lifecycle. The Great Egret (*Ardea alba*) is likely to forage at farm dams on occasion. A number of additional migratory species may occur on occasion in the study area during their winter migration (Appendix A).

Important habitat for these migratory birds is defined in the significance criteria for listed migratory species (DotE 2013) as follows:

- Habitat utilised by a migratory species occasionally or periodically within the region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

These migratory birds could forage in the study area. Large areas of potential habitat are also present in the locality. The proposal site is not considered important habitat for any of these species, according to the significant impact criteria for migratory species (DEWHA 2009). This is due to the fact that the habitat in the proposal site would not support an ecologically significant proportion of the population of these species, is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species ranges, and is not within an area where these species are declining.

4.4.6 Other ecological MNES

No World Heritage Properties, National Heritage Places or Wetlands of International Importance occur within the locality. The study area is not located near the Great Barrier Reef or a Commonwealth Marine Area. These MNES are not considered further in this report.

5. Assessment of impacts

5.1 Introduction

The following sections discuss the potential impacts of the proposal on native biota across both certified and non-certified lands. This discussion includes both the potential for direct and indirect impacts during construction and operation.

Construction would occur within certified land only. No assessments of significance are required for impacts on threatened biota listed under the TSC Act, and MNES listed under the EPBC Act, that occur within certified land (see section 2.1.2). Mitigation measures have been provided to minimise the impacts on biodiversity values within certified land (see section 6.2).

An area of non-certified land associated with Thompsons Creek abuts the northern end of the proposal site, east of The Northern Road (see Figure 4.1). This area supports the River-flat Eucalypt Forest EEC. Given its proximity to the proposal site, environmental safeguards will be implemented to reduce the potential for any indirect impacts on the River-flat Eucalypt Forest EEC within non-certified lands at this location (see section 6.2). While no substantial impacts are anticipated on the native vegetation present, an assessment of the likely significance of the potential impacts on the EEC has been prepared on a precautionary basis pursuant to Section 5A of the EP&A Act (see section 6.2).

It is unlikely that there would be any removal of trees or any substantial adverse impacts on the vegetation within the area of non-certified land in the study area. As such, the proposal would not result in a notable impact on habitat for threatened fauna that may occur in this area on occasion, such as the Grey-headed Flying-fox and microchiropteran bats. Consequently, formal assessments of the likely significance of impacts on threatened fauna are not considered necessary.

5.2 Construction impacts

5.2.1 Vegetation clearing

The majority of the proposal is located in already cleared agricultural land, minimising impacts on biodiversity values. Up to 39.06 ha of land would be impacted by the proposal, of which 35.1 ha is already cleared and disturbed land. Despite the avoidance of native vegetation where practicable, the proposal would result in the removal of a small area of native vegetation. All clearing of native vegetation (4.26 ha) would occur within certified lands.

No threatened flora species or populations were identified within the proposal site. The proposal would remove potential habitat for a number of threatened flora species and populations from within certified land, in particular, potential habitat for the endangered population of *Marsdenia viridiflora* R. Br. subsp. *viridiflora,* which is known to occur in close proximity to the proposal site.

Environmental safeguards to minimise the clearing of native vegetation are provided in section 6.2.

5.2.2 Removal of fauna habitats

The study area mainly comprises highly modified areas of cleared agricultural and residential land with limited habitat value for native fauna. Small patches of fragmented native woodland and riparian forest vegetation that provide habitat for native fauna, including threatened species, would be removed. All clearing of native vegetation and fauna habitats would occur within certified lands.

The proposal would remove up to 35.1 ha of highly modified land, comprising cleared areas, exotic grassland and garden vegetation. These modified landscapes have limited value for native fauna given the degree of historic and ongoing fragmentation and disturbance; lack of habitat complexity; and the presence of aggressive native and introduced fauna species.

The proposal would remove up to 4.26 ha of native vegetation. Native woodland and forest vegetation within the study area includes a range of habitat features for native biota, including fallen timber, sparse hollow-bearing trees, occasional accumulations of leaf litter, and patches of dense shrubs.

Up to 17 hollow-bearing trees would be removed. Note that of these, about five trees along The Northern Road are unlikely to be removed as works would be on the opposite side of the road. Hollow-bearing trees would be retained where feasible. Hollow-bearing trees would be retained where feasible within design constraints. No hollow-bearing trees would be removed from non-certified land. Hollow-bearing trees are an important habitat resource, providing denning, nesting or sheltering sites for many birds, bats, arboreal mammals, reptiles and amphibians. Hollows in the study area are limited in number (reflecting historical vegetation clearing). Hollow availability for native species may also be limited by occupation of hollows by the aggressive Common Starling which was observed in the study area. Hollow-bearing trees within the study area exist either as isolated trees in roadside verges or along edges of isolated vegetation patches (see Figure 4.1). These trees provide nesting and denning habitat for possums and more mobile species such as birds and potentially also microbats.

Given the existing levels of disturbance and impacts from various anthropogenic sources, the study area does not support habitat suitable for many native threatened species. Much of the native vegetation that does persist within the study area is modified floristically, with many areas dominated by exotic understorey species, and a dominance of exotic species in the midstorey that favour common generalist aggressive fauna species such as Noisy Miners. Notwithstanding this, the study area provides various foraging, shelter, nesting habitat for range of fauna such as common and widespread generalist woodland birds, common reptile species such as small skinks and common frog species, as discussed in section 4.3.2.

Up to 11 farm dams would be impacted by the proposal. Two dams would be removed entirely, and other dams would have their catchment reduced. Removal of dams would remove shelter, breeding and foraging habitat for common fauna species such as waterbirds, turtles and frogs. The removal of dams would also result in the loss of foraging habitat for microchiropteran bats and birds such as the Welcome Swallow (*Hirundo neoxena*) that forage above waterbodies. A reduction of catchment may result in water level reductions in some dams, or more regular drying out of some dams, which could result in fauna mortality.

There would not be any construction works within Thompsons Creek. There will be some construction activities at the unnamed creek in the south, including replacement of the culvert on The Northern Road and construction of the new road off Robinson Road. Other small, ephemeral drainage lines within the proposal site may also be disturbed. No creeks that would be disturbed are likely to provide habitat for native fish given their ephemeral nature, small size and location in the landscape. The proposal would not remove any key fish habitat, and no habitat for threatened species listed under the FM Act is present in the study area. The proposal would include the replacement of culverts and pipes with suitable structures, and as such the proposal is unlikely to interfere with fish passage.

The proposal would remove known and potential habitat for the Cumberland Plain Land Snail and Grey-headed Flying-fox, as well as other terrestrial threatened fauna species that may occur on occasion. The impacts on threatened fauna species is discussed in more detail in section 5.5.

Environmental safeguards are proposed in section 6.2.1 to minimise the impact on fauna as a result of clearing.

5.2.3 Fragmentation of habitat

The proposal would be located in a highly fragmented, semi-rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings, and construction of linear infrastructure (such as transmission lines and roads). These land uses have created barriers to movement for some fauna species, particularly those that are limited by dispersal abilities and habitat preferences. More mobile species such as birds and bats can readily traverse this landscape. The suite of fauna species recorded in field surveys is dominated by generalist species of open country, reflecting the fragmented nature of vegetation at the proposal site.

The proposal would clear up to 4.26 ha of native vegetation primarily comprising the edges of small, fragmented stands scattered within the site. The habitats that would be impacted are highly modified and fragmented from historical clearing and current developments and the proposal would not sever any existing corridors or isolate stands of habitat.

5.2.4 Fauna injury, mortality or displacement

There is potential for injury to or mortality of native fauna where native vegetation is to be cleared or disturbed. Tree-dwelling fauna and less mobile, small terrestrial fauna (such as the threatened Cumberland Plain Land Snail as well as common frogs and reptiles) that may be sheltering in vegetation within the study area are at most risk. The proposal would also cause displacement of more mobile fauna. The magnitude of likely impacts would vary between types of fauna, depending on their size and ecology. Some fauna may be able to seek refuge and persist in alternative habitat outside the proposal site.

Birds are relatively mobile and so most individuals would be able to avoid vegetation clearing (which is minimal) or construction operations. Most individuals that would be directly affected by construction of the proposal would be displaced initially rather than killed. Continued survival of displaced fauna would depend on the carrying capacities of neighbouring remnants and the existing fauna present and their territories. Many of the small patches in nearby areas are likely to be at carrying capacity already.

Mortality of less mobile individuals, such as nestlings, old or sick birds would also occur. Birds that currently breed in or in the vicinity of the proposal site, that are likely to include common and widespread species such as Noisy Miners and Australian Magpies, may have breeding success disrupted for one or more seasons.

There would be mortality of terrestrial animals less able to avoid the disturbance, including individuals sheltering in leaf litter, woody debris, tree hollows, crevices or under bark. These would include the Cumberland Plain Land Snail, smaller terrestrial mammals, nocturnal species and especially arboreal mammals and microbats which may be sheltering in felled trees. Displaced individuals would be vulnerable to predation since they would be disturbed in daylight hours and would experience energy costs, increased risk of predation and increased competition for resources (especially for alternative hollows).

Environmental safeguards including pre-clearing surveys, fauna rescue and relocation protocols, are proposed in section 6.2.1 to minimise the risk of mortality of fauna as a result of clearing.

5.2.5 Indirect impacts

Sedimentation and erosion

The proposal has the potential to result in sedimentation and erosion within the site and adjoining areas through soil disturbance and construction activities. Potential sources of soil and water pollution include:

- Soil disturbance during construction activities
- Inappropriate management of soil and material stockpiles
- Increased sediment transfer and erosion potential in areas cleared of vegetation
- Flood event during construction (particularly during works in riparian areas).

Sediment laden runoff to waterways can alter water quality and adversely affect aquatic life. Erosion and sedimentation could reduce habitat quality and ecosystem health within River-flat Eucalypt Forest along Thompsons Creek and the unnamed creek in the south. Sediments can smother macroinvertebrate organisms residing in the receiving waterway, alter aquatic habitat by filling interstices of riffle habitat with fine sediment, and reduce water clarity which impacts on the efficiency of submerged aquatic plants to photosynthesise. If severe erosion were to occur, suspended sediment particles could clog or damage gill membranes. All of these altering functions can impact on macroinvertebrates which are a major food source for fish, frogs, wetland birds and some microbats.

Environmental safeguards to reduce the potential for erosion and sedimentation are described in section 6.2.1, and include the use of erosion and sediment control devices.

Pollution

The proposal has the potential to result in pollution and contaminated runoff, in particular as a result of hydrocarbon leaks or spills from vehicles or equipment used in construction. Environmental safeguards to reduce the potential impacts associated with pollution are described in section 6.2.1, and include appropriate location of stockpiles and bunding of chemicals.

Introduction or spread of weeds

The proposal has the potential to increase the introduction and spread of exotic plants and pathogens through increased visitation, fragmentation of vegetation and disturbance of soil. Increased weed invasion can lead to decreased diversity of native flora, compromised structural integrity of native vegetation communities and a decrease in habitat quality for native fauna.

Exotic flora species, including a number of noxious weeds, are already abundant throughout the study area. In this context, any increase in weeds as a result of the proposal is therefore likely to have a minor impact on surrounding vegetation and land uses. Nonetheless, weed management measures would be included in the Construction Environment Management Plan (CEMP) (see section 6.2.1).

Introduction of pathogens

Construction activities have the potential to introduce or spread pathogens such as *Phytophthora cinnamomi* (Phytophthora), *Uredo rangelii* (Myrtle Rust) and *Batrachochytrium dendrobatidis* (Chytrid fungus) throughout the study area through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and

damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can wipe out entire populations once introduced into an area.

The potential for impacts associated with these pathogens is low, given the disturbed nature of much of the study area, existing visitation levels, and the environmental safeguards that would be implemented during the construction process (see section 6.2.1).

Noise and vibration

The study area currently experiences ongoing noise and vibration, primarily from heavy traffic flows along Bringelly Road and The Northern Road. Schools, business activities and infrastructure associated with small-scale farming operations all contribute to existing noise levels and vibration in the immediate vicinity of the proposal site.

The proposal would increase noise levels and vibration in the vicinity of the study area during construction, through plant and machinery operation and earth moving activities. Native fauna may temporarily vacate or avoid areas disturbed by construction activities but no substantial impacts on native fauna are anticipated as a result of noise and vibration generated by the proposal. Given the existing noise and vibration levels in the study area, the increase in noise levels as a result of construction is unlikely to substantially impact native biota.

Edge effects

Edge effects are described as an ecological impact at two or more interfacing habitat types. Edge effects are inherent or natural in nature but can have negative impacts if their creation alters ecological processes. They also change habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the boundary between areas. In general, edge effects increase in relation to the dissimilarity between adjoining habitats.

Removal of vegetation causes a number of new environmental conditions to develop along the edges of the cleared environments, in particular in environments that originally contain the upper strata levels (canopy and/ or shrub layer) of vegetation. The removal of vegetation generally promotes the invasion of exotic species and/or disturbance tolerant native plants. With the invasion of these new species it often becomes difficult for the original plant species to recolonise once disturbed.

In general, potential edge effects associated with clearing for development can include the degradation of adjacent habitat through:

- Changes in microclimate (e.g. temperature, wind, light humidity)
- Changes in hydrology (i.e. surface and sub-surface water flows)
- Changes in floristics (i.e. species composition and abundance)
- Creation of new ecotones
- Alteration to the pattern and frequency of fire
- Invasion by exotic plant and animal species
- Increase in sedimentation
- Increase in tree death (e.g. dieback, impact on root zone)
- Improved access for predators.

The study area is already highly disturbed, and the impacts of edge effect are visible across much of the study area. The proposal is unlikely to substantially increase the influence of edge effects within the study area.

5.3 Operation impacts

5.3.1 Short-term impacts

In the short-term, operation of the proposal is likely to have little impact on native biodiversity values. There may be some introduction of weeds as a result of movement of vehicles, however this would not differ substantially from current levels of weed introduction. Operation of the proposal would result in noise, lights and vibration along the route, similar to the levels currently experienced by fauna in the area. The risk of fauna mortality as a result of vehicle strike may increase as a result of the widening of the roads. The widened road would also increase the barrier effect where vegetation is present on either side, making it more difficult for small fauna such as small birds, frogs and reptiles to cross the gap.

5.3.2 Long-term impacts

In the long-term, vehicle use of The Northern Road and Bringelly Road would increase, due to an increase in development of the area. The proposal is located within the SWGC, and new residential and industrial areas are likely to be constructed in the future. In addition, the proposed western Sydney airport at Badgerys Creek would also likely be constructed to the north of the proposal. This increase in construction, residences, and industrial areas would lead to a substantial increase in road traffic through the study area. As such, noise, light and vibration would increase, as would the risk of fauna mortality, thus having a potentially greater impact on resident fauna. There would also be an increased risk of introduction of weeds and chemical spills, potentially having a greater risk of impact on native vegetation and aquatic habitats. Impacts associated with these proposals would be subject to separate environmental assessments. Future development of the SWGC, however, would further reduce flora and fauna habitats available in the immediate vicinity of the proposal, thus reducing flora and fauna populations that may be impacted by these increased direct and indirect impacts.

5.4 Key threatening processes

A threatening process is defined as a key threatening process (KTP) if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community (DotE 2015d). A process can be listed as a KTP if it could either:

- Cause a native species or ecological community to become eligible for inclusion in a threatened list (other than the conservation dependent category)
- Cause an already listed threatened species or threatened ecological community to become more endangered
- Adversely affect two or more listed threatened species or threatened ecological communities.

KTPs are listed under the TSC Act, FM Act and EPBC Act. Some KTPs are listed under more than one Act. KTPs of relevance to the proposal are discussed in Table 5.1. Mitigation measures to limit the impacts of these KTPs are discussed in section 6.2.

Table 5.1 Key threatening processes of relevance to the proposal

KTP	Status	Comment
Clearing of native vegetation	TSC Act; EPBC Act	Clearing of native vegetation has occurred historically within and around the study area. The proposal would result in the clearing of up to 4.26 ha of native vegetation from certified land only. Implementation of vegetation management measures would minimise impacts on native vegetation (see section 6.2).
Clearing of hollow-bearing trees	TSC Act	Up to 17 hollow-bearing trees would be removed for the proposal. These all occur in certified land within the proposal sites. Note that about five trees along The Northern Road are unlikely to be removed as works would be on the opposite side of the road. Hollow-bearing trees would be retained where feasible. The implementation of fauna management procedures would minimise impacts on fauna and their habitats during construction where removal of hollow-bearing trees cannot be avoided (see section 6.2).
Removal of dead wood and dead trees	TSC Act	Fallen timber and standing dead trees (stags) provide important habitat for a range of native species and are important to ecosystem health. The proposal would result in the removal or disturbance of stags and fallen timber during construction of the proposal, however few of these habitat features are present given 'cleaning up' for grazing. The implementation of fauna management measures would minimise impacts on fauna and their habitats (see section 6.2).
Invasion of plant communities by perennial exotic grasses	TSC Act	The study area has been subject to historic agricultural practices, and exotic perennial grasses are already established throughout the study area, including all stands of native vegetation. Weed management procedures would be implemented to limit any further spread of weeds as a result of the proposal (see section 6.2).
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	TSC Act; EPBC Act	Large parts of the study area either include or is directly adjacent to areas of garden that support exotic species. The proposal has the potential to further exacerbate this KTP. The implementation of vegetation management measures would minimise the potential impacts on native vegetation as a result of this KTP (section 6.2).
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners	TSC Act	Psyllids (small sap-sucking insects that secrete a sugary shield, called a lerp), and Bell Miners (*Manorina melanophrys*) are native and occur naturally in moderate abundance in localised areas. Bell Miners are aggressive and often exclude other bird species from their territories. This can lead to psyllid populations increasing to a degree that damage to canopy species becomes evident. Bell Miners are abundant within the study area; and the clearing of vegetation may increase their incidence in adjacent patches, potentially increasing the operation of this KTP.
Invasion and establishment of exotic vines and scramblers	TSC Act	Exotic vines can have a significant effect on biodiversity, through smothering native vegetation and seedlings, and preventing natural recruitment, particularly in riparian areas. Patches of vegetation within the study area already support infestations of exotic vines and scramblers including Madeira Vine, Moth Vine and Bridal Creeper. The proposal has the potential to increase disturbance in areas of similar vegetation that are not infested with exotic vines, resulting in new infestations. Similarly, the proposal has the potential to spread propagules and vegetative material from invasive species within the study area, which may also result in new infestations. The implementation of vegetation management measures would minimise the potential impacts on native vegetation as a result of this KTP (section 6.2).

KTP	Status	Comment
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	TSC Act	African Olive has the ability to significantly alter ecosystem structure through the formation of a dense mid-canopy in native vegetation communities, preventing the growth of native grasses and herbs. African Olive was recorded within the study area and increased disturbance associated with the proposal has the potential to increase the spread of this species within the local area. The implementation of vegetation management measures would minimise the potential impacts on native vegetation as a result of this KTP (section 6.2).
Invasion, establishment and spread of *Lantana camara*	TSC Act	Lantana can suppress native vegetation and seedling recruitment through shading and competition. The species often responds favourably to disturbance, including edges and canopy breaks in woodland. Lantana is scattered throughout the study area, and increased disturbance has the potential to allow infestation of additional areas and spread into adjacent lands. The implementation of vegetation management measures would minimise the potential impacts on native vegetation as a result of this KTP (section 6.2).
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act	Construction activities have the potential to introduce Myrtle Rust to the study area. The fungus infects leaves of susceptible plants producing spore-filled lesions on young actively growing leaves, shoots, flower buds and fruits. Leaves may become buckled or twisted and may die as a result of infection. Infection on highly susceptible plants may result in plant death (DPI 2013). Implementation of hygiene protocols would minimise the risk of introduction or spread of this pathogen (see section 6.2).
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	TSC Act; EPBC Act	Construction activities have the potential to introduce amphibian chytrid to the study area. Chytrid fungus has been implicated in the dramatic decline of many amphibians worldwide and is an identified threat to a number of native frogs (DotE 2015b). The fungus can be introduced in spores in water, moist soil or other debris. Implementation of hygiene protocols would minimise the risk of introduction or spread of this pathogen (see section 6.2).
Infection of native plants by Phytophthora cinnamomi	TSC Act; EPBC Act	*Phytophthora cinnamomi* is a soil borne pathogen that occurs in warm, moist conditions. Infected species may show a range of symptoms, and some plants may be killed and lead to areas of dieback. The proposal has the potential to introduce the pathogen to the study area, through the transport and movement of plant, machinery and vehicles, as well as through any landscaping works following construction. Implementation of hygiene protocols would minimise the risk of introduction or spread of this pathogen (see section 6.2).
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	TSC Act	There would be no construction works within Thompsons Creek or the southern un-named creek as part of the proposal. The proposal is unlikely to alter the natural flow regimes of these waterways. Mitigation measures are recommended to minimise impacts on aquatic habitats (see section 6.2).
Instream structures and other mechanisms that alter natural flow	FM Act	There would be no construction works within Thompsons Creek or the southern un-named creek as part of the proposal. The proposal is unlikely to alter the natural flow regimes of these waterways. Mitigation measures are recommended to minimise impacts on aquatic habitats (see section 6.2).

KTP	Status	Comment
The degradation of native riparian vegetation along NSW water courses	FM Act	The proposal would remove about 0.96 ha of native riparian vegetation within the proposal site. Degradation of riparian vegetation has occurred within the study area, with most patches of riparian vegetation isolated from other native vegetation, and subject to edge effects. Indirect impacts may further impact riparian vegetation downstream of the proposal site. The implementation of weed management measures, erosion and sediment control measures and aquatic management measures is recommended to limit impacts on riparian vegetation or further reduction in water quality (see section 6.2).
The removal of large woody debris from NSW rivers and streams	FM Act	There would be no construction works within Thompsons Creek as part of the proposal. Construction at the southern unnamed creek has the potential to disturb large woody debris. Mitigation measures are recommended to minimise impacts on aquatic habitats (see section 6.2).
Predation by *Gambusia holbrooki* Girard, 1859 (plague minnow or mosquito fish)	TSC Act FM Act	Mosquito Fish are likely to occur in farm dams in the study area. Dewatering of farm dams during the construction process has the potential to release this species into local waterways. Implementation of a protocol for the management of Mosquito Fish is recommended (see section 6.2).

5.5 Impacts on threatened biota and MNES within certified land

The proposal would remove 3.30 ha of Cumberland Plain Woodland and 0.96 ha of River-flat Eucalypt Forest located within certified land only, as well as 31.44 ha of cleared grassland and gardens. These vegetation types occur as highly modified patches of vegetation, subject to historical clearing and existing edge effects.

Cumberland Plain Woodland provides potential habitat for the *Marsdenia viridiflora* R. Br. subsp. *viridiflora* endangered population and a number of threatened flora species. The proposal would remove up to 3.30 ha of potential habitat for these species in certified land only. These species are unlikely to occur in non-certified land in the study area as these species are unlikely to occur in River-flat Eucalypt Forest. This small area of potential habitat to be removed is not likely to threaten the persistence of these species in the locality.

The Cumberland Plain Land Snail was recorded in Cumberland Plain Woodland in certified land within the proposal site and study area. The proposal would remove a small area of known habitat as well as additional areas of potential habitat for this species. Up to 3.30 ha of known and potential habitat would be removed. All impacts on this species would be restricted to certified land.

The threatened Grey-headed Flying-fox was heard near the proposal site. Potential foraging habitat for this species is present within woodland and forest in certified land. A number of other threatened birds and microbats and migratory birds are also likely to occur in this area (see section 4.4.4 and section 4.4.5). Threatened and migratory species that are known or may occur include highly mobile species that would mainly occur on a transient basis only. The proposal would not remove any large stands of native vegetation, rather would mainly impact edges of small patches. Up to 4.26 ha of potential habitat would be removed for these species within certified land. Furthermore, at least ten and up to 12 hollow-bearing trees would also be removed within certified land which would reduce the incidence of potential roosting habitat for some threatened microbat species and possibly nesting habitat for common hollow-dependent birds, such as the Galah and Eastern Rosella.

The migratory Cattle Egret was also recorded in cleared grassland in certified land. The proposal would remove about 31.44 ha of known and potential foraging habitat for this species. There is no breeding habitat for this species in the study area. Large areas of potential habitat for this species are present in the locality.

The clearing of native vegetation and associated habitat for TECs and species and migratory species within certified areas has already been assessed and offset under the SWGC Biodiversity Certification process (for example by setting aside the Western Sydney Parklands). No assessments of significance or approvals are required for impacts on threatened biota listed under the TSC Act and EPBC Act within certified lands.

There is no habitat in the study area for threatened biota listed under the FM Act.

Environmental safeguards are provided in section 6.2 to minimise the impacts of the proposal on biodiversity values within certified land.

5.6 Impacts on threatened biota and MNES within non-certified land

There would be no direct impacts on River-flat Eucalypt Forest within non-certified land. River-flat Eucalypt Forest at Thompsons Creek is highly disturbed and subject to edge effects. The proposal may contribute to indirect impacts to this community through the further spread of weeds, sedimentation and introduction of pollutants. Environmental safeguards would be implemented to minimise the potential for these indirect impacts. An assessment of significance has been completed to assess these potential indirect impacts on River Flat Eucalypt Forest (see Appendix C).

The proposal would not have any direct impacts on threatened species habitat including the Cumberland Plain Land Snail and the Grey-headed Flying-fox within non-certified areas. There are unlikely to be any direct or indirect impacts on any other threatened flora or fauna species in non-certified land. Consequently, no assessments of significance have been prepared for threatened flora or fauna species, or migratory species with respect to the small area of potential impact on non-certified lands.

Environmental safeguards are provided in section 6.2 to minimise the impacts of the proposal on biodiversity values within non-certified land.

6. Management of impacts

6.1 Avoiding and minimising impacts during design

6.1.1 Constraints assessment

An options report for the proposal assessed seven options for The Northern Road and Bringelly Road interchange (RMS 2015). The constraints and opportunities assessment of the seven options allowed for the selection of a route that minimised impacts on biodiversity values as much as possible. The majority of the preferred route is located in cleared land, thus avoiding substantial clearing of native vegetation and removal of flora and fauna habitats. There would be no direct impacts on Thompsons Creek.

6.1.2 Detailed design

During the detailed design process, the impact of the proposal on areas with high biodiversity values in non-certified areas and ENV would be minimised where practicable, by:

- Minimising the area of native vegetation to be cleared and hence impacts on TECs listed under the TSC Act, EPBC Act and ENV
- Avoiding identified hollow-bearing trees, where practicable.

6.2 Mitigating impacts

6.2.1 Construction

The environmental safeguards outlined in Table 6.1 would be implemented to address the potential impacts of the proposal on biodiversity values. A CEMP would be prepared, that would identify the specific measures for the 'Pre-construction' and 'Construction' stages and would include work methods, contingencies, roles and responsibilities.

Table 6.1 Environmental safeguards (construction)

Issue	Safeguard	Timing	Responsibility
Environmental management	A CEMP will be prepared, including the specific mitigation/management measures and sub plans listed below along with work methods, contingencies, roles and responsibilities. The mitigation/management measures included in the CEMP and sub-plans would be implemented during pre-construction and construction stages.	Pre-construction	Construction contractor
Worker inductions	Ensure all workers are provided with an environmental induction prior to starting construction activities on site. This would include information on the ecological values of the site and protection measures to be implemented to protect biodiversity during construction.	Pre-construction	Construction contractor
Erosion and sediment	Erosion and sediment control measures would be established prior to construction in accordance with the principles and guidelines included in Soils and Construction – Managing Urban Stormwater Volume 1 (Landcom, 2004) and Volume 2D – Main Roads (DECC, 2008). Controls would be managed and maintained in accordance with the CEMP to ensure their ongoing functionality	Pre-construction	Construction contractor

Issue	Safeguard	Timing	Responsibility
Dust	Specific measures will be incorporated into the CEMP to minimise the generation of dust and associated impacts on natural environments adjacent and downstream of the site. These should include: • Setting maximum speed limits for construction traffic within the site to limit dust generation • Use of a water tanker or similar to spray unpaved roads during construction where required • Application of dust suppressants or covers on soil stockpiles • Immediate removal off site of excavated fill materials not required for backfilling • Disturbed areas are to be progressively stabilised to prevent erosion and weed establishment, in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RMS projects* (RMS Environment Branch 2011).	Pre-construction/ construction	Construction contractor
Contaminants	Specific measures will be incorporated into the CEMP to minimise the potential for chemical spills and associated impacts on natural environments adjacent to and downstream of the site. These should include: • Storage of chemicals in clearly marked and bunded areas • Management of sewerage tanks, including regular emptying and disposal off site • Regular inspection of vehicles and mechanical plant for leakage of fuel or oil • No refuelling of vehicles, vehicle maintenance or washing of vehicles within 20 m of waterways • An emergency plan for spills, to minimise the risk of impacts on retained vegetation and downstream habitats.	Pre-construction/ construction	Construction contractor
Vegetation clearance and habitat loss	Disturbance and removal of some areas of native vegetation and habitat will be unavoidable during the construction phase. To reduce the potential for adverse impacts on ecologically sensitive areas the following measures will be implemented: • A suitably qualified ecologist must be engaged prior to any clearing works to clearly demarcate vegetation protection areas, clearing limits, hollow-bearing trees, and complete a pre-clearing survey report for RMS to summarise results and to guide clearing activities, in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RMS projects* (RMS Environment Branch 2011) • Implement hygiene protocols to prevent the introduction and spread of such pathogens as specified in *Protecting and managing biodiversity on RMS projects* (RMS Environment Branch, 2011). This would include exclusion zones around retained areas of native vegetation. All machinery and plant should be cleaned prior to work on site.	Pre-construction/ construction	Construction contractor, site ecologist/ environmental officer

Issue	Safeguard	Timing	Responsibility
Fauna relocation plan	A licence would be required under section 91 of the TSC Act for the relocation/translocation of the Cumberland Plain Land Snail from the proposal site. A relocation/translocation plan would be prepared as part of this licence application and would form part of the CEMP.	Pre-construction/ construction	Site ecologist/ environmental officer
Pre-clearance surveys for threatened species	Pre-clearance surveys will be undertaken by a qualified ecologist and the required methodology will be developed for target species as part of the CEMP. Surveys should include: • Cumberland Plain Land Snails would be relocated to appropriate habitat adjacent to the site in accordance with the relocation/translocation plan prepared as part of the s91 application. • Survey of any culverts that need removal to search for roosting bats. Should roosting bats be found, a management plan should be prepared as a sub-plan to the CEMP to manage to exclusion of bats prior to removal of any culverts • A procedure for clearing potential habitat, including hollow-bearing trees would be prepared in accordance with RMS Specification G40 • An experienced, licenced wildlife carer or ecologist would be present to supervise vegetation clearing and capture then relocate fauna if required, in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RMS project*s (RMS Environment Branch 2011) • Fauna handling and vegetation removal would be in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RMS projects* (RMS Environment Branch 2011) • Salvage and relocation of habitat features (eg hollow logs and branches) would be in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RMS projects* (RMS Environment Branch 2011).	Pre-construction/ construction	Construction contractor, site ecologist/ environmental officer
Weeds	Weed management and control would be undertaken in accordance with the Roads and Maritime Biodiversity Guidelines (RMS 2011).	Pre-construction/ construction	Construction contractor

Issue	Safeguard	Timing	Responsibility
Aquatic habitats and water quality	The following measures should be incorporated into the CEMP to manage impacts on aquatic habitats and water quality: • A protocol for the management of dewatering of farm dams to prevent introduction of Mosquito Fish into surrounding waterways should be implemented • Dams should be progressively emptied over a number of days to allow native fauna to relocate. An experienced, licenced wildlife carer or ecologist would be required to assist with relocation of fauna such as turtles, or with humane disposal of noxious fish • Any large woody debris should be relocated rather than removed • Monitoring of local water quality to identify any potential spills or deficient erosion and sediment controls would be undertaken • Implement reasonable and feasible water quality control measures to prevent pollution of waterways and drainage lines in the area downstream of the proposed works.	Pre-construction/ construction	Construction contractor

6.2.1 Operation

The environmental safeguards outlined in Table 6.2 would be implemented to address the potential impacts of the proposal on biodiversity values during operation.

Table 6.2 Environmental safeguards (operation)

Issue	Safeguard	Timing	Responsibility
Weeds	Ongoing weed management and control in accordance with the Roads and Maritime Biodiversity Guidelines (RMS 2011).	Operation	Roads and Maritime

6.3 Offsetting impacts

The clearing of native vegetation and associated habitat for TECs, species and migratory species within certified areas has already been offset under the SWGC Biodiversity Certification process (for example by setting aside the Western Sydney Parklands). The proposal would not clear any vegetation within non-certified lands in the study area, including vegetation mapped as ENV. As such, no offsets are required for the proposal under the Biodiversity Certification Order (Minister for the Environment 2007). No offsetting according to the Roads and Maritime (2011) Guideline for Biodiversity Offsets is required as there would be no clearing of native vegetation within non-certified land.

7. Conclusion

The proposal site is a modified environment characterised in the most part by cleared agricultural land. The proposal would require the clearing of up to 4.26 ha of native vegetation within the proposal site, mainly comprising the edges of small, fragmented stands of Cumberland Plain Woodland CEEC and River-flat Eucalypt Forest EEC within certified land.

There would be no direct impacts on native vegetation within non-certified land. Within non-certified land, the proposal may indirectly impact River-flat Eucalypt Forest EEC. A seven-part test has been prepared to assess these possible indirect impacts. Given the avoidance of direct impacts, and measures to minimise the potential for indirect impacts on the community, the proposal is considered unlikely to have a significant impact on River-flat Eucalypt Forest.

As there would be no clearing of native vegetation within non-certified lands, there are unlikely to be any notable direct or indirect impacts on threatened or migratory biota, including the Grey-headed Flying-fox, and no formal assessments of significance with respect to these species are warranted.

Cumberland Plain Woodland in certified land within the proposal site provides known and potential habitat for threatened and migratory species listed under the TSC Act and EPBC Act. Assessment and approval for impacts on these threatened and migratory biota is not required with respect to certified lands within the SWGC. Environmental safeguards are proposed, including pre-clearing surveys for species such as the Cumberland Plain Land Snail and measures to minimise impacts on fauna (such as roosting microbats) during clearing.

There is no habitat for threatened aquatic fauna listed under the FM Act in the proposal site or immediately downstream of the proposal site. Impacts on Key Fish Habitat resulting from construction and operation are likely to be minimal. Environmental safeguards would be implemented to minimise impacts on water quality and flows.

Specific mitigation measures have been provided to minimise the potential for adverse impacts on adjoining and downstream habitats during construction. These include erosion, sediment, fauna management and weed control measures. Temporary fencing would be set up to prevent access to adjacent areas of native vegetation, and to protect trees and native vegetation to be retained, particularly within the non-certified area adjoining the northern end of the proposal site.

The proposal is unlikely to result in a significant impact on any threatened biota listed under the TSC Act and EPBC Act with respect to non-certified land in the study area. As such, a species impact statement is not required. None of the vegetation with the potential to be impacted in non-certified land is mapped as ENV, and thus no offsets are required in accordance with the Biocertification Order. Referral of the proposal to the Australian Minister for the Environment under the EPBC Act is not considered necessary.

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Appendix A Likelihood of occurrence of threatened and migratory species within the study area

Threatened ecological communities that occur in the study area

Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	No stands in the study area meet the condition criteria for the listing of the CEEC under the EPBC Act	Grassy woodland/forest endemic to the hills and plains of the Cumberland Plain. Canopy typically dominated by *Eucalyptus moluccana*, and *E. tereticornis*, with *E. crebra, Corymbia maculata* and *E. eugenoides* occurring less frequently. Shrub layer dominated by *Bursaria spinosa*, and grasses such as *Themeda australis* and *Microlaena stipoides* var *stipoides*.	Known to occur within 10 km (OEH 2015)	Recorded.	Low impact Proposal would remove 3.30 ha from within certified land.
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC	-	Occurs on flats, drainage lines and river terraces of coastal floodplains where flooding is periodic and soils generally rich in silt, lack deep humic layers and have little or no saline (salt) influence. Occurs south from Port Stephens in the NSW North Coast, Sydney Basin and South East Corner bioregions. Characterised by a tall open canopy layer of eucalypts with variable species composition.	Known to occur within 10 km (OEH 2015)	Recorded.	Low impact Proposal would remove 0.96 ha from within certified. No clearing within non-certified land.

Key: CEEC – critically endangered ecological community; EEC – endangered ecological community.

Likelihood of occurrence of threatened flora in the study area

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Acacia pubescens	Downy Wattle	V	V	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	14 records within 10 km (OEH 2015); Species or species' habitat likely to occur within 10 km (DotE 2015)	Possible. Suitable potential habitat is present, however no individuals were recorded during surveys.	Low impact. Unlikely to be impacted by the proposal given lack of evidence in the proposal site. Removal of 3.30 ha of potential habitat from certified land.
Allocasuarina glareicola	-	E	E	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. No tertiary alluvial gravels or Castlereagh woodland in the study area.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with *Cryptostylis subulata* and the *Cryptostylis erecta*. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Species or species' habitat may occur within 10 km (DotE 2015)	Unlikely. Potential habitat present however the study area has been subjected to high levels of soil disturbance.	Negligible impact. Unlikely to be impacted by the proposal given previous disturbance.
Cynanchum elegans	White-flowered Wax Plant	E	E	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	6 records within 10 km (OEH 2015); Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. Potential habitat present however the study area has been subjected to high levels of soil disturbance.	Negligible impact. Unlikely to be impacted by the proposal given previous disturbance.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Dillwynia tenuifolia	Dillwynia tenuifolia, Kemps Creek	EP	-	Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area. This population occurs on a small outlier of the Berkshire Park Soil Landscape; the site supports a transition from Castlereagh Ironbark Forest to Castlereagh Scribbly Gum Woodland.	26 records within 10 km (OEH 2015)	Nil. Study area outside the boundary of this population.	Nil.
Dillwynia tenuifolia	-	V	-	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	40 records within 10 km (OEH 2015)	Nil. No suitable forest habitat present.	Nil.
Eucalyptus benthamii	Camden White Gum	V	V	Occurs on the alluvial flats of the Nepean River and its tributaries. Known distribution from The Oaks (south) to Grose Wold (north) and Kedumba Valley (west). 2 major subpopulations: in Kedumba Valley and Bents Basin State Recreation Area. Occurs in wet open forest on alluvial flats, in well drained alluvial sands and gravels to 1 m deep.	10 records within 10 km , last recorded 1992 (OEH 2015); Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. Could occur along riparian areas, however most of the alluvial flats are cleared land. No individuals recorded during surveys.	Negligible impact. Unlikely to be impacted by the proposal given previous disturbance and lack of evidence at the proposal site.
Eucalyptus scoparia	Wallangarra White Gum	E	V	Occurs mostly in Queensland with only three known occurrences in NSW near Tenterfield. In NSW it is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	1 record within 10 km (OEH 2015)	Present. Planted trees present in the study area. Outside natural range.	Low impact. Removal of planted specimens.
Genoplesium baueri	Yellow Gnat-orchid	E	E	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Species or species' habitat may occur within 10 km (DotE 2015)	Nil. No sandstone forest present.	Nil.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V		Occurs only within western Sydney in an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. Outlier populations also at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels. Occurs in association with Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forests.	2 records within 10 km (OEH 2015)	Possible. Suitable potential habitat is present, however no individuals were recorded during surveys.	Low impact. Unlikely to be impacted by the proposal given lack of evidence in the proposal site. Removal of 3.30 ha of potential habitat from certified land.
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	Occurs between Moss Vale/Bargo and lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. Broad habitat range including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks.	11 records within 10 km (OEH 2015); Species or species' habitat known to occur within 10 km (DotE 2015)	Possible. Suitable potential habitat is present, however no individuals were recorded during surveys.	Low impact. Unlikely to be impacted by the proposal given lack of evidence in the proposal site. Removal of 3.30 ha of potential habitat from certified land.
Haloragis exalata subsp. *Exalata*	Wingless Raspwort	V	V	Occurs in 4 widely scattered localities in eastern NSW, in the central coast, south coast and north-western slopes. Requires protected and shaded damp situations in riparian habitats.	Species or species' habitat may occur within 10 km (DotE 2015)	Nil. Outside of species' known distribution.	Nil.
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	EP	-	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. The population occurs as very scattered plants in areas of remnant vegetation. It is a climber that grows in vine thickets and open shale woodland.	21 records within 10 km (OEH 2015)	Possible. Suitable potential habitat is present, however no individuals were recorded during surveys.	Low impact. Unlikely to be impacted by the proposal given lack of evidence in the proposal site. Removal of 3.30 ha of potential habitat from certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Pelargonium sp. *Striatellum*	Omeo Stork's-bill	E	E	*Pelargonium* sp. (G.W. Carr 10345), syn. *P. striatellum*, is a tufted perennial forb known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Species or species' habitat may occur within 10 km (DotE 2015)	Nil. No suitable habitat. Outside of species' known distribution.	Nil.
Persoonia nutans	Nodding Geebung	E	E	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	8 records within 10 km (OEH 2015); Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. No suitable woodland or forest habitat present.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Pimelea curviflora var. *curviflora*	-	V	V	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Species or species' habitat may occur within 10 km (DotE 2015)	Unlikely. No sandstone-transition habitat present. No records in the locality.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Pimelea spicata	Spiked Rice-flower	E	E	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	9 records within 10 km (OEH 2015); Species or species' habitat known to occur within 10 km (DotE 2015)	Possible. Suitable potential habitat is present, however no individuals were recorded during surveys.	Low impact. Unlikely to be impacted by the proposal given lack of evidence in the proposal site. Removal of 3.30 ha of potential habitat from certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Pomaderris brunnea	Rufous Pomaderris	V	V	Mainly occurs in SW Sydney (Wollondilly and Camden LGAs), with other populations in the Hawkesbury-Wollemi region, near Walcha in the New England tablelands and Gippsland in VIC. In NSW, grows in moist woodland or open forest on clay and alluvial soils on flood plains and creek lines. Near Sydney occurs in open woodland dominated by E. amplifolia with Allocasuarina sp. and Bursaria sp. understorey, or on alluvial flats with eucalypts including *E. elata, E. piperita* and *E. punctata* (Sutter 2011).	Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. Potential habitat present in alluvial woodland and forest. Outside of species' known distribution.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Pterostylis gibbosa	Illawarra Greenhood	E	E	Known from a small number of populations in the Illawarra, Nowra and Hunter regions. First collected in western Sydney. Only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by *Eucalyptus tereticornis, E. longifolia* and *Melaleuca decora*. Near Nowra, the species grows in an open forest of *Corymbia maculata, E. tereticornis* and *E. paniculata*. In the Hunter region, the species grows in open woodland dominated by *E. crebra, E. tereticornis* and *Callitris endlicheri*.	Species or species' habitat may occur within 10 km (DotE 2015)	Unlikely. Potential habitat present however the study area has been subjected to high levels of soil disturbance. No records in the locality.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. Potential habitat present however the study area has been subjected to high levels of soil disturbance.	Negligible impact. Unlikely to be impacted by the proposal given previous disturbance.
Pultenaea parviflora	-	E	V	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	86 records within 10 km (OEH 2015); Species or species' habitat likely to occur within 10 km (DotE 2015)	Possible. Suitable potential habitat is present, however no individuals were recorded during surveys.	Low impact. Unlikely to be impacted by the proposal given lack of evidence in the proposal site. Removal of 3.30 ha of potential habitat from certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Streblus pendulinus	Siah's Backbone	-	E	Siah's Backbone occurs from Cape York Peninsula to Milton, south-east New South Wales (NSW), as well as Norfolk Island. Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest.	Species or species' habitat known to occur within 10 km (DotE 2015)	Nil. No suitable rainforest habitat present.	Nil.
Thelymitra kangaloonica	Kangaloon Sun Orchid	-	CE	Only known from three locations near Robertson in the Southern Highlands. Grows in seasonally swampy sedgeland on grey silty clay loam at 600–700 m above sea level. Flowers in late October and early November.	Species or species' habitat may occur within 10 km (DotE 2015)	Nil. No suitable habitat. Outside of species' known distribution.	Nil.
Thesium australe	Austral Toadflax	V	V	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass (*Themeda australis*).	Species or species' habitat may occur within 10 km (DotE 2015)	Possible. Suitable potential habitat is present, however no individuals were recorded during surveys.	Low impact. Unlikely to be impacted by the proposal given lack of evidence in the proposal site. Removal of 3.30 ha of potential habitat from certified land.

Key: CE – critically endangered; E – endangered; EP – endangered population; V – vulnerable.

Likelihood of occurrence of threatened fauna in the study area

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Birds	-	-	-	-	-	-	-
Botaurus poiciloptilus	Australasian Bittern	E	E	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly *Typha* spp. and *Eleocharis* spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	1 record within 10 km (OEH 2015); Species or species' habitat known to occur within 10 km (DotE 2015)	Unlikely. No suitable wetland habitat present.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Rostratula australis	Australian Painted Snipe	E	E	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. Few dams with suitable habitat present in the study area.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V		Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands dominated by box and ironbark eucalypts, or less commonly smooth-barked gums, stringybarks and tea-treas. Forage over home range of >5 ha. Tend to occur within largest woodland patches in the landscape. They forage for insects, nectar and honeydew. The nest is hidden by foliage high in the crown of a tree.	1 record within 10 km (OEH 2015)	Unlikely. Small patches of vegetation present are unlikely to be suitable for this species.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Oxyura australis	Blue-billed Duck	V		Partly migratory, travels short distances between breeding swamps and over-wintering lakes. Young birds disperse in April-May from breeding swamps in inland NSW to Murray River system and coastal lakes. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Nests in Cumbungi over deep water or in trampled Lignum, sedges or spike-rushes. Completely aquatic, swimming along the edge of dense cover.	1 record within 10 km , last recorded 1980 (OEH 2015)	Unlikely. No suitable wetland habitat present.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Stagonopleura guttata	Diamond Firetail	V		Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.	2 records within 10 km (OEH 2015)	Likely. May occur on occasion in woodland and adjacent grassland vegetation.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.
Petroica phoenicea	Flame Robin	V		Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	4 records within 10 km (OEH 2015)	Likely. May occur on occasion in woodland and adjacent grassland vegetation. Unlikely to breed in the area as it usually breeds in upland areas.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.
Stictonetta naevosa	Freckled Duck	V		Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/creeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.	1 record within 10 km (OEH 2015)	Nil. No suitable wetland habitat present.	Nil.
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	2 records within 10 km (OEH 2015)	Unlikely. Limited suitable foraging habitat present. Unlikely to breed in the area given the low incidence of hollow-bearing trees and patchiness of vegetation.	Negligible impact. Unlikely to be impacted by the proposal given the limited suitable habitat present.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1 km from feeding site. Nests in large (about 20 cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	11 records within 10 km (OEH 2015)	Unlikely. Minimal foraging habitat present. Unlikely to breed in the area gas it usually breeds in upland forests.	Negligible impact. Unlikely to be impacted by the proposal given the limited suitable habitat present.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Considered a sedentary species, but local seasonal movements are possible. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Nests on low, live or dead forks or branches of trees or stumps, or occasionally on fallen trees or limbs.	3 records within 10 km (OEH 2015)	Unlikely. Small patches of vegetation present are unlikely to be suitable for this species.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Hieraaetus morphnoides	Little Eagle	V		Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	5 records within 10 km (OEH 2015)	Likely. May forage on occasion over the study area. Unlikely to breed in the area given the lack of suitable remnant vegetation.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.
Glossopsitta pusilla	Little Lorikeet	V		Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts. Most breeding records are from the western slopes.	1 record within 10 km (OEH 2015)	Possible. May forage on occasion in the study area. Unlikely to breed in the area given the lack of suitable remnant vegetation.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Ninox strenua	Powerful Owl	V		Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (diameter at breast height 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400-1,450 ha. Forages within open and closed woodlands as well as open areas.	16 records within 10 km (OEH 2015)	Possible. May forage on occasion in the study area. Unlikely to breed in the area given the lack of suitable remnant vegetation.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.
Anthochaera phrygia	Regent Honeyeater	CE	E	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	2 records within 10 km (OEH 2015); Species or species' habitat known to occur within 10 km (DotE 2015)	Unlikely. No suitable foraging habitat present.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Petroica boodang	Scarlet Robin	V		In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	1 record within 10 km (OEH 2015)	Possible. May occur on occasion in woodland and adjacent grassland vegetation. Unlikely to breed in the area as it usually breeds in upland areas.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.
Chthonicola sagittata	Speckled Warbler	V		Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits a wide range of Eucalyptus-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of a low dense plant.	12 records within 10 km (OEH 2015)	Unlikely. Small patches of vegetation present are unlikely to be suitable for this species.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Lophoictinia isura	Square-tailed Kite	V		Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km2.	1 record within 10 km (OEH 2015)	Unlikely. Small patches of vegetation present are unlikely to be suitable for this species.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Lathamus discolor	Swift Parrot	E	E	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	2 records within 10 km (OEH 2015); Species or species' habitat likely to occur within 10 km (DotE 2015)	Possible. Individuals may forage on occasion during the winter migration. Does not breed in NSW.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.
Daphoenositta chrysoptera	Varied Sittella	V		Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	18 records within 10 km (OEH 2015)	Likely. May forage on occasion in the study area. Unlikely to breed in the area given the lack of suitable remnant vegetation. Many local records. Recorded nearby by PB (2012).	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Mammals	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.
Phascolarctos cinereus	Koala	V	V	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	Species or species' habitat known to occur within 10 km (DotE 2015)	Unlikely. No local populations present. The limited potential foraging habitat present is patchy and has minimal connectivity with larger habitat areas.	Negligible impact. Unlikely to be impacted by the proposal given the limited habitat present and lack of connectivity
Pseudomys novaehollandiae	New Holland Mouse		V	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Species or species' habitat likely to occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Dasyurus maculatus	Spot-tailed Quoll	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. No local populations present. The limited potential habitat present is patchy and has minimal connectivity with larger habitat areas.	Negligible impact. Unlikely to be impacted by the proposal given the limited habitat present and lack of connectivity
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability. Will also forage in urban gardens and cultivated fruit crops.	18 records within 10 km (OEH 2015) Foraging, feeding or related behaviour known to occur within 10 km (DotE 2015)	Present. Would forage in the area when eucalypts are in flower. No breeding camp present.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Generally occurs east of the Great Dividing Range along NSW coast. Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony.	20 records within 10 km (OEH 2015)	Likely. Would forage throughout the study area. May roost under the bridge or in culverts. No breeding habitat present.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Proposal would not remove any habitat from non-certified land. Temporary disturbance of potential roost sites.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging movements recorded).	3 records within 10 km (OEH 2015)	Possible. May forage along Thompsons Creek. Unlikely to occur in small scattered woodland patches. Unlikely to breed in the area given the lack of large areas of remnant vegetation.	Negligible impact. Proposal would not remove any habitat from non-certified land.
Mormopterus norfolkensis	Eastern Freetail-bat	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark.	22 records within 10 km (OEH 2015)	Likely. Would forage through the study area. May roost and breed in hollow-bearing trees.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Removal of up to 12 hollow-bearing trees. Proposal would not remove any habitat from non-certified land.
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees.	11 records within 10 km (OEH 2015)	Likely. Would forage through the study area. May roost and breed in hollow-bearing trees.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Removal of up to 12 hollow-bearing trees. Proposal would not remove any habitat from non-certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley. Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds. In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	4 records within 10 km (OEH 2015) Species or species' habitat known to occur within 10 km (DotE 2015)	Unlikely. No preferred foraging habitat present. No breeding habitat present.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Myotis macropus	Southern Myotis	V		Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water. Breeds November or December.	11 records within 10 km (OEH 2015)	Likely. Would forage along creeklines and above dams in the study area. May roost under the bridge or in culverts or in hollow-bearing trees.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Removal of up to 12 hollow-bearing trees. Disturbance of potential roost site (culvert). Proposal would not remove any habitat from non-certified land.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings.	1 record within 10 km (OEH 2015)	Likely. Would forage through the study area. May roost and breed in hollow-bearing trees.	Low impact. Removal of 4.26 ha of potential habitat from certified land. Removal of up to 12 hollow-bearing trees. Proposal would not remove any habitat from non-certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Reptiles	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.
Frogs	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Heleioporus australiacus	Giant Burrowing Frog	V	V	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	4 records within 10 km (OEH 2015); Species or species' habitat likely to occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.
Litoria aurea	Green and Golden Bell Frog	E	V	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (*Typha* spp.) or spike rushes (*Eleocharis* spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	Species or species' habitat may occur within 10 km (DotE 2015)	Unlikely. No farm dams with large quantities of emergent vegetation present.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Litoria raniformis	Growling Grass Frog		V	Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.	Species or species' habitat may occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.
Fish	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Macquaria australasica	Macquarie Perch	V	E	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Species or species' habitat may occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.
Prototroctes maraena	Australian Grayling		V	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea.	Species or species' habitat may occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.
Gastropods	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Meridolum corneovirens	Cumberland Plain Land Snail	E		Occurs within a small area of the Cumberland Plain, from Richmond and Windsor to Picton. Found primarily under litter of bark, leaves and logs, or in loose soil around grass clumps within Cumberland Plain Woodland. Has also been found under rubbish. Feeds on fungus. During periods of drought can burrow into the soil to escape the dry conditions.	79 records within 10 km (OEH 2015)	Present. Recorded in woodland patch near the intersection of The Northern Road and Bringelly Road. May occur in other woodland patches with good levels of leaf litter present.	Moderate impact. Proposal would remove 4.26 ha from certified land. No habitat would be removed from non-certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Pommerhelix duralensis	Dural Land Snail		E	The species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringes of the Cumberland Plain on shale-sandstone transitional landscapes. The majority of confirmed records for the species occur within The Hills Shire Local Government Area. The species is also found within the Local Government Areas of Blue Mountains City, Penrith City, Hornsby Shire and Parramatta City (Ridgeway, 2010).	Species or species' habitat likely to occur within 10 km (DotE 2015)	Nil. Outside the known distribution of this species.	Nil.

Key: CE – critically endangered; E – endangered; V – vulnerable.

Likelihood of occurrence of migratory species in the study area

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Rostratula australis	Australian Painted Snipe	E	C	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Unlikely. Few dams with suitable habitat present in the study area.	Negligible impact. Unlikely to be impacted by the proposal given the lack of suitable habitat.
Monarcha melanopsis	Black-faced Monarch	-	M	Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	Species or species' habitat known to occur within 10 km (DotE 2015)	Possible. May forage on occasion within riparian vegetation.	Low impact. Removal of 4.26 ha of potential habitat from within certified land. Proposal would not removal any potential habitat from within non-certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Ardea ibis	Cattle Egret	-	C,J	Occurs across NSW. Principal breeding sites are the central east coast from Newcastle to Bundaberg. Also breeds in major inland wetlands in north NSW (notably the Macquarie Marshes). Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Uses predominately shallow, open and fresh wetlands with low emergent vegetation and abundant aquatic flora. Sometimes observed in swamps with tall emergent vegetation and commonly use areas of tall pasture in moist, low-lying areas.	Species or species' habitat may occur within 10 km (DotE 2015)	Present. Foraging habitat present in paddocks.	Low impact. Proposal would remove 31.44 ha of foraging habitat for this species from within certified land. No habitat present within non-certified land. No impact on breeding habitat.
Apus pacificus	Fork-tailed Swift	-	C,J,K	Recorded in all regions of NSW. Non- breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.	Species or species' habitat likely to occur within 10 km (DotE 2015)	Possible. May forage on occasion high above the study area.	Nil.
Ardea alba	Great Egret	-	C,J	Occurs across NSW. Within NSW there are breeding colonies within the Darling Riverine Plains and Riverina regions, and minor colonies across its range including the north and north-east of the state. Reported from a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial).	Breeding known to occur within 10 km (DotE 2015)	Likely. May forage on occasion at farm dams.	Low impact. Removal of a small area of artificial wetland from certified land.
Gallinago hardwickii	Latham's Snipe	-	C,J,K	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabits permanent and ephemeral wetlands. Typically in open, freshwater wetlands with low, dense vegetation (including swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	Species or species' habitat may occur within 10 km (DotE 2015)	Possible. May forage on occasion at farm dams.	Low impact. Removal of a small area of artificial wetland from certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Merops ornatus	Rainbow Bee-eater	-	J	Distributed across much of mainland Australia, and several near-shore islands. Occurs in a range of habitats, including open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia. Nests are made in sandy banks.	Species or species' habitat may occur within 10 km (DotE 2015)	Possible. May forage and breed in the study area.	Low impact. Removal of 4.26 ha of potential habitat from within certified land. Proposal would not removal any potential habitat from within non-certified land.
Rhipidura rufifrons	Rufous Fantail	-	M	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	Species or species' habitat known to occur within 10 km (DotE 2015)	Possible. May forage on occasion during migration. No breeding habitat present.	Low impact. Removal of 4.26 ha of potential habitat from within certified land. Proposal would not removal any potential habitat from within non-certified land.
Myiagra cyanoleuca	Satin Flycatcher	-	M	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	Species or species' habitat known to occur within 10 km (DotE 2015)	Possible. May forage on occasion during migration. No breeding habitat present.	Low impact. Removal of 4.26 ha of potential habitat from within certified land. Proposal would not removal any potential habitat from within non-certified land.

Scientific name	Common name	TSC status	EPBC status	Habitat association	Source	Likelihood of occurrence	Potential impact
Monarcha trivirgatus	Spectacled Monarch	-	M	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. Prefers thick understorey in rainforest, wet gullies and waterside vegetation as well as mangroves.	Species or species' habitat known to occur within 10 km (DotE 2015)	Unlikely. Outside usual range. Limited suitable habitat present.	Negligible impact. Unlikely to be impacted by the proposal given the limited habitat present and lack of connectivity
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	C	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Species or species' habitat known to occur within 10 km (DotE 2015)	Nil. No suitable habitat present.	Nil.
Hirundapus caudacutus	White-throated Needletail	-	C,J,K	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Species or species' habitat known to occur within 10 km (DotE 2015)	Possible. May forage on occasion high above the study area.	Nil.

Key: C – China-Australia Migratory Bird Agreement; J - Japan-Australia Migratory Bird Agreement; K – Republic of Korea-Australia Migratory Bird Agreement; M- migratory terrestrial.

Appendix B Survey results

Flora species recorded in the study area

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Acanthaceae	*Brunoniella australis*	Blue Trumpet	-	u	-	-	-
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	-	-	u	-	-
Adiantaceae	*Cheilanthes sieberi*	Rock Fern	-	u	u	-	-
Alismataceae	*Damasonium minus*	Starfruit	-	-	-	u	-
Aloaceae	*Aloe* (?) *succotrina*	-	*	o	-	-	o
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	-	u	-	-	-
Anacardiaceae	*Harpephyllum caffrum*	-	*	-	-	-	u
Apiaceae	*Centella asiatica*	Indian Pennywort	-	o	o	-	o
Apiaceae	*Foeniculum vulgare*	Fennel	*	u	u	-	u
Apocynaceae	*Araujia sericifera*	Moth Vine	*	o	o	-	o
Apocynaceae	*Nerium oleander*	Oleander	*	-	-	-	u
Apocynaceae	*Tylophora barbata*	Bearded Tylophora	-	-	u	-	-
Araucariaceae	*Araucaria columnaris*	-	*	-	-	-	u
Araucariaceae	*Araucaria cunninghamii*	Hoop Pine	*	-	-	-	u
Arecaceae	*Archontophoenix cunninghamiana*	Bangalow Palm	-	-	-	-	u
Arecaceae	*Phoenix canariensis*	-	*	-	-	-	o
Arecaceae	*Phoenix sylvestris*	-	*	-	-	-	u
Arecaceae	*Syagrus romanzoffianum*	-	*	-	-	-	u
Arecaceae	*Washingtonia filifera*	-	*	-	-	-	u
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*	o	o	-	-
Asparagaceae	*Asparagus aethiopicus*	Ground Asparagus	*	u	-	-	u
Asparagaceae	*Asparagus officinalis*	Asparagus	*	-	-	-	u
Asteraceae	*Ageratina adenophora*	Crofton Weed	*	-	o	-	-

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Asteraceae	*Ageratina riparia*	Mistflower	*	-	o	-	-
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*	o	o	-	o
Asteraceae	*Calotis dentex*	Burr-daisy	-	u	-	-	-
Asteraceae	*Cirsium vulgare*	Spear Thistle	*	u	u	-	u
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*	u	u	-	-
Asteraceae	*Conyza sumatrensis*	Tall fleabane	*	u	u	-	-
Asteraceae	*Euchiton sphaericus*	Star Cudweed	-	u	-	-	-
Asteraceae	*Hypochaeris radicata*	Catsear	*	u	-	-	u
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood	-	o	-	-	-
Asteraceae	*Senecio madagascariensis*	Fireweed	*	u	-	-	-
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*	u	-	-	-
Azollaceae	*Azolla filiculoides* var. *rubra*	-	-	-	-	u	-
Basellaceae	*Anredera cordifolia*	Madeira Vine	*	-	u	-	u
Bignoniaceae	*Jacaranda mimosifolia*	Jacaranda	*	-	-	-	u
Bignoniaceae	*Pandorea pandorana* subsp. *pandorana*	Wonga Wonga Vine	-	-	-	-	u
Brassicaceae	*Hirschfeldia incana*	Buchan Weed	*	-	-	-	u
Cactaceae	*Opuntia inermis*	-	*	u	-	-	-
Campanulaceae	*Poranthera microphylla*	-	-	o	-	-	-
Caprifoliaceae	*Lonicera japonica*	Japanese Honeysuckle	*	-	-	-	o
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak	-	u	-	-	-
Casuarinaceae	*Casuarina glauca*	Swamp Oak	-	-	o	-	-
Chenopodiaceae	*Chenopodium album*	Fat Hen	*	u	-	-	-
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	-	o	o	-	-

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush	-	u	-	-	-
Clusiaceae	*Hypericum gramineum*	Small St John's Wort	-	o	-	-	-
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	-	o	o	-	-
Commelinaceae	*Tradescantia fluminensis*	Wandering Jew	*-	-	o	-	o
Convolvulaceae	*Dichondra repens*	Kidney Weed	-	o	-	-	o
Crassulaceae	*Bryophyllum delagoense*	Mother of millions	*	o	-	-	o
Crassulaceae	*Crassula (?) socialis*	-	*	u	-	-	o
Cupressaceae	*Cupressus lusitanica*	Mexican Cypress	*	u	-	-	-
Cupressaceae	*Cupressus sempervirens 'Stricta'*	-	*	u	-	-	-
Cupressaceae	*Cupressocyparis leylandii*	-	-	-	-	-	o
Cyperaceae	*Carex appressa*	Tall Sedge	-	-	u	u	-
Cyperaceae	*Carex inversa*	Knob Sedge	-	u	u	-	-
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge	*	-	u	u	-
Cyperaceae	*Cyperus laevigatus*	-	-	-	u	-	-
Cyperaceae	*Eleocharis acuta*	-	-	-	-	o	-
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower	-	u	-	-	-
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower	-	-	-	-	u
Ericaceae	*Astroloma humifusum*	Native Cranberry	-	o	-	-	-
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath	-	u	-	-	-
Euphorbiaceae	*Triadica sebifera*	Chinese Tallowood	*	-	-	-	u
Fabaceae (Caesalpinioideae)	*Gleditsia triacanthos*	Honey Locust	*	-	-	-	u
Fabaceae (Caesalpinioideae)	*Senna pendula* var. *glabrata*	-	*	u	u	-	u

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Fabaceae (Faboideae)	*Bossiaea prostrata*	-	-	u	-	-	-
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	-	-	u	-	-	-
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil	-	o	o	-	-
Fabaceae (Faboideae)	*Dillwynia sieberi*	-	-	u	-	-	-
Fabaceae (Faboideae)	*Glycine clandestina*	Twining Glycine	-	o	o	-	o
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine	-	o	-	-	-
Fabaceae (Faboideae)	*Indigofera australis*	Australian Indigo	-	o	-	-	-
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	-	u	-	-	u
Fabaceae (Faboideae)	*Trifolium subterraneum*	Subterranean Clover	*	-	u	-	o
Fabaceae (Mimosoideae)	*Acacia binervia*	Coast Myall	-	-	-	-	u
Fabaceae (Mimosoideae)	*Acacia decurrens*	Black Wattle	-	o	o	-	-
Fabaceae (Mimosoideae)	*Acacia falcata*	-	-	o	-	-	-
Fabaceae (Mimosoideae)	*Acacia fimbriata*	Fringed Wattle	-	-	-	-	u
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally	-	-	-	-	u
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle	-	o	o	-	-

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Fabaceae (Mimosoideae)	*Acacia parramattensis*	Parramatta Wattle	-	o	o	-	-
Geraniaceae	*Geranium solanderi* var. *solanderi*	-	-	-	u	-	-
Goodeniaceae	*Goodenia hederacea subsp. hederacea*	-	-	u	u	-	-
Goodeniaceae	*Goodenia* (?) *paniculata*	-	-	-	-	u	-
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	-	-	u	-	-
Juncaceae	*Juncus continuus*	-	-	-	-	u	-
Juncaceae	*Juncus usitatus*	-	-	u	o	o	-
Lamiaceae	*Ajuga australis*	Austral Bugle	-	-	u	-	-
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*	-	--	-	u
Lobeliaceae	*Pratia purpurascens*	Whiteroot	-	o	o	-	-
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	-	-	u	-	-	-
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush	-	o	-	-	-
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	-	-	-	-	u
Loranthaceae	*Amyema miquelii*	Box Mistletoe	-	o	-	-	-
Loranthaceae	*Amyema pendulum* subsp. *pendulum*	-	-	o	-	-	-
Magnoliaceae	*Magnolia grandiflora*	Southern Magnolia	*	-	-	-	-
Malaceae	*Cotoneaster glaucophyllus*	-	*	u	-	-	o
Malaceae	*Cotoneaster pannosus*	-	*	-	-	-	o
Malvaceae	*Malva parviflora*	Small-flowered Mallow	*	u	u	-	o
Malvaceae	*Sida corrugata*	Corrugated Sida	-	u	-	-	-
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*	o	o	-	o
Meliaceae	*Melia azedarach*	White Cedar	-	-	u	-	u
Moraceae	*Ficus rubiginosa*	Port Jackson Fig	-	-	-	-	u

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Myoporaceae	*Eremophila debilis*	Amulla	-	u	-	-	-
Myrsinaceae	*Anagallis arvensis*	Scarlet Pimpernel	*		u	-	u
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	-	o	u	-	o
Myrtaceae	*Angophora subvelutina*	Broad-leaved Apple	-	-	o	-	-
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	-	-	-	-	u
Myrtaceae	*Callistemon viminalis*	Weeping Bottlebrush	*	-	-	-	u
Myrtaceae	*Corymbia citriodora*	Lemon-scented Gum	*	-	-	-	u
Myrtaceae	*Corymbia maculata*	Spotted Gum	-	-	-	-	u
Myrtaceae	*Eucalyptus amplifolia* subsp. *amplifolia*	-	-	-	o	-	-
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	-	u	-	-	u
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	-	o	-	-	o
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark	-	u	-	-	u
Myrtaceae	*Eucalyptus globoidea*	White Stringybark	-	u	-	-	-
Myrtaceae	*Eucalyptus grandis*	Flooded Gum	*	-	-	-	o
Myrtaceae	*Eucalyptus microcorys*	Tallowwood	*	-	-	-	o
Myrtaceae	*Eucalyptus moluccana*	Grey Box	-	c	o	-	o
Myrtaceae	*#Eucalyptus nicholii*	Narrow-leaved Black Peppermint	*	-	-	-	u
Myrtaceae	*Eucalyptus paniculata* subsp. *paniculata*	-	-	-	-	-	u
Myrtaceae	*Eucalyptus polyanthemos*	Red Box	*	-	-	-	u
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany	*	-	-	-	u
Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum	*	-	-	-	u
Myrtaceae	*#Eucalyptus scoparia*	Wallangarra White Gum	*	-	-	-	o

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	-	c	o	-	o
Myrtaceae	*Kunzea ambigua*	Tick Bush	-	u	-	-	-
Myrtaceae	*Lophostemon confertus*	Brush Box	*	-	-	-	u
Myrtaceae	*Melaleuca decora*	-	-	-	o	-	-
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark	*	-	-	-	u
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	-	-	o	-	-
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	-	u	o	-	-
Myrtaceae	*Syzygium australe*	Brush Cherry	-	-	-	-	u
Myrtaceae	*Syzygium luehmannii*	Small-leaved Lilly Pilly	*	-	-	-	u
Davalliaceae	*Nephrolepis cordifolia*	Fishbone Fern	*	-	-	-	u
Ochnaceae	*Ochna serrulata*	Mickey Mouse Plant	*	u	u	-	u
Oleaceae	*Ligustrum lucidum*	Large-leaved Privet	*	o	o	-	o
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	*	o	o	-	o
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive	*	c	u	-	o
Onagraceae	*Epilobium billardierianum* subsp. *billardierianum*	-	-	-	-	u	-
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	--	-	-	-	o	-
Oxalidaceae	*Oxalis perennans*		-	o	u	-	-
Passifloraceae	*Passiflora edulis*	Common Passionfruit	*	u	u	-	u
Phormiaceae	*Dianella caerulea* var. *producta*	-	-	u	-	-	-
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	-	u	u	-	-
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	-	-	u	-	-
Phytolaccaceae	*Phytolacca octandra*	Inkweed	*	u	u	-	u
Pinaceae	*Pinus pinea*	Stone Pine	*	-	-	-	u

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Pinaceae	*Pinus radiata*	Radiata Pine	*	-	-	-	u
Pinaceae	*Pinus sylvestris*	Scotch pine	*	-	-	-	u
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	-	u	-	-	-
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	-	c	o	-	-
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	-	-	u	-	u
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*	u	u	-	u
Plantaginaceae	*Plantago debilis*	Shade Plantain	-	-	u	-	-
Poaceae	*Aira cupaniana*	Silvery Hairgrass	*	-	-	-	u
Poaceae	*Aristida ramosa*	Purple Wiregrass	-	u	-	-	-
Poaceae	*Aristida vagans*	Threeawn Speargrass	-	o	u	-	-
Poaceae	*Avena fatua*	Wild Oats	*	u	-	-	u
Poaceae	*Bothriochloa macra*	Red Grass	-	u	-	-	-
Poaceae	*Briza minor*	Shivery Grass	*	u	u	-	u
Poaceae	*Bromus catharticus*	Praire Grass	*	-	-	-	o
Poaceae	*Chloris gayana*	Rhodes Grass	*	o	o	-	o
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	-	u	-	-	-
Poaceae	*Cynodon dactylon*	Common Couch	-	c	-	-	c
Poaceae	*Digitaria ciliaris*	Summer Grass	*	u	-	-	u
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	-	u	-	-	-
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*	u	o	-	o
Poaceae	*Entolasia marginata*	Bordered Panic	-	o	-	-	-
Poaceae	*Entolasia stricta*	Wiry Panic	-	u	-	-	-
Poaceae	*Eragrostis curvula*	African Lovegrass	*	u	u	-	u
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	-	u	u	-	u

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Poaceae	*Eragrostis pilosa*	Soft Lovegrass	*	-	-	-	u
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass	-	-	u	-	-
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass	-	o	o	-	o
Poaceae	*Oplismenus imbecillis*	-	-	-	u	-	-
Poaceae	*Panicum simile*	Two-colour Panic	-	o	-	-	-
Poaceae	*Paspalum dilatatum*	Paspalum	*	o	o	-	c
Poaceae	*Paspalum distichum*	Water Couch	-	-	-	o	-
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass	*	-	u	-	c
Poaceae	*Phleum pratense*	Timothy	*	-	-	-	u
Poaceae	*Phragmites australis*	Common Reed	-	-	-	c	-
Poaceae	*Phyllostachys aurea*	Fishpole Bamboo	*	-	-	-	u
Poaceae	*Rytidosperma racemosus* var. *racemosus*	-	-	u	-	-	-
Poaceae	*Setaria viridis*	Green Pigeon Grass	*	-	-	-	o
Poaceae	*Sporobolus africanus*	Parramatta Grass	*	-	-	-	u
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass	-	-	u	-	-
Poaceae	*Themeda australis*	Kangaroo Grass	-	c	-	-	-
Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	*	u	-	-	u
Polygonaceae	*Persicaria decipiens*	Slender Knotweed	-	-	-	u	-
Polygonaceae	*Persicaria hydropiper*	Water Pepper	-	-	-	u	-
Polygonaceae	*Rumex brownii*	Swamp Dock	-	-	-	u	-
Polygonaceae	*Rumex crispus*	Curled Dock	*	-	-	o	-
Potamogetonaceae	*Potamogeton crispus*	Curly Pondweed	-	-	-	o	-
Proteaceae	*Grevillea robusta*	Silky Oak	*	u	u	-	u

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Proteaceae	*Hakea salicifolia*	Willow-leaved Hakea	-	-	-	-	u
Ranunculaceae	*Clematis glycinoides*	Headache Vine	-	-	-	-	u
Ranunculaceae	*Ranunculus inundatus*	River Buttercup	-	-	-	u	-
Ranunculaceae	*Ranunculus repens*	Creeping Buttercup	*	-	-	u	-
Rosaceae	*Rubus fruticosus* sp. agg.	Blackberry complex	*	u	u	-	-
Rosaceae	*Rubus parvifolius*	Native Raspberry	-	-	u	-	-
Rubiaceae	*Asperula conferta*	Common Woodruff	-	u	-	-	-
Salicaceae	*Salix caprea*	-	*	-	-	u	-
Sapindaceae	*Acer negundo*	Box Elder	*	-	-	-	u
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush	-	u	-	-	-
Sapindaceae	*Dodonaea viscosa* subsp. *cuneata*	Wedge-leaf Hop-bush	-	o	-	-	-
Plantaginaceae	*Veronica plebeia*	Trailing Speedwell	-	o	o	-	-
Scrophulariaceae	*Verbascum thapsus* subsp. *thapsus*	Great Mullein	*	-	-	-	o
Solanaceae	*Cestrum parqui*	Green Cestrum	*	u	u	-	u
Solanaceae	*Lycium ferocissimum*	African Boxthorn	*	u	-	-	u
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	*	u	-	-	-
Solanaceae	*Solanum jasminoides*	-	*	-	-	-	u
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*	u	u	-	u
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	-	u	-	-	-
Thymelaeaceae	*Pimelia linifolia* subsp. *linifolia*	-	-	u	-	-	-
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi	-	-	-	o	-
Ulmaceae	*Ulmus parvifolia*	Chinese Elm	*	-	-	-	o
Urticaceae	*Urtica incisa*	Stinging Nettle	-	o	o	-	-
Verbenaceae	*Lantana camara*	Lantana	*	u	u	-	u

Family	Scientific name	Common name	Not indigenous to LGA	Cumberland Plain Woodland	River-flat Eucalypt Forest	Dams	Gardens and footpaths
Verbenaceae	*Verbena bonariensis*	Purpletop	*	u	u	-	u
Verbenaceae	*Verbena rigida*	Veined Verbena	*	u	u	-	u
Violaceae	*Viola hederacea*	Ivy-leaved Violet	-	-	u	-	-

Key: ? – possible species identification, U= uncommon, O= occasional, C= common, #=species of conservation significance.

Fauna species recorded in study area and surrounds

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	PB 2011 Bringelly Road Upgrade REF	SKM 2012 Northern Road Upgrade REF	GHD (current)
Amphibians	-	-	-	-	-	-	-
Litoria dentata	Bleating Tree Frog	-	-	-	x	-	-
Litoria latopalmata	Broad-palmed Frog	-	-	-	x	x	-
Limnodynastes peronii	Brown-striped Frog	-	-	-	x	x	-
Crinia signifera	Common Eastern Froglet	-	-	-	x	x	x
Litoria fallax	Eastern Dwarf Tree Frog	-	-	-	x	x	-
Litoria peronii	Peron's Tree Frog	-	-	-	x	x	-
Uperoleia laevigata	Smooth Toadlet	-	-	-		x	-
Limnodynastes tasmaniensis	Spotted Grass Frog	-	-	-	x	x	-
Litoria tyleri	Tyler's Tree Frog	-	-	-	x	-	-
Uperoleia rugosa	Wrinkled Toadlet	-	-	-	-	-	x
Birds	-	-	-	-	-	-	-
Tachybaptus novaehollandiae	Australasian Grebe	-	-	-	-	x	-
Falco longipennis	Australian Hobby	-	-	-	-	x	-
Cracticus tibicen	Australian Magpie	-	-	-	x	x	x
Corvus coronoides	Australian Raven	-	-	-	x	x	-
Acrocephalus australis	Australian Reed-warbler	-	-	-	-	x	-
Threskiornis molucca	Australian White Ibis	-	-	-	x		-
Chenonetta jubata	Australian Wood Duck	-	-	-	x	x	x
Manorina melanophrys	Bell Miner	-	-	-	x	x	x
Coracina novaehollandiae	Black-faced Cuckoo-shrike	-	-	-	x	x	x
Accipiter fasciatus	Brown Goshawk	-	-	-	x	-	-
Acanthiza pusilla	Brown Thornbill	-	-	-	x	x	-

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	PB 2011 Bringelly Road Upgrade REF	SKM 2012 Northern Road Upgrade REF	GHD (current)
Cacomantis variolosus	Brush Cuckoo	-	-	-	x	-	
Ardea ibis	Cattle Egret	-	-	C, J	-	x	x
Anas castanea	Chestnut Teal	-	-	-	-	x	
Sturnus tristis	Common Myna	*	-	-	x	x	x
Sturnus vulgaris	Common Starling	*	-	-	x	x	x
Ocyphaps lophotes	Crested Pigeon	-	-	-	x	x	x
Taeniopygia bichenovii	Double-barred Finch	-	-	-	-	x	
Gallinula tenebrosa	Dusky Moorhen	-	-	-	x	x	
Platycercus eximius	Eastern Rosella	-	-	-	-	x	x
Psophodes olivaceus	Eastern Whipbird	-	-	-	-	x	
Eopsaltria australis	Eastern Yellow Robin	-	-	-	x	-	
Turdus merula	Eurasian Blackbird	*	-	-	-	-	x
Fulica atra	Eurasian Coot	-	-	-	-	-	x
Petrochelidon ariel	Fairy Martin	-	-	-	-	x	
Todiramphus macleayii	Forest Kingfisher	-	-	-	x	-	
Eolophus roseicapillus	Galah	-	-	-	x	x	x
Cisticola exilis	Golden-headed Cisticola	-	-	-	x	-	
Cracticus torquatus	Grey Butcherbird	-	-	-	x	-	x
Rhipidura albiscapa	Grey Fantail	-	-	-	x	x	x
Anas gracilis	Grey Teal	-	-	-	-	x	
Passer domesticus	House Sparrow	*	-	-	x	-	
Ardea intermedia	Intermediate Egret	-	-	-	-	x	
Gallinago hardwickii	Latham's Snipe	-	-	M	x	-	
Dacelo novaeguineae	Laughing Kookaburra	-	-	-	-	x	
Cacatua sanguinea	Little Corella	-	-	-	-	x	
Microcarbo melanoleucos	Little Pied Cormorant	-	-	-	-	x	
Anthochaera chrysoptera	Little Wattlebird	-	-	-	-	x	

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	PB 2011 Bringelly Road Upgrade REF	SKM 2012 Northern Road Upgrade REF	GHD (current)
Grallina cyanoleuca	Magpie-lark	-	-	-	-	x	x
Vanellus miles	Masked Lapwing	-	-	-	-	x	x
Dicaeum hirundinaceum	Mistletoebird	-	-	-	x	-	-
Falco cenchroides	Nankeen Kestrel	-	-	-	-	x	-
Philemon corniculatus	Noisy Friarbird	-	-	-	-	x	x
Manorina melanocephala	Noisy Miner	-	-	-	x	x	x
Oriolus sagittatus	Olive-backed Oriole	-	-	-	-	x	-
Anas superciliosa	Pacific Black Duck	-	-	-	x	x	x
Cracticus nigrogularis	Pied Butcherbird	-	-	-	-	x	-
Porphyrio porphyrio	Purple Swamphen	-	-	-	-	x	x
Trichoglossus haematodus	Rainbow Lorikeet	-	-	-	x	-	-
Anthochaera carunculata	Red Wattlebird	-	-	-	x	x	-
Neochmia temporalis	Red-browed Finch	-	-	-	x	x	-
Psephotus haematonotus	Red-rumped Parrot	-	-	-	x	x	-
Pycnonotus jocosus	Red-whiskered Bulbul	*	-	-	-	x	-
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	-	-	-	-	x	-
Zosterops lateralis	Silvereye	-	-	-	-	x	-
Pardalotus punctatus	Spotted Pardalote	-	-	-	-	x	-
Streptopelia chinensis	Spotted Turtle-Dove	*	-	-	x	-	-
Threskiornis spinicollis	Straw-necked Ibis	-	-	-	-	-	x
Pardalotus striatus	Striated Pardalote	-	-	-	-	x	-
Acanthiza lineata	Striated Thornbill	-	-	-	-	x	-
Cacatua galerita	Sulphur-crested Cockatoo	-	-	-	x	x	-
Malurus cyaneus	Superb Fairy-wren	-	-	-	x	x	x
Podargus strigoides	Tawny Frogmouth	-	-	-	-	x	-

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	PB 2011 Bringelly Road Upgrade REF	SKM 2012 Northern Road Upgrade REF	GHD (current)
Daphoenositta chrysoptera	Varied Sittella	-	V	-	x	-	-
Smicrornis brevirostris	Weebill	-	-	-	-	x	-
Hirundo neoxena	Welcome Swallow	-	-	-	x	x	x
Sericornis frontalis	White-browed Scrubwren	-	-	-	-	x	-
Egretta novaehollandiae	White-faced Heron	-	-	-	-	x	-
Melithreptus lunatus	White-naped Honeyeater	-	-	-	x	-	-
Ardea pacifica	White-necked Heron	-	-	-	-	-	x
Lichenostomus penicillatus	White-plumed Honeyeater	-	-	-	-	x	-
Gerygone olivacea	White-throated Gerygone	-	-	-	-	x	-
Hirundapus caudacutus	White-throated Needletail	-	-	M	x	-	-
Corcorax melanorhamphos	White-winged Chough	-	-	-	x	-	-
Rhipidura leucophrys	Willie Wagtail	-	-	-	x	x	x
Acanthiza nana	Yellow Thornbill	-	-	-	x	x	x
Lichenostomus chrysops	Yellow-faced Honeyeater	-	-	-	x	x	-
Gastropods	-	-	-	-	-	-	-
Austrorhytida capillacea	Common Southern Carnivorous Snail	-	-	-	-	-	x
Meridolum corneovirens	Cumberland Plain Land Snail	-	E	-	-	x	x
Mammals	-	-	-	-	-	-	-
Trichosurus vulpecula	Common Brushtail Possum	-	-	-	-	x	x
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	-	V	-	x	-	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V	-	x	-	-
Vulpes vulpes	Fox	*	-	-	-	x	-
Capra hircus	Goat	*	-	-	x	-	-

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	PB 2011 Bringelly Road Upgrade REF	SKM 2012 Northern Road Upgrade REF	GHD (current)
Nyctophilus gouldi	Gould's Long-eared Bat	-	-	-	-	x	-
Chalinolobus gouldii	Gould's Wattled Bat	-	-	-	x	x	-
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	-	x	-	-
Pteropus poliocephalus	Grey-headed Flying-fox	-	V	V	x	-	x
Vespadelus vulturnus	Little Forest Bat	-	-	-	-	x	-
Oryctolagus cuniculus	Rabbit	*	-	-	x	-	x
Myotis macropus	Southern Myotis	-	V	-	x	-	-
Petaurus breviceps	Sugar Glider	-	-	-	x	-	-
Vespadelus sp.	Unidentified Forest Bat	-	-	-	-	-	x
Tadarida australis	White-striped Freetail-bat	-	-	-	x	x	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	-	x	-	-
Reptiles	-	-	-	-	-	-	-
Eulamprus tenuis	Barred-sided Skink	-	-	-	x	-	-
Pogona barbata	Bearded Dragon	-	-	-	x	-	-
Cryptoblepharus virgatus	Cream-striped Shinning-skink	-	-	-	x	x	-
Lampropholis delicata	Dark-flecked Garden Sunskink	-	-	-	x	x	x
Tiliqua scincoides	Eastern Blue-tongue	-	-	-	x	x	-
Pseudonaja textilis	Eastern Brown Snake	-	-	-	x	-	-
Intellagama lesueurii	Eastern Water Dragon	-	-	-	-	x	-
Eulamprus quoyii	Eastern Water-skink	-	-	-	x	x	-
Lampropholis guichenoti	Pale-flecked Garden Sunskink	-	-	-	x	x	-
Pseudechis porphyriacus	Red-bellied Black Snake	-	-	-	-	x	-
Ctenotus robustus	Robust Ctenotus	-	-	-	x	-	-

Key: * - introduced; V – vulnerable, E – endangered, M – migratory, C – China-Australia Migratory Bird Agreement; J - Japan-Australia Migratory Bird Agreement; x – recorded

Appendix C Assessment of significance

Assessment of significance - Threatened Ecological Communities

River-flat Eucalypt Forest

River-flat Eucalypt Forest is listed as an endangered ecological community under the TSC Act. An assessment of significance is only required for potential impacts on this community where it is located within non-certified lands of the study area.

River-flat Eucalypt Forest is found on the river flats of the coastal floodplains. It typically has a tall open tree layer of eucalypts exceeding 40 m, however the study area contains canopy vegetation varying from 12-20 m in height.

While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include Forest Red Gum (*Eucalyptus tereticornis*), Cabbage Gum (*E. amplifolia)*, Rough-barked Apple (*Angophora floribunda)* and Broad-leaved Apple (*A. subvelutina*) (OEH, 2015b). Additional canopy species recorded in RFEF within the study area include Thin-leaved Stringybark (*Eucalyptus eugenioides*), Grey Box (*Eucalyptus moluccana*) and Swamp Oak (*Casuarina glauca*).

The community is associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. River-flat Eucalypt Forest generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees (OEH, 2015b).

There would be no direct impacts on River-flat Eucalypt Forest within non-certified land. The proposal may contribute to indirect impacts to this community through the further spread of weeds, sedimentation and introduction of pollutants. Environmental safeguards would be implemented to minimise the potential for these indirect impacts (see Figure 4.1).

Section 5A Assessment: River-flat Eucalypt Forest on Coastal Floodplains
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to this threatened ecological community.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable to this threatened ecological community.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
A small area of this vegetation community is located in non-certified land in the north of the study area at Thompsons Creek. There would be no direct impacts on River-flat Eucalypt Forest within non-certified land. This community extends along Thompsons Creek for a number of kilometres in a north-easterly direction. Potential indirect impacts along a disturbed edge would not place the local occurrence at risk of extinction.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Section 5A Assessment: River-flat Eucalypt Forest on Coastal Floodplains

The proposal has the potential to indirectly impact River-flat Eucalypt Forest adjacent to the proposal site through erosion and sedimentation runoff downslope of the construction works, potential pollution through chemical spills, and spread of weeds. Within the study area and adjoining areas, this ecological community has been degraded through historic and ongoing disturbances. River-flat Eucalypt Forest at this location is a narrow linear strip of vegetation along Thompsons Creek. The vegetation that would be impacted is already highly disturbed through edge effects as a result of adjacent cleared land, rubbish, erosion from scour, and runoff from The Northern Road.

Occurrences of this community consist of thin linear strips of canopy trees over an understorey typically dominated by exotic species due to nutrient enrichment and weed dispersal from surrounding residential and agricultural areas. Vegetation is heavily infested by exotic species such as Madeira Vine (*Anredera cordifolia*), Moth Vine (*Araujia sericifera*), Bridal Creeper (*Asparagus asparagoides*), Prairie Grass (*Bromus catharticus*) Rhodes Grass (*Chloris gayana*), Blackberry (*Rubus fruiticosus* sp. agg.), Panic Veldtgrass (*Ehrharta erecta*), African Lovegrass (*Eragrostis curvula*), African Boxthorn (*Lycium ferocissimum*), Curled Dock (*Rumex crispus*), Fireweed (*Senecio madagascariensis*) and Wandering Jew (*Tradescantia fluminensis*).

In this context, any indirect impacts on this community would be unlikely to alter the composition of adjoining retained vegetation such that the local occurrence of this community would be placed at risk of extinction.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

There would be no direct impacts on River-flat Eucalypt Forest within non-certified land. Indirect impacts such as further spread of weeds, sedimentation and introduction of pollutants may occur as a result of the proposal. The vegetation present in the proposal site represents a very small component of the mapped occurrence of this community within the locality (NPWS 2002). Given there would be no direct impacts and the area that may be indirectly impacted is very small and is already exposed to edge effects, the modification of a small area of this community is unlikely to impact the long-term survival of the community within the locality.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action

Vegetation in the study area is highly fragmented and largely isolated from extensive patches of vegetation within the locality by roads and cleared agricultural land. There would be no direct impacts on River-flat Eucalypt Forest within non-certified land, and thus no area of this community would become fragmented or isolated.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

As previously discussed, the area of this community that may be modified has been subject to historic and ongoing degradation. The vegetation is highly modified, and comprises the edge of a narrow linear fragment already subject to edge effects and erosion. Given the highly disturbed nature of the very small area that is located within the non-certified portion of the study area, this vegetation is not important to the long-term survival of the community in the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There is no critical habitat listed for this threatened ecological community.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

No stand-alone recovery plan has been developed for this community; instead it is included within the Cumberland Plain Recovery Plan (DECC, 2010). The overall objective of this recovery plan is to provide for the long-term survival and protection of threatened biota within the Cumberland Plain. There would be no direct impacts on River-flat Eucalypt Forest within non-certified land. Possible indirect impacts along a highly disturbed edge are unlikely to interfere with the recovery of this community. Mitigation measures to minimise indirect impacts would be included in the CEMP.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

Section 5A Assessment: River-flat Eucalypt Forest on Coastal Floodplains

The proposal has the potential to introduce or increase the operation of the following KTPs within this community through soil disturbance and increased visitation to the area:

- Invasion of native plant communities by exotic perennial grasses.
- Infection of native plants by *Phytophthora cinnamomi.*
- Infection of native frogs by amphibian chytrid causing the disease chytridiomycosis.

River-flat Eucalypt Forest within the non-certified land is already subject to weed invasion from adjoining agricultural and residential areas. The proposal is unlikely to influence the introduction or further spread of exotic species, given their dominance throughout the study area in the understorey of most occurrences of native vegetation.

Mitigation measures to minimise indirect impacts would be included in the CEMP.

Conclusion of Assessment of Significance for River-flat Eucalypt Forest

The proposal is highly unlikely to result in a significant impact on River-flat Eucalypt Forest within non-certified land within the study area, pursuant to s.5A of the EP&A Act given:

- There would be no direct impacts on River-flat Eucalypt Forest within non-certified land
- Indirect impacts would occur along an already modified and disturbed edge.

Consequently, the proposal will not have a significant impact on the local occurrence of the community and a SIS is not required.

Potential indirect impacts from construction in the adjoining proposal site would be minimised through environmental safeguards.

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