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ARTC InlandRail

Inland Rail Programme

Narrabri to North Star Project

Environmental Impact Statement

Technical Report 1: **Traffic, Transport and Access Assessment**

Technical Report 2: **Biodiversity Assessment Report**

Image: Newell Highway north of Narrabri, NSW

Technical Report 2:
Biodiversity Assessment Report

Image: Railway near Edgeroi, NSW

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AUSTRALIAN RAIL TRACK CORPORATION
INLAND RAIL – NARRABRI TO NORTH STAR EIS

Biodiversity Assessment Report
IR Document Number: 02-2600-PE-P11-DE-0060

FINAL

October 2017

AUSTRALIAN RAIL TRACK CORPORATION INLAND RAIL – NARRABRI TO NORTH STAR EIS

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FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Australian Rail Track Corporation

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Report No. 3607/R05/Final
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This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Executive Summary

The Australian Government has committed to building a significant new piece of national transport infrastructure by constructing an inland railway between Melbourne and Brisbane, via central-west New South Wales (NSW) and Toowoomba in Queensland. The Inland Rail project ('Inland Rail') is a major national project that will enhance Australia's existing national rail network and serve the interstate freight market. This report relates to the Narrabri to North Star section of Inland Rail.

The proposal will involve upgrading the existing rail line between Narrabri and North Star including upgrading the existing track and track formation, replacing culverts and bridges, constructing five new crossing loops, rationalising and upgrading level crossings, curve easing and other ancillary works.

This Biodiversity Assessment Report (BAR) has been prepared on behalf of the Australian Rail Track Corporation (ARTC) to assess the potential ecological impacts of the proposal in accordance with the *Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major proposals (FBA)*.

The BioBanking Credit Calculator (BBCC) was applied following extensive literature reviews, the identification of relevant landscape features and detailed flora and fauna field surveys undertaken in September 2014, July and December 2015 and February and April 2016 of the Development Site, in accordance with the Framework for Biodiversity Assessment (FBA) (OEH 2014a).

Following the application of appropriate avoidance and mitigation measures, the BioBanking Assessment identified the following biodiversity features and subsequent credits required to offset the impacts of the proposal:

- 18,826 ecosystem credits for eight plant community types occurring within the Development Site including impacts on eight threatened ecological communities (TECs)
- 364 species credits for finger panic grass (*Digitaria porrecta*)
- 2607 species credits for creeping tick-trefoil (*Desmodium campylocaulon*)
- 1898 species credits for Belson's panic (*Homopholis belsonii*) and
- 1632 species credits for koala (*Phascolarctos cinereus*).

An offset strategy is being developed for the proposal in accordance with the FBA to satisfy these credit requirements.

Glossary

BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BBCC	BioBanking Credit Calculator
Buffer Area	550 metre buffer established along each side of the centre line of a linear shaped development footprint.
BVT	Biometric Vegetation Type
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority
DECC	NSW Department of Environment and Climate Change (now OEH)
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
Development Footprint	The area of permanent impact within the Development Site.
Development Site	The total impact zone associated with the proposal which incorporates both permanent and temporary disturbance.
DNG	Derived Native Grassland
DoEE	Commonwealth Department of the Environment and Energy
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (now DoEE)
Ecosystem credit	a measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
Existing rail corridor	The corridor within which existing rail infrastructure, subject to works as part of Inland Rail, are located. The existing rail corridor is defined by ARTC to mean everywhere within 15 metres of the outermost rails; or within the boundary fence where boundary fences are provided and are closer than 15 metres; or if the property boundary is less than 15 metres, the property boundary; or a permanent structure such as a fence, wall or level crossing separating the operating rail corridor from eased or non-operational land.
FBA	Framework for Biodiversity Assessment
FM Act	*Fisheries Management Act 1994* (NSW)
GIS	Geographical Information System
Greenfield	Previously undeveloped sites for commercial development or exploitation
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
IR	Inland Rail
KP	Kilometre point (rail line kilometrage)

LGA	Local Government Area
LPI	Land and Property Information
MGA	Map Grid of Australia
MNES	Matters of National Environmental Significance
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
SAT	Spot Assessment Technique
Species credit	the class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Species Profile Database.
SSI	State Significant Infrastructure
SWMP	Soil and water management sub-plan
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
TSPD	Threatened Species Profile Database
VIS	Vegetation Information System
WoNS	Weed of National Significance

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1.0 Introduction

1.1 Overview

The Australian Government has committed to delivering a significant piece of national transport infrastructure by constructing a high performance and direct interstate freight rail corridor between Melbourne and Brisbane. The Inland Rail programme (Inland Rail) involves the design and construction of a new inland rail connection, about 1,700 kilometres long, between Melbourne and Brisbane. Inland Rail is a transformational rail infrastructure initiative that will enhance Australia's existing national rail network and serve the interstate freight market.

Australian Rail Track Corporation Ltd (ARTC) is seeking approval to construct and operate the Narrabri to North Star section of Inland Rail ('the proposal'), which consists of 188 kilometres of upgraded rail track and associated facilities.

The proposal requires approval from the NSW Minister for Planning under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposal is also a controlled action under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), and requires approval from the Australian Minister for the Environment and Energy.

This report has been prepared by Umwelt (Australia) Pty Limited (Umwelt) as part of the environmental impact statement (EIS) for the proposal. The EIS has been prepared to accompany the application for approval of the proposal, and addresses the environmental assessment requirements of the Secretary of the Department of Planning and Environment (the SEARs), issued on 8 November 2016.

1.2 The Proposal

1.2.1 Location

The proposal is generally located in the existing rail corridor between the town of Narrabri and the village of North Star, via Moree. The location of the proposal is shown in **Figure 1.1**.

1.2.2 Key Features

The key features of the proposal involve:

- upgrading the track, track formation, and culverts within the existing rail corridor for a distance of 188 kilometres between Narrabri and North Star
- realigning the track where required within the existing rail corridor to conform with required platform clearances for Inland Rail trains
- providing five new crossing loops within the existing rail corridor, at Bobbiwaa, Waterloo Creek, Tycannah Creek, Coolleearllee, and Murgo
- providing a new section of rail line at Camurra, about 1.6 kilometres long, to bypass the existing hairpin curve (the Camurra bypass)
- removing the existing bridges and providing new rail bridges over the Mehi and Gwydir Rivers and Croppa Creek

- realigning about 1.5 kilometres of the Newell Highway near Bellata, and providing a new road bridge over the existing rail corridor (the Newell Highway overbridge)

- providing a new road bridge over the existing rail corridor at Jones Avenue in Moree (the Jones Avenue overbridge).

The key features of the proposal are shown in **Figure 1.2**.

Ancillary work would include works to level crossings, signalling and communications, signage and fencing, and services and utilities.

Further information on the proposal is provided in the EIS.

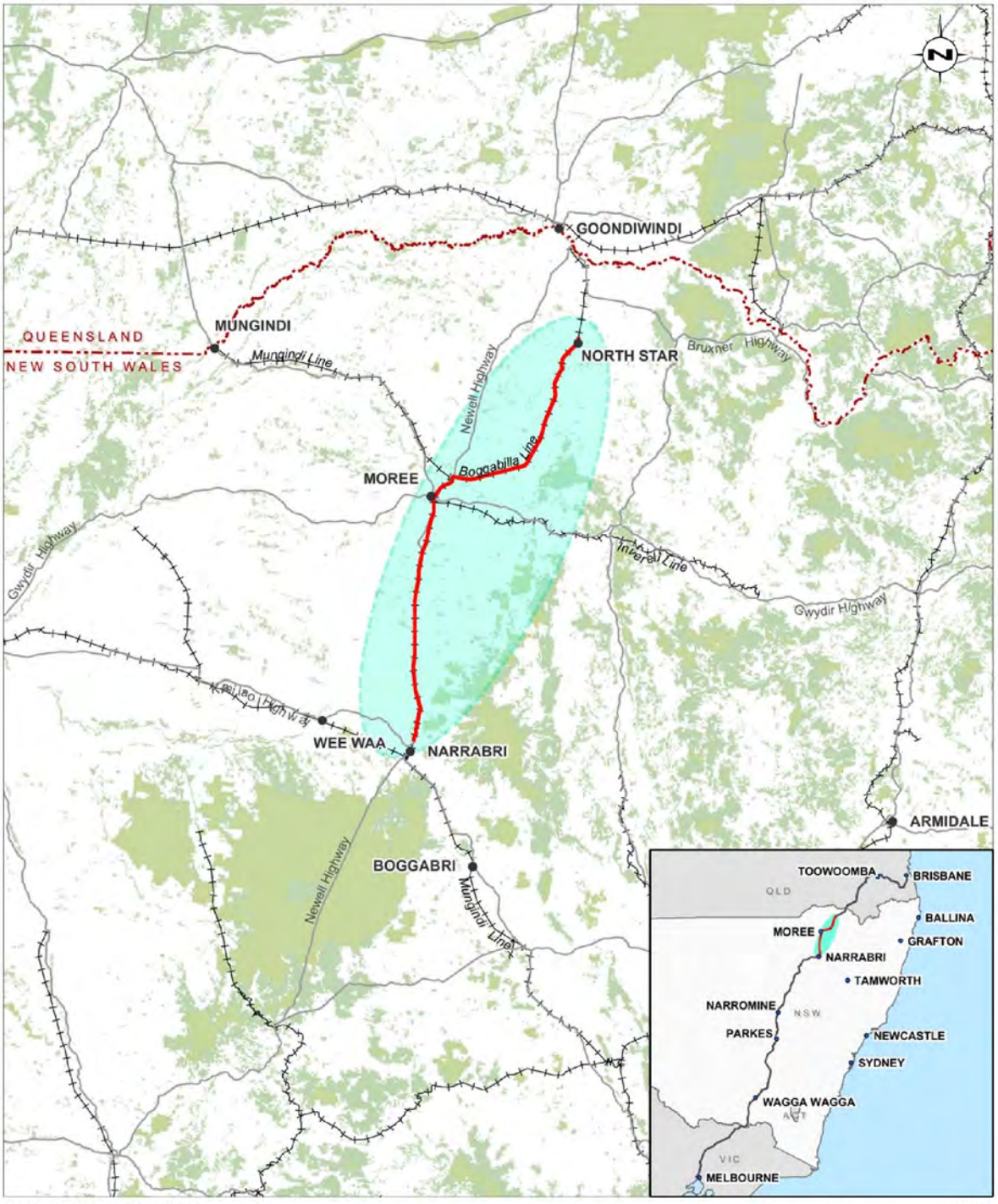
1.2.3 Timing

Subject to approval of the proposal, construction is planned to start in early to mid 2018, and is expected to take about 24 months. Existing train operations along the Narrabri to North Star line would continue prior to, during, and following construction. Inland Rail as a whole is expected to be operational in 2025.

1.2.4 Operation

Prior to the opening of Inland Rail as a whole, the proposal would be used by existing rail traffic, which includes trains passengers and grain at an average rate of about four trains per day. It is estimated that the operation of Inland Rail would involve an annual average of about 10 trains per day travelling north of Moree (between North Star and Moree) and 12 trains per day travelling south of Moree (between Moree and Narrabri) in 2025. This would increase to about 19 trains per day north of Moree (between North Star and Moree) and 21 trains per day south of Moree (between Moree and Narrabri) in 2040. The trains would be a mix of grain, intermodal (freight), and other general transport trains.

Once operational in 2020, the proposal would enable increased train running speeds in many areas that are currently the subject of restrictions due to local track conditions. Daily average train volumes are not expected to significantly change until Inland Rail through connection in 2025.



LEGEND

- Proposal site
- Proposal location
- Main road
- Railway
- State border

FIGURE 1.1

Location of the Proposal

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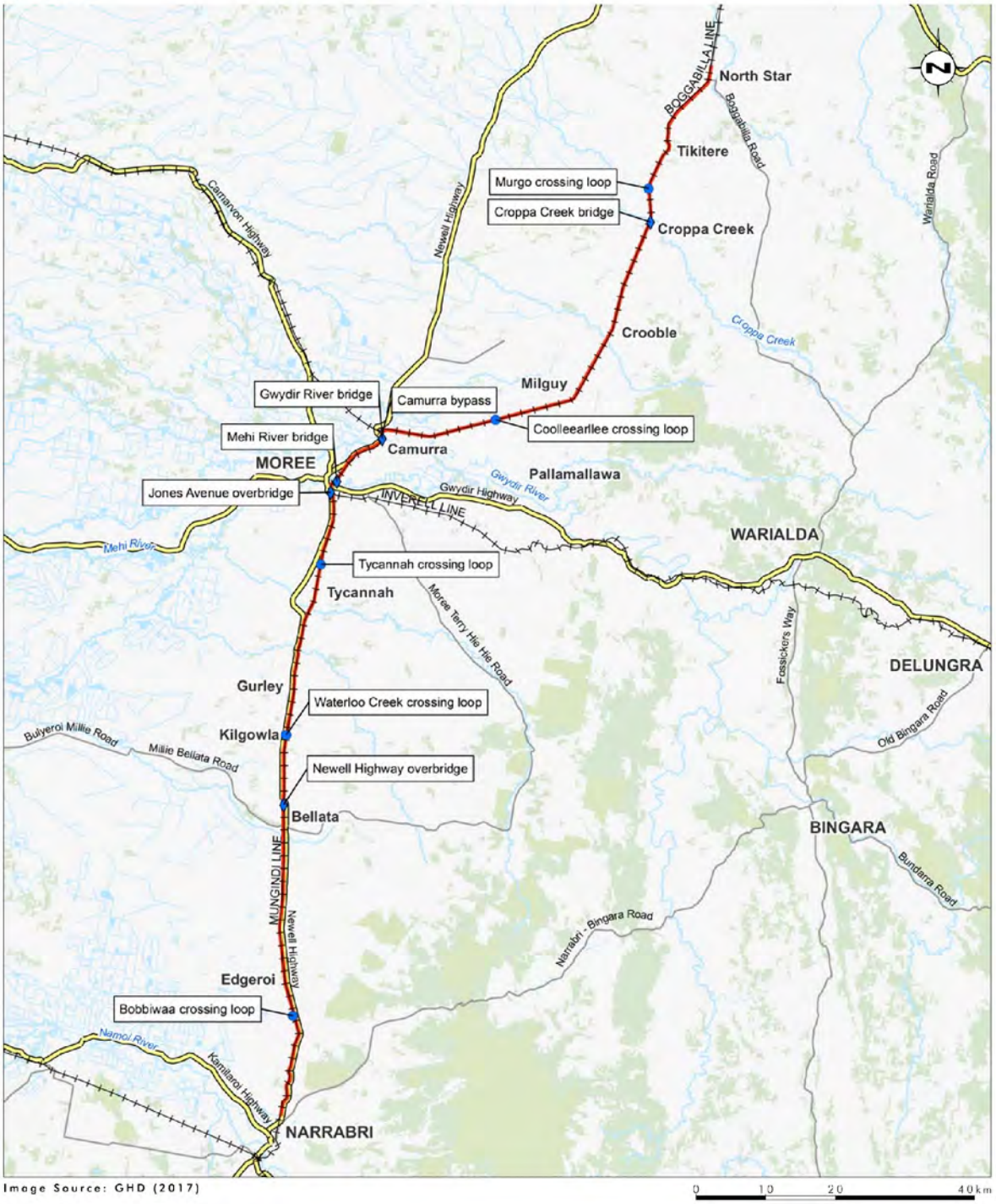

Image Source: GHD (2017)

LEGEND

- New bridge
- Crossing loop
- The proposal
- Railway
- Highway
- Road

FIGURE 1.2

Key Features of the Proposal

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1.3 Purpose and Scope of this Report

The purpose of this report is to assess potential biodiversity issues from the operation and construction of the proposal, and where required, identify feasible and reasonable mitigation measures.

This Biodiversity Assessment Report (BAR) has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs). **Table 1.1** outlines the requirements relevant to this assessment.

The structure and content of the report has been specifically designed to meet the requirement of the NSW Biodiversity Offsets Policy for Major Projects: Framework for Biodiversity Assessment (FBA) and has been prepared in accordance with that policy.

Table 1.1 SEARs Related to Biodiversity Assessment Report and OEH Submission on SEARs

Requirements for Biodiversity	Where addressed in this report
SEARs	
1. The Proponent must assess biodiversity impacts in accordance with the current guidelines including the Framework for Biodiversity Assessment (FBA).	Throughout this BAR
2. The Proponent must assess any impacts on biodiversity values not covered by the FBA as specified in s2.3	Section 5.7
3. The Proponent must assess impacts on the EECs, threatened species and/or populations as listed in Attachment B and provided the information specified in s9.2 of the FBA.	Section 5.4
4. The Proponent must identify whether the project as a whole, or any component of the project, would be classified as a Key Threatening Process in accordance with the listing in the *Threatened Species Conservation Action 1995* (TSC Act), *Fisheries Management Act 1994* (FM Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).	Section 5.5
OEH Submission	
1. Biodiversity impacts related to the proposed project are to be assessed and documented in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995*.	Throughout this BAR
2. Impacts on the species and ecological communities listed in Attachment B will require further consideration and provision of the information specified in s9.2 of the Framework for Biodiversity Assessment.	Section 5.4

Requirements for Biodiversity	Where addressed in this report
Attachment B – Species/Populations/Ecological Communities which require further consideration. • *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC* under the TSC and EPBC Acts, • *Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South Bioregions EEC* under the TSC Act, • *Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC* under the TSC Act, • *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions EEC* under the TSC Act, • *Marsh Club-rush sedgeland in the Darling Riverine Plains Bioregion CEEC* under the TSC Act, • *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions EEC* under the TSC and EPBC Acts, • *Native Vegetation on Cracking Clay Soils of the Liverpool Plains EEC under the TSC Act and CEEC* under the EPBC Act, • *White Box Yellow Box Blakely's Red Gum Woodland EEC under the TSC Act and CEEC* under the EPBC Act, • large-eared pied bat (*Chalinolobus dwyeri*) vulnerable under the TSC and EPBC Acts, • five-clawed worm-skink (*Anomalopus mackayi*) endangered under the TSC Act and vulnerable under the EPBC Acts, • pale imperial hairstreak (*Jalmenus eubulus*) critically endangered under the TSC Act, • ooline (*Cadellia pentastylis*) vulnerable under the TSC and EPBC Acts, • *Cyperus conicus* endangered under the TSC Act, • creeping tick-trefoil (*Desmodium campylocaulon*) endangered under the TSC Act, • bluegrass (*Dichanthium setosum*) vulnerable under the TSC and EPBC Acts, • finger panic grass (*Digitaria porrecta*) endangered under the TSC Act, • Belson's panic (*Homopholis belsonii*) endangered under the TSC Act and vulnerable under the EPBC Act, • spiny peppercress (*Lepidium aschersonii*) vulnerable under the TSC and EPBC Acts, • native milkwort (*Polygala linariifolia*) endangered under the TSC Act, • scant pomaderris (*Pomaderris queenslandica*) endangered under the TSC Act, and • *Tylophora linearis* vulnerable under the TSC Act and endangered under the EPBC Act.	Section 5.4

Specifically this assessment:

- describes the existing terrestrial environment of the Development Site in terms of its ecological values, including type and condition of vegetation communities and terrestrial habitats
- identifies flora and fauna species and ecological communities within the Development Site that have the potential to be impacted by the proposal
- determines the presence or likelihood of occurrence of threatened flora and fauna species and populations and Threatened Ecological Communities (TECs) listed under the *Threatened Species Conservation Act 1995* (TSC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- calculates the offset credit requirements for ecosystem credits and species credits generated as a result of the permanent impacts of the proposal in accordance with the FBA (OEH 2014a).

The FBA process requires the calculation of biodiversity credits using a NSW Government credit calculator. The credits calculated and presented in this report have been prepared based on a proposal site (refer to **Appendix A**). It is noted that since this time, a range of alterations to the proposal were made following completion of further technical assessments and engineering design of the proposal which result in some changes to the proposal site. For this reason the proposal site used in this assessment, whilst substantially similar to the final proposal site, is different to that described in the remainder of the EIS. It is expected that the final credit generation for the proposal will be confirmed as an outcome of the detailed design process and that biodiversity offsetting for the proposal will be based on the final credit calculations.

The FBA requires specific terminology to be used to describe the site and impact area being assessed in an FBA report. For this reason the terminology in this report which is FBA specific differs from that used in the EIS. To avoid any doubt, **Table 1.2** below compares the terminology.

Table 1.2 Comparison of BAR and EIS Terminology

FBA Terminology	EIS Terminology
Development Site	Proposal site and the Additional Assessment Area
Development Footprint	Proposal site

It is noted that the SEARs specifically relating to Commonwealth Matters of National Environmental Significance (MNES) are addressed in the *ARTC Inland Rail – Narrabri to North Star Commonwealth Matters Assessment* (Umwelt 2017).

1.4 Development Site Information

For the purposes of this BAR, for the proposal represents the area shown on **Figure 1.3**. The Development Footprint comprises the portion of the Development Site that will be subject to permanent impact and for which ecosystem and threatened species credits have been calculated in accordance with the FBA. The Development Site will be subjected to a range of permanent and temporary disturbances as outlined in **Section 4.3** and **Section 4.4**. The Development Site is shown on the figures in **Appendix A**.

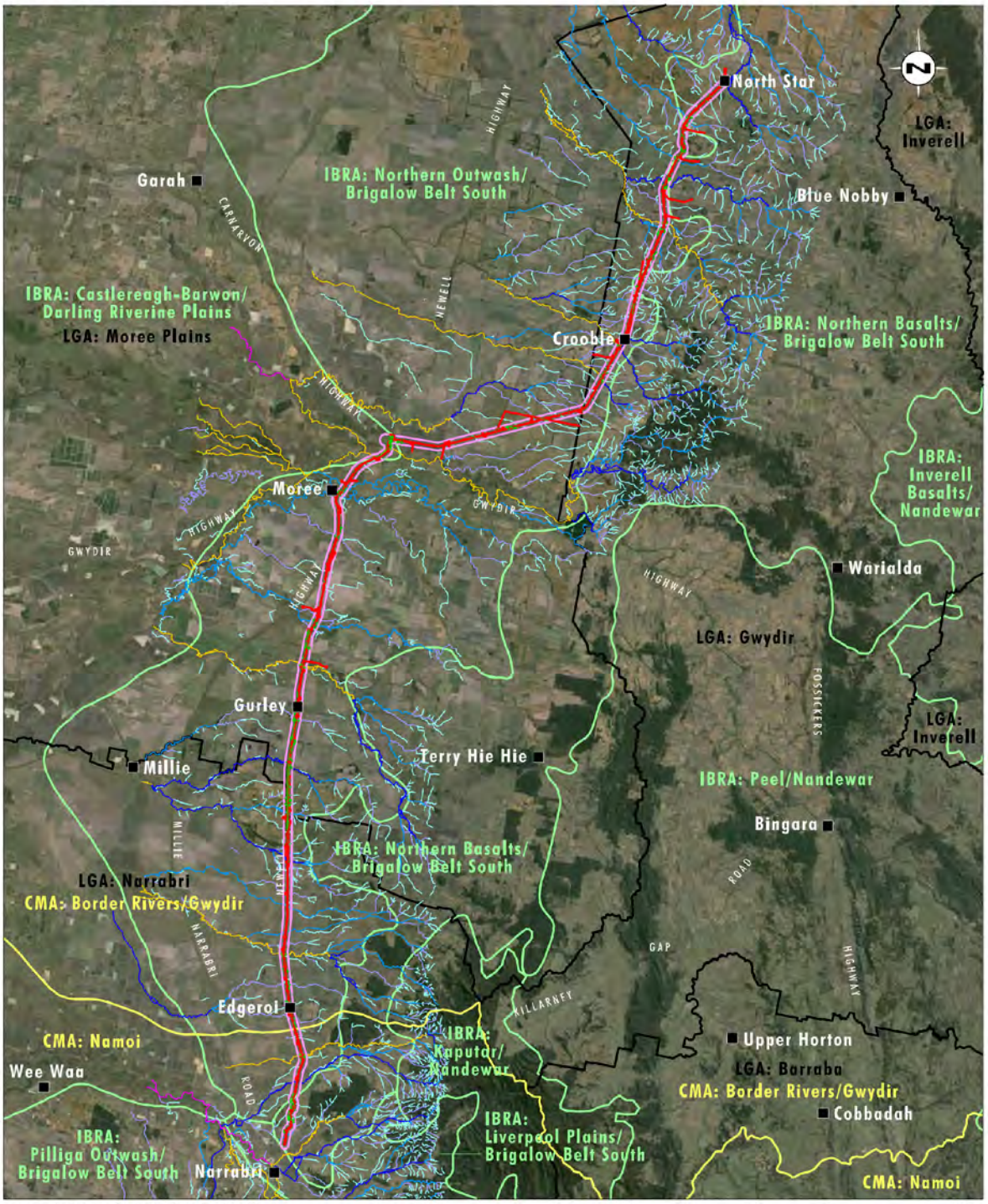

Image Source: Google Earth (2013)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014), Umwelt (2016)

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Legend

- Development Site
- 550m Buffer Area
- IBRA Regions and Subregion Areas
- Local Government Area
- Catchment Management Authority
- Native Vegetation Area
- Town Location

Stream Order:
- 1st Order
- 2nd Order
- 3rd Order
- 4th Order
- 5th Order
- 6th Order

FIGURE 1.3

Narrabri to North Star Development Site Features

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1.4.1 Location

The proposal will generally be located within the rail corridor between Narrabri and North Star in north-western NSW (refer to **Figure 1.2**). It traverses three local government areas (LGAs), with the southern section of the proposal located in the Narrabri LGA, the middle section in the Moree Plains LGA, and the northern section in the Gwydir LGA. The three LGAs are predominantly rural, with the main local industries based around agriculture (mainly cotton and grains) and grazing. Moree Plains and Gwydir Shire both adjoin the NSW-Queensland border.

The Development Site is generally defined by fences located approximately 20 metres either side of the rail line, however in some sections where fences are not present the Development Site may be wider, extending out to about 30 to 40 metres from the rail line or wider where site compounds are proposed. The Development Footprint varies along the length of the proposal depending on the construction activities that are proposed in any given area.

Table 1.3 Development Site Location in the Landscape

Narrabri to North Star	
IBRA Bioregions	Brigalow Belt South Darling Riverine Plains
IBRA Subregions	Northern Basalts Northern Outwash Castlereagh-Barwon
Major Catchment Areas	Border Rivers Gwydir Namoi
Mitchell Landscapes	Belata Sands Croppa Clay Plains Croppa Creek Channels and Floodplains Gwydir Alluvial Plains Gwydir Channels and Floodplains Kaputar Slopes Liverpool Alluvial Plains Namoi Channels and Floodplains Yallaroi Basalts
LGAs	Gwydir Moree Plains Narrabri

1.4.2 Size

The Development Site covers approximately 1,563 hectares.

1.4.3 Topography and Natural Features

The Development Site is typical of the Border Rivers/Gwydir and Darling Riverine Plains Bioregions. The southern end of the Development Site is located immediately north of Narrabri on an embankment above the Namoi River. The alignment traverses the Gwydir River floodplain. The northern end at North Star is located south of the Macintyre River within the Border Rivers basin. The proposal crosses 90 watercourses. These include rivers (Mehi River and Gwydir River), creeks (such as Mulgate Creek, Bobbiwa Creek, Gehan Creek, Tookey Creek and Gil Gil Creek) and other intermittent watercourses and canals constructed to convey irrigation waters.

Part of the Development Site crosses an alluvial floodplain associated with the Mehi River and the Gwydir River. The terrain in this area is typically near level to gently undulating. Further sections of the Development Site are located in the Gunnedah Basin crossing the Goondiwindi thrust fault into the New England Fold Belt east of Camurra. The subsurface conditions of the Gunnedah Basin are dominated by Quaternary and Tertiary aged river plain sediments including black and red clayey silt and black and yellow brown clay soils. Exceptions to this include the Jurassic aged clayey sandstone unit north of Narrabri and partially consolidated polymictic gravel around Bellata. East of the Goondiwindi fault, variable soil conditions are mapped including deep reactive clays, basaltic soils, and red brown sandy and silty clay soils. Tertiary aged mafic volcanics outcrop intermittently from south of Moree to North Star.

Patches of native vegetation exist sporadically within the Development Site and are typically associated with riparian corridors, Travelling Stock Reserves (TSRs), road reserves or farm woodland remnants. These patches generally comprised a woodland community with the dominant canopy species including bimble box (*Eucalyptus populnea*), belah (*Casuarina cristata*), silver-leaved ironbark (*Eucalyptus melanophloia*) and white cypress pine (*Callitris glaucophylla*). Extensive areas of natural grasslands also exist in the Development Site.

The majority of the Development Site has been heavily modified by past and ongoing disturbances associated with the rail corridor and surrounding agricultural activities. Clearance and maintenance of the rail corridor has resulted in the fragmentation and subsequent high level of disturbance and degradation of vegetation communities within the rail corridor.

1.5 Key Resources, Policies and Documents

The following key resources, policies and documents were used to prepare the Biodiversity Assessment Report for the proposal:

- Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major proposals (OEH 2014a)
- Credit Calculator for Major Projects and BioBanking Operational Manual (OEH 2016a)
- BioBanking Assessment Methodology 2014 (OEH 2014b)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities –Working Draft (DEC 2004)
- BioBanking Credit Calculator (Major Project Assessment Type) (BBCC 2016), accessed in May 2016
- OEH Threatened Species Profile Database (TSPD) (OEH 2016b), assessed between April and July 2016
- Vegetation Information System (VIS) Classification Database (OEH 2016c), accessed between April and July 2016

- BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2016d), accessed in April 2016
- Department of the Environment and Energy (DoEE) Protected Matters Database (DoEE 2016a), accessed in April 2016 and March 2017
- NSW Guide to Surveying Threatened Plants (OEH 2016e).

1.6 Report Preparation

This BAR was prepared by Ryan Parsons (Senior Ecologist) and Kate Connolly (Senior Ecologist), with review and technical direction from Allison Riley (Principal Ecologist). Field surveys were led by Ryan Parsons and Amy Nelson (Ecologist). Ryan, Kate, Allison and Amy are all accredited under the TSC Act as BioBanking and BioCertification Assessors.

1.6.1 Structure of the Report

The structure of the report is outlined below:

- Section 1 – provides the introduction to the report
- Section 2 – outlines the methods used in the assessment
- Section 3 - outlines the results of the field surveys and biobanking credit calculator application
- Section 4 – describes the avoidance measures implemented and minimisation of impacts as part of the proposal
- Section 5 – provides a summary of impacts in accordance with the FBA
- Section 6 – summarises the biodiversity offsetting options for the proposal
- Section 7 – provides a list of references used throughout the report and assessment.

2.0 Methods

As discussed in **Section 1.3**, the FBA process requires the calculation of biodiversity credits using a NSW Government credit calculator. The credits calculated and presented in this report have been prepared based on a proposal site (refer to **Appendix A**). It is noted that since this time, a range of alterations to the proposal were made following completion of further technical assessments and engineering design of the proposal which result in some changes to the proposal site. For this reason the proposal site used in this assessment, whilst substantially similar to the final proposal site, is different to that described in the remainder of the EIS. It is expected that the final credit generation for the proposal will be confirmed as an outcome of the detailed design process and that biodiversity offsetting for the proposal will be based on the final credit calculations.

2.1 Assessment Approach

The long linear nature of the Development Site meant that multiple regions within the landscape were crossed. The FBA methodology and credit calculator is based on assessing a Development Site within specific regions. Overall the Development Site crosses the following regions:

- **Catchment Management Authority (CMA) boundaries:**
    - Border Rivers/Gwydir
    - Namoi
- **Local Government Areas (LGA):**
    - Gwydir
    - Moree Plains
    - Narrabri
- **Interim Biogeographic Regionalisation of Australia (IBRA):**
    - Brigalow Belt South
    - Darling Riverine Plains
- **IBRA Subregions:**
    - Northern Basalts
    - Northern Outwash (note that for the Namoi CMA assessment this IBRA subregion is not available for selection in the BBCC, instead the Liverpool Plains part B CMA subregion was selected as it equates to the same geographical area)
    - Castlereagh-Barwon

- **Mitchell Landscapes:**
    - Belata Sands
    - Croppa Clay Plains
    - Croppa Creek Channels and Floodplains
    - Gwydir Alluvial Plains
    - Gywdir Channels and Floodplains
    - Kaputar Slopes
    - Liverpool Alluvial Plains
    - Namoi Channels and Floodplains
    - Yallaroi Basalts.

OEH BioBanking expert John Seidel was consulted regarding the most appropriate assessment approach where multiple regions are intersected by a linear Development Site. It was recommended that for each combination of the CMA and IBRA subregion a separate FBA assessment should be undertaken as these are the most important regions to consider according to the FBA Methodology. In order to enter the vegetation communities into the BBCC a Biometric Vegetation Type (BVT) needs to be assigned which is based on the CMA area. The IBRA subregion is used to filter the species-credit species which are required to be surveyed and assessed. As a result each combination of the CMA and IBRA subregion require a separate assessment, comprising the following:

- Assessment 1 – Namoi CMA and Northern Basalts IBRA Subregion
- Assessment 2 – Namoi CMA and Northern Outwash IBRA Subregion
- Assessment 3 – Border Rivers/Gwydir CMA and Northern Outwash IBRA Subregion
- Assessment 4 – Border Rivers/Gwydir CMA and Castlereagh-Barwon IBRA Subregion
- Assessment 5 – Border Rivers/Gwydir CMA and Northern Basalts IBRA Subregion.

In addition, it was recommended by OEH that the landscape value assessment be completed for the whole Development Site rather than for each individual assessment area. The six Mitchell landscapes intersected by the Development Site are assessed in the landscape value assessment by entering the largest patch size for each Mitchell Landscape. The other regions including LGA and IBRA region are not important in an FBA Assessment.

It was also confirmed by OEH that plot/transect data collected from within the Development Site across the range of CMA and IBRA subregions could be used to undertake each of the three separate assessments described above, irrespective of where in the Development Site the data was collected. This approach allows plot/transect data collected for each vegetation zone delineated within the Development Site to be used in each of the adjacent BBCC assessments, with additional replicate sampling in accordance with the minimum plot/transects (refer to **Table 2.1**) per vegetation zone not required.

Figure 2.1 shows the location of the five assessment areas.

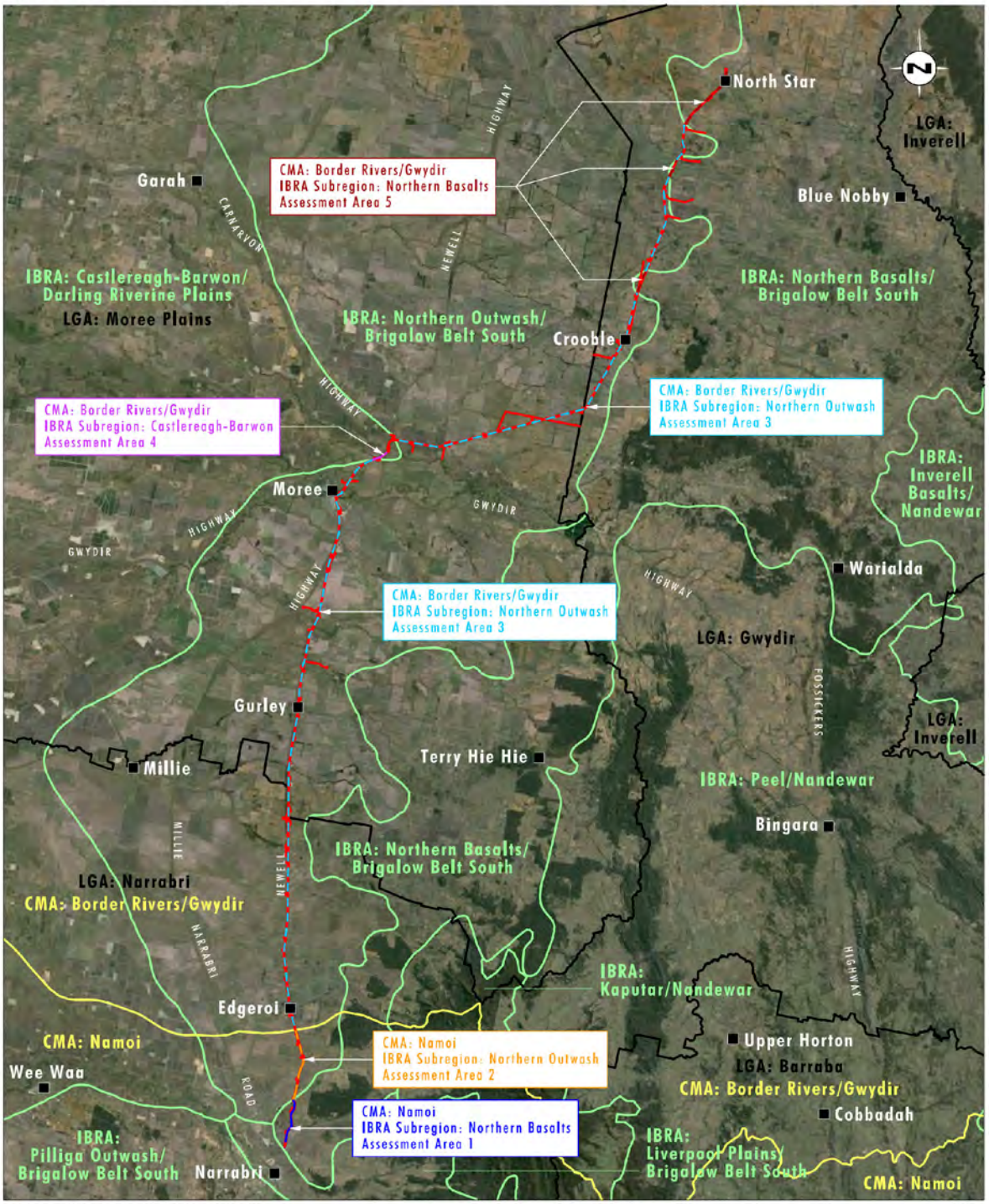

Image Source: Google Earth (2013)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014), Umwelt (2016)

0 10 20 40km
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Legend

- Development Site
- IBRA Regions and Subregion Areas
- Local Government Area
- Catchment Management Authority
- Town Location

FIGURE 2.1

Assessments Undertaken in the Biodiversity Assessment Report (BAR)

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2.2 Landscape Features

2.2.1 Identifying Landscape Features

Landscape features within the Development Site and the 550 metre buffer area were determined through reviewing aerial photography and relevant GIS layers. For linear developments, the FBA (OEH 2014a) requires a 550 metre buffer area of the Development Site located from the centre line of the linear development (refer to Figures A1-A56 in **Appendix A**). Landscape features that were reviewed included:

- IBRA bioregions and IBRA subregions
- Mitchell landscapes
- rivers, streams and estuaries (using the Strahler (1952) ordering system) at 1:50,000 scale
- wetlands
- native vegetation extent
- state and/or regional biodiversity links.

2.2.2 Determining Landscape Value

Determining the 'Landscape Value' of the Development Site (linear-based developments) is calculated by assessing the following landscape attributes:

- current and future percent native vegetation cover
- connectivity value
- patch size
- change in area to perimeter ratio.

For this proposal, and in accordance with Appendix 5 of the FBA (OEH 2014a), the buffer area was established 550 metres either side of the centre of the rail line within the Development Site.

2.2.2.1 Percent Native Vegetation Cover

'Percent Native Vegetation Cover' is determined by the current percent native vegetation cover and the future percent native vegetation cover within the buffer area. This was determined using digital aerial photography interpretation using the Manifold GIS software package. Aerial photographs captured during 2014-2015 were used to digitise all native woody vegetation within the buffer area. Further refinement of these areas was undertaken following field surveys of the Development Site.

2.2.2.2 Connectivity Value

To determine the connectivity value, the Development Site was assessed for the presence of native vegetation connecting links, state, regional or local biodiversity links as required by the FBA (OEH 2014a).

Connecting links are present when an area of native vegetation in a Development Site adjoins native vegetation surrounding the site and it is:

- in moderate to good condition, and
- has a patch size of > 1 hectare, and
- is separated by a distance of < 100 metres (or ≤ 30 metres for non-woody ecosystems), and
- is not separated by a large waterbody, dual carriageway, wider highway or similar hostile link.

Connectivity value scores are determined based on the following connecting links, as defined in Table 17 of Appendix 5 of the FBA (OEH 2014a):

- State significant biodiversity link
- regionally significant biodiversity link
- very large area biodiversity link
- large area biodiversity link
- local area biodiversity link.

2.2.2.3 Patch Size

A 'Patch' is an area of native vegetation that:

- occurs on the Development Site, and
- is in moderate to good condition, and
- includes native vegetation that has a gap of less than 100 metres from the next area of moderate to good condition native vegetation (or ≤ 30 metres for non-woody vegetation).

For linear-based developments, the patch size is calculated for each Mitchell Landscape occurring within the Development Site. The patch may extend onto adjoining land that is not part of the Development Site. An assessment of the patch size class and the patch size score was then determined using Table 18 of the FBA (OEH 2014a).

2.2.2.4 Change in Area to Perimeter Ratio

The change in area to perimeter ratio was calculated by selecting all patches of native woody vegetation greater than 1 hectare in size within the 550 metre buffer zone that would be impacted by the Development Site. The total area in metres squared was divided by the total perimeter in metres before development. This was then completed again for the post development scenario and entered into the BBCC.

2.3 Native Vegetation Assessment

2.3.1 Literature and Database Review

A review of previous documents and reports relevant to the proposal was undertaken. This included regional and sub-regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys undertaken in the vicinity of the Development Site and also relevant ecological database searches. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species, endangered populations (EPs) and TECs. Relevant documents included:

- A Vegetation Map for the Namoi Catchment Management Authority (OEH 2009)
- Mapping of the EPBC-listed "Natural Grasslands on the basalt and fine textured alluvial plains of the northern NSW and southern Queensland" in the Namoi Catchment (ELA 2010)
- Vegetation of the Bellata, Gravesend, Horton and Boggabri 1:100 000 Map Sheets, NSW (Cannon *et al*. 2002)
- The Reconstructed Distribution and Extent of Indigenous Vegetation Types in the Moree Plains Shire (White 2002)
- Border Rivers Gwydir/Namoi Regional Native Vegetation Mapping (OEH 2015)
- Travelling Stock Reserve Conservation Values spatial layer (Rural Lands Protection Board 2010)
- Melbourne Brisbane Inland Railway Parkes to Narromine and Narrabri to North Star – Ecological Investigations (Umwelt 2014)
- VIS Classification Database (OEH 2016c), accessed between April and July 2016
- OEH Threatened Species Profile Database for known/predicted Threatened Ecological Communities (TECs) in the Northern Basalts, Northern Outwash and Castlereagh-Barwon IBRA subregions, accessed between April and July 2016
- DoEE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed April 2016.

2.3.2 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Site was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping in the Development Site.

Vegetation communities in the Development Site were mapped on-screen overlaying the 2014-2015 high resolution aerial photographs provided by ARTC. Mapping was undertaken using the Manifold System 8.0 Enterprise Edition GIS in a 32 bit mode. Use of GIS allowed zooming to a relatively large scale, generally at a scale between 1:2000 and 1:4000.

Generally the minimum mapping unit for a vegetation zone was 0.1 hectare, however mapping was completed at a finer scale in order to map the small stands of weeping myall woodland, narrow bands of vegetation as well as smaller patches connected to larger areas of remnant vegetation outside the Development Site. A 3 to 1 crown separation ratio was generally applied for mapping areas of remnant woodland.

2.3.3 Systematic Plot/Transect Surveys

A total of 54 systematic plots/transect surveys were conducted across the Development Site during the surveys undertaken for this assessment (refer to **Appendix A**). These surveys were undertaken over 15 days and two survey periods, being:

- 3 - 12 February 2016, and
- 20 - 24 April 2016.

Furthermore, 287 rapid vegetation assessments were undertaken over five days between 25 and 29 September 2014 as part of the ecological constraints analysis undertaken by Umwelt (2014) (refer to **Section 2.3.4**).

2.3.3.1 Plot/Transect Selection and Stratification of the Development Site

Designing an appropriate survey requires consideration of both survey methods and effort. Reference was made to the VIS Classification Database to identify Plant Community Types (PCTs), as well as reviews of other regional and local vegetation mapping and reporting (refer to **Section 2.3.1**) when designing the field survey. The Development Site PCTs were further stratified into Vegetation Zones (condition states) following the initial field survey of the site to determine the appropriate number of transect/plots required in accordance with the FBA (OEH 2014a) as outlined in **Table 2.1**.

Table 2.1 Minimum Number of Plots/Transects Required per Zone Area (OEH 2014a)

Vegetation Zone Area (ha)	Minimum Number of Plot/Transect
0-4	1 transect/plot per 2 ha (or part thereof) or 1 transect/plot if vegetation is in low condition
>4-20	3 transects/plots or 2 transects/plots if vegetation is in low condition
>20-50	4 transects/plots or 3 transects/plots if vegetation is in low condition
>50-100	5 transects/plots or 3 transects/plots if vegetation is in low condition
>100-250	6 transects/plots or 4 transects/plots if vegetation is in low condition
>250-1000	7 transects/plots or 5 transects/plots if vegetation is in low condition (More transects/plots may be needed if the condition of the vegetation is variable across the zone)
>1000	8 transects/plots or 5 transects/plots if vegetation is in low condition or in a homogenous landscape in the Western Division (More transects/plots may be needed if the condition of the vegetation is variable across the zone)

Table 2.2 below outlines the adequacy of the plot/transect flora survey with respect to the FBA Methodology (OEH 2014a) pertinent to the Development Site.

Table 2.2 Adequacy of Vegetation Survey in the Development Site

Veg Zone	PCT ID (BVT IDs) and PCT Name *Condition Class*	Area in the Development Site (ha)	Number of Biometric Plots/Transects	
			Required (FBA 2014)	Undertaken During Survey
1	PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	6.95	3	6
2	PCT35 (BR120, NA117) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion *Moderate to Good*	4.75	3	3
3	PCT39 (BR130, NA129) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion *Moderate to Good*	1.19	1	2
4	PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion *Moderate to Good_Natural Grassland*	268.64	7	15
5	PCT56 (BR186, NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good*	71.95	5	7
6	PCT56 (BR186; NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good_DNG*	108.20	6	7
7	PCT71 (BR127, NA126) Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion *Moderate to Good*	0.04	1	1

Veg Zone	PCT ID (BVT IDs) and PCT Name *Condition Class*	Area in the Development Site (ha)	Number of Biometric Plots/Transects	
			Required (FBA 2014)	Undertaken During Survey
8	PCT78 (BR196, NA193) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	14.70	3	4
9	PCT135 (BR284, NA271) Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion *Moderate to Good*	3.79	2	3
10	PCT413 (BR346, NA348) Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion *Moderate to Good*	2.59	1	3
	Cleared/Non-native vegetation	1,080.44	0	3
Total		**1,563.25**	**32**	**54**

2.3.3.2 Plot/Transect Data Collected

At each plot/transect data was recorded according to Section 5 of the FBA (OEH 2014a). This involved setting out 20 x 50 metre and 20 x 20 metre plots and a 50 metre transect. The location of each quadrat was recorded using a hand-held GPS with accuracy of ± 5 metres. The Map Grid of Australia (MGA) coordinate system was used. The location of the 54 plots/transects undertaken within the Development Site is shown in **Appendix A**.

At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 metre plot. Searches of each 20 x 20 metre plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of the shrub, mid-storey, canopy and emergent layers were also thoroughly examined. Effort was made to search the tree canopy and tree trunks for mistletoes, vines and epiphytes.

For each flora species recorded in the plot, the following data was collected in accordance with Table 1 of the FBA (OEH 2014a):

- stratum/layer in which the species occurs
- growth form
- scientific name and common name

- cover
- abundance rating.

At each standard flora quadrat, 10 points along a 50 metre transect were assessed for:

- percentage native overstorey cover
- percentage native mid-storey cover.

In addition, 50 points along a 50 metre transect were assessed for:

- percentage native groundcover (grass)
- percentage native groundcover (shrubs)
- percentage native ground cover (other)
- percentage exotic plant cover.

Additional details were also recorded in each quadrat, including soil texture, drainage and depth; site disturbances; physiography (position in the landscape); and vegetation structure (strata percentage covers, heights and dominant species). Photographic records were also taken at each site.

2.3.4 Semi-quantitative Rapid Sampling

287 rapid vegetation assessments were completed within the Development Site (refer to **Appendix A**) during the floristic surveys and as part of the ecological constraints analysis undertaken by Umwelt (2014). Assessment areas were not fixed area-based, but were generally confined to an area similar to that of a 20 x 20 metre quadrat. The railway corridor was often defined by fences located approximately 20 metres either side of the tracks, however in sections where fences were not present surveys were extended out to approximately 30 to 40 metres.

Rapid sampling was used in combination with rapid reconnaissance and meandering transects primarily to assist in the delineation and refinement of vegetation mapping with respect to the distribution of native and non-native vegetation areas. Rapid vegetation assessment points were located within distinct vegetation community units (rather than within ecotones) to allow data collection for each community without confounding effects from adjacent communities. Dominant, common and some uncommon plant taxa were recorded within each rapid vegetation assessment point. The vegetation structure at each rapid vegetation assessment point was documented, including the dominant species in each stratum.

2.3.5 Meandering Transects

Meandering transects were undertaken through vegetation units across much of the Development Site, particularly for the delineation and refinement of vegetation mapping and searching for threatened and otherwise significant species, endangered populations and TECs. Meandering transects enabled floristic sampling across a much larger area than systematic plots, allowing the survey to achieve a combination of detailed observation and broader appreciation. Records along transects supplemented floristic sampling carried out as part of quadrat survey, however, the data collected was in the form of presence records, rather than semi-quantitative cover abundance scores (note that the cover and abundance of additional species was generally low). Where meandering transects revealed significant variation within a vegetation unit, or a potential new vegetation community, additional quadrat survey was undertaken.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Development Site.

2.3.6 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within quadrats and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Royal Botanic Gardens Sydney 2016).

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

2.3.7 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Site. Vegetation mapping involved the following key steps:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- preliminary review of the modelled distribution of vegetation communities as part of the Border Rivers Gwydir/Namoi Regional Native Vegetation Mapping (OEH 2015)
- predicting the distribution of particular vegetation communities based on understanding the distribution of Biometric vegetation types (OEH 2016c) and plant communities
- preparation of a draft vegetation community map based on interpretation of digital airborne imagery and preliminary delineation of vegetation community floristics
- ground-truthing of the vegetation map based on survey effort documented in **Section 2.3**
- revision of vegetation community floristic delineations based on plot data
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were named in accordance with the naming conventions of those vegetation communities identified by the VIS Classification Database (OEH 2016c).

2.3.8 Threatened Ecological Community Delineation Techniques

Vegetation communities identified in the Development Site were compared to TECs listed under the Commonwealth EPBC Act and NSW TSC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- Full-floristic quadrat assessment, rapid assessments and meandering survey to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee

- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth DoEE and the NSW OEH
- comparison with other assessments of TECs in the region.

2.3.9 Plant Community Type (PCT)/Biometric Vegetation Type (BVT) Allocation

Each of the vegetation communities described within the Development Site were aligned with an equivalent PCT/BVT as detailed in the VIS Classification Database (OEH 2016c). For each vegetation community described in the Development Site, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs/BVTs was generated. The profiles for each of the possible PCT/BVT were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details.

2.4 Threatened Species

2.4.1 Literature and Database Review

A review of previous documents and reports relevant to the proposal was undertaken. This included reports, previous ecological surveys undertaken in the vicinity of the Development Site and also relevant ecological database searches. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents and resources included:

- OEH Threatened Species Profile Database for known/predicted threatened species in the Northern Basalts, Northern Outwash and Castlereagh-Barwon IBRA subregions, accessed between April and July 2016
- OEH BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2016d), accessed in April 2016
- PlantNET (Royal Botanic Gardens Sydney) database search for Rare or Threatened Australian Plant species within the Gwydir, Moree Plains and Narrabri LGAs, accessed July 2016
- DoEE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed April 2016 and March 2017
- Melbourne to Brisbane Inland Rail Alignment Study – Appendix H Preliminary Environmental Assessment (Parsons Brinckerhoff *et al*. 2010).

A preliminary assessment using the TSPD was undertaken which provided a list of species-credit species that might require survey and the suitable survey periods for each species. The results of the database searches, literature review and TSPD review were used to design the survey requirements for species-credit species so that adequate surveys were undertaken.

Note: Ecosystem-credit species are predicted by the landscape attributes and are not required to be specifically targeted during field surveys.

The *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC 2004) and Commonwealth Threatened Species Survey and Assessment Guidelines were considered when undertaking the threatened species surveys in the Development Site.

2.4.2 Species-credit Flora Surveys

Species-credit flora surveys were undertaken over 19 days and three survey periods, being:

- 25 – 29 September 2014
- 3 - 12 February 2016
- 20 - 24 April 2016.

A preliminary list of species-credit flora species with potential to occur in the Development Site was generated during the literature review, completion of database searches , review of the Attachment B of the SEARs (refer to **Section 1.3**) and the TSPD. Searches of the TSPD were undertaken for the applicable IBRA subregions (Northern Basalts, Northern Outwash and Castlereagh-Barwon) and CMA regions (Border Rivers/Gwydir and Namoi).

Table 2.3 identifies the species-credit flora species that were determined to potentially occur in the Development Site and therefore require targeted and seasonal surveys.

Targeted surveys were undertaken for the species listed in **Table 2.3** and included targeted on-ground searches in suitable habitat throughout the Development Site. Searches for these species were undertaken in suitable habitat along numerous walking meandering transects and within the plot and transect surveys. These generally involved walking suitable habitat areas and searching for the targeted species between the rail tracks and the fences marking the edge of the corridor. Where there were no fences, surveys were generally undertaken up to 30 metres either side of the tracks or further where the Development Site extended further out from the rail line. The seasonal survey requirements for all species-credit flora species with the potential to occur within the Development Site were met during the September 2014, February and April 2016 survey periods.

Table 2.3 Species-credit Flora Species Requiring Targeted Survey

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
austral toadflax *Thesium australe* (Vulnerable under the TSC and EPBC Acts)	×	✓	×	×	×	September - February	Targeted threatened flora searches in suitable habitat undertaken in September 2014 and February 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.
Belson's panic *Homopholis belsonii* (Endangered under the TSC Act and vulnerable under the EPBC Act)	✓	✓	✓	✓	✓	December - April	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
bluegrass *Dichanthium setosum* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	×	✓	December - May	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.
creeping tick-trefoil *Desmodium campylocaulon* (Endangered under the TSC Act)	×	×	✓	✓	✓	December - May	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
Cyperus conicus (Endangered under the TSC Act)	×	×	✓	×	✓	All year	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.
finger panic grass *Digitaria porrecta* (Endangered under the TSC Act)	✓	✓	✓	✓	✓	December - May	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
pine donkey orchid *Diuris tricolor* (Vulnerable under the TSC Act)	×	×	×	×	✓	September-October	Targeted threatened flora searches in suitable habitat undertaken in September 2014 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.
native milkwort *Polygala linariifolia* (Endangered under the TSC Act)	✓	✓	✓	×	×	All year	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
scant Pomaderris *Pomaderris queenslandica* (Endangered under the TSC Act)	×	✓	×	×	✓	All year	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.
slender darling pea *Swainsona murrayana* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	✓	×	September - February	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
spiny peppercress *Lepidium aschersonii* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	×	✓	September - May	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.
ooline *Cadallia pentastylis* (Vulnerable under the TSC and EPBC Acts)	×	×	✓	×	×	All year	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
Tylophora linearis (Vulnerable under the TSC Act and Endangered under the EPBC Act)	×	×	✓	×	×	September - May	Targeted threatened flora searches in suitable habitat undertaken in September 2014, February and April 2016 throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

^ Months that surveys are required according to the Threatened Species Profile Database for the Border Rivers/Gwydir and Namoi CMAs (searched May 2016).

2.4.3 Species-credit Fauna Surveys

Species-credit fauna surveys were undertaken over 16 days and three survey periods, being:

- 1 – 2 July 2015
- 7 - 16 December 2015
- 20 - 23 April 2016.

A preliminary list of species-credit fauna species with potential to occur in the Development Site was generated during the literature review, completion of database searches and preliminary assessment using the BBCC and the TSPD. Searches of the TSPD were undertaken for the applicable IBRA subregions (Northern Basalts, Northern Outwash and Castlereagh-Barwon) and CMA regions (Border Rivers/Gwydir and Namoi).

Table 2.4 identifies the species-credit fauna species that were considered to potentially occur in the Development Site and that required targeted surveys. Targeted surveys for species-credit fauna species listed in **Table 2.4** below were undertaken at 15 sites within the Development Site, along with opportunistic fauna surveys throughout the Development Site (refer to **Appendix A**).

Targeted surveys were undertaken for the species listed in **Table 2.4** and included a range of survey techniques including targeted area searches, Anabat recorders, call playback and spotlighting. During the survey period, opportunistic sightings and bird calls of targeted species were also noted during walking or travelling through the site in a hi-rail vehicle. The seasonal survey requirements for all species-credit fauna species with the potential to occur within the Development Site were met during the July, November and December 2015 survey periods. The details of the targeted surveys are discussed in **Sections 2.4.3.1** to **2.4.3.10** below and specific survey locations are shown in **Appendix A**.

Table 2.4 Species-credit Fauna Species Requiring Targeted Survey

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
pale imperial hairstreak *Jalmenus eubulus* (Critically endangered under the TSC Act)	×	×	✓	×	×	November – December and February - March	Targeted butterfly surveys undertaken in December 2015 at sites 9, 16a and 21. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.1** for further detail.
five-clawed worm-skink *Anomalopus mackayi* (Endangered under the TSC Act and vulnerable under the EPBC Act)	×	×	✓	✓	✓	All year	Diurnal reptile searches undertaken in December 2015 at all sites except Site 8. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.2** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
pale-headed snake *Hoplocephalus bitorquatus* (Vulnerable under the TSC Act)	✓	✓	✓	✓	✓	October – April	Spotlighting surveys in suitable habitat undertaken in December 2015 at all sites except for Site 8. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.3** for further detail.
Dunmall's snake *Furina dunmalli* (Vulnerable under the EPBC Act)	×	×	✓	×	×	October - April	Spotlighting surveys in suitable habitat undertaken in December 2015 at all sites except for Site 8. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.3** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
regent honeyeater *Anthochaera phrygia* (Critically Endangered under the TSC and EPBC Acts)	×	✓	×	×	×	All year	Targeted diurnal bird surveys undertaken in December 2015 at all sites within the Development Site. Targeted winter surveys were not undertaken as there are no records of this species within 10 kilometres of the Development Site (OEH 2016d). Key foraging habitat in accordance with the National Recovery Plan (DoE 2016b) was not identified within the Development Site.
black-necked stork *Ephippiorhynchus asiaticus* (Endangered under the TSC Act)	×	✓	✓	✓	✓	All year	Diurnal bird surveys undertaken in December 2015 at all sites within the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.4** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
grey falcon *Falco hypoleucus* (Endangered under the TSC Act)	×	✓	×	✓	×	All year	Diurnal bird surveys undertaken in December 2015 at all sites within the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.4** for further detail.
black-breasted buzzard *Hamirostra melanosternon* (Vulnerable under the TSC Act)	×	✓	×	×	×	All year	Diurnal bird surveys undertaken in December 2015 at all sites within the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.4** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
flock bronzewing *Phaps histrionic* (Endangered under the TSC Act)	×	×	×	✓	×	October - March	Diurnal bird surveys undertaken in December 2015 at all sites within the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.4** for further detail.
superb parrot *Polytelis swainsonii* (Vulnerable under the TSC and EPBC Acts) (breeding habitat only)	×	×	×	×	×	September - December	Diurnal bird surveys undertaken in December 2015 at all sites within the Development Site. Targeted hollow habitat searches throughout the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.5** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
koala *Phascolarctos cinereus* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	✓	✓	All year	Spotlighting surveys in suitable habitat undertaken in December 2015 at all sites within the Development Site except Site 8. Spot Assessment Technique (SAT) surveys in suitable habitat undertaken in December 2015 at all sites within the Development Site except Site 8. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.6** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
rufous bettong *Aepyprymnus rufescens* (Vulnerable under the TSC Act)	✓	✓	×	×	×	All year	Spotlighting surveys in the Development Site undertaken in December 2015 at all sites within the Development Site except Site 8. Targeted surveys were not undertaken for this species given that there are no records of this species within 10 kilometres of the Development Site (OEH 2016d) and the habitat within the Development Site is considered to be substantially degraded given the high level of fragmentation and small size of remnant vegetation such that this species is unlikely to utilise the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
eastern pygmy-possum *Cercartetus nanus* (Vulnerable under the TSC Act)	✓	✓	×	×	×	September - April	Spotlighting surveys in the Development Site undertaken in December 2015 at all sites within the Development Site except Site 8. Targeted surveys were not undertaken for this species given that there are no records of this species within 10 kilometres of the Development Site (OEH 2016d) and the habitat within the Development Site is considered to be substantially degraded given the high level of fragmentation and small size of remnant vegetation such that this species is unlikely to utilise the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
squirrel glider *Petaurus norfolcensis* (Vulnerable under the TSC Act)	✓	✓	×	×	✓	All year	Spotlighting surveys in the Development Site undertaken in December 2015 at all sites within the Development Site except Site 8. Targeted surveys were not undertaken for this species given that there are no records of this species within 10 kilometres of the Development Site (OEH 2016d) and the habitat within the Development Site is considered to be substantially degraded given the high level of fragmentation and small size of remnant vegetation such that this species is unlikely to utilise the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
brush-tailed phascogale *Phascogale tapoatafa* (Vulnerable under the TSC Act)	×	✓	×	×	×	All year	Spotlighting surveys in the Development Site undertaken in December 2015 at all sites within the Development Site except Site 8. Targeted surveys were not undertaken for this species given that there are no records of this species within 10 kilometres of the Development Site (OEH 2016d) and the habitat within the Development Site is considered to be substantially degraded given the high level of fragmentation and small size of remnant vegetation such that this species is unlikely to utilise the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
black-striped wallaby *Macropus dorsalis* (Endangered under the TSC Act)	×	✓	×	×	×	All year	Spotlighting surveys in suitable habitat undertaken in December 2015 at all sites within the Development Site except Site 8. Refer to **Section 2.4.3.7** for further detail.
Sloane's froglet *Crinia sloanei*	V	-	✓	✓	✓	June-August	Spotlighting and call playback surveys undertaken in July 2015 in suitable habitat across 2 locations within the Development Site. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.8** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
grey-headed flying-fox *Pteropus poliocephalus* (Vulnerable under the TSC and EPBC Acts) (breeding habitat only)	×	×	×	×	×	September - May	Spotlighting surveys in suitable habitat undertaken in December 2015 at all sites except 8. Opportunistic observations undertaken throughout all Umwelt survey periods. Refer to **Section 2.4.3.9** for further detail.
bristle-faced free-tailed bat *Mormopterus eleryi* (Endangered under the TSC Act)	×	×	✓	×	✓	October – March	Echolocation surveys using SD1 Anabat Recorders undertaken in December 2015 at all sites except 8, 9, 12, 13 and 14. Targeted inspections of timber, steel and concrete bridges for roosting bats in September 2014. Refer to **Section 2.4.3.10** for further detail.

Common Name *Scientific Name*	Location by Assessment and CMA/IBRA Subregion					Required Survey Period^	Survey Technique, Timing and Location
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
large-eared pied bat *Chalinolobus dwyeri* (Vulnerable under the TSC and EPBC Acts) (breeding habitat only)	✓	✓	×	×	×	September - April	Echolocation surveys using SD1 Anabat Recorders undertaken in December 2015 at all sites except 8, 9, 12, 13 and 14. Targeted inspections of timber, steel and concrete bridges for roosting bats in September 2014. Refer to **Section 2.4.3.10** for further detail.

^ Months that surveys are required according to the Threatened Species Profile Database for the Border Rivers/Gwydir and Namoi CMAs (searched May 2016).

2.4.3.1 Pale imperial Hairstreak Surveys

The pale imperial hairstreak was targeted by conducting 30-minute butterfly surveys where brigalow (*Acacia harpophylla*) was present, in December 2015. The searches were conducted using a butterfly net with 456 mm diameter hoop and fine mesh. All butterflies captured were identified to species, where possible.

Butterfly surveys were conducted at Sites 9, 16a and 21. Four additional surveys were conducted at isolated Brigalow patches located at approximately KP 701 km, 703.3 km, 704.5 km and 730.0 km (refer to Figures A1-A56 in **Appendix A**).

Opportunistic observations were also recorded throughout the survey period.

2.4.3.2 Five-clawed Worm-skink Surveys

The five-clawed worm-skink was targeted by conducting diurnal reptile searches in suitable habitat within the Development Site in December 2015. This involved raking leaf litter and searching under fallen logs, in particular buried logs for 30 minutes at each site.

Five-clawed worm-skink searches were conducted at all sites except Site 8. Due to the size of Site 9, three separate reptile searches were conducted within the site boundary at approximately KP 619 km, 626.5 km and 629 km (refer to Figures A1-A56 in **Appendix A**).

Opportunistic observations were also recorded throughout the survey period.

2.4.3.3 Pale-headed Snake and Dunmall's Snake Surveys

The pale-headed snake and Dunmall's snake were targeted by conducting nocturnal spotlighting surveys over two nights for up to 30 minutes or for the entire survey site, whichever occurred first in December 2015. Both the ground and trees were searched for the presence of these species focusing on potential suitable habitat in live and dead trees, under loose bark, and fallen timber. Spotlighting was either completed on foot and/or from the hi-rail vehicle depending on the size of the site using 30 watt Lightforce hand-held spotlights and head torch. Spotlighting was undertaken generally between 9.00 pm and 2.00 am, commencing approximately one hour after dusk. In addition, opportunistic spotlighting was undertaken from a slow-moving hi-rail vehicle while travelling between fauna survey locations at night.

Spotlighting surveys targeting the pale-headed snake and Dunmall's snake were conducted at all sites, except for Site 8, within the Development Site (refer to Figures A1-A56 in **Appendix A**).

Opportunistic observations were also recorded throughout the survey period.

2.4.3.4 Diurnal Bird Surveys for the Black-necked Stork, Black-breasted Buzzard, Flock Bronzewing, and Grey Falcon

Diurnal bird surveys were conducted for black-necked stork, black-breasted buzzard, flock bronzewing and grey falcon on two separate days across the survey sites in December 2015. Bird surveys were conducted at various times of the day, primarily early to mid-morning and mid to late afternoon. Surveys targeted likely habitat for each species such as aerial observations for birds of prey (grey falcon and black-breasted buzzard) and wetland habitats for waterfowl (black-necked stork). Each survey consisted of a slow walking transect within the survey site for 20 minutes. Bird species were identified from characteristic calls and by observation using binoculars with magnification up to 10x.

Diurnal bird surveys were undertaken for black-necked stork, black-breasted buzzard, flock bronzewing, and grey falcon at all sites within the Development Site (refer to **Appendix A**).

Opportunistic observations were also recorded throughout the survey period.

2.4.3.5 Superb Parrot Breeding Habitat Surveys

The superb parrot is a species-credit species for breeding habitat only in both the Border River/Gwydir and Namoi CMAs. Breeding habitat for the superb parrot includes hollows more than 60 mm in diameter that are located more than 4 metres above ground. This habitat was surveyed for by undertaking targeted hollow tree surveys across the Development Site in December 2015. Any suitable trees that were located were marked as a GPS waypoint, and the number of hollows and tree species were recorded along with a photo of the tree. Selected suitable habitat trees were watched for at least an hour, in the morning where possible for any superb parrot activity.

Superb parrot breeding habitat surveys were conducted at Site 8 and any additional trees that were not located within this Site but were within the Development Site to KP 590.5 km were also surveyed. Diurnal 20-minute bird surveys were conducted for the superb parrot at Site 8 on two separate days (refer to **Appendix A**). Any additional trees that were not located within the fauna survey site but were within the Development Site were also surveyed.

Opportunistic observations were also recorded throughout the survey period.

2.4.3.6 Koala Surveys

The koala was targeted by undertaking spot assessment technique (SAT) and nocturnal spotlighting in December 2015. The koala SAT was undertaken in eucalypt dominated sites only as per the technique outlined in Phillips and Callaghan (2011). If a scat or koala was located a GPS location, photo and sex of the individual was recorded (where applicable). Koala SAT surveys were conducted at all sites except Site 8 due to no trees occurring within the Development Site boundary at this site. Due to the size of Site 9, three koala SAT's were completed at approximately the KP 618.5 km, 621 km and 626.5 km (refer to **Appendix A**).

Nocturnal spotlighting searches for the koala were conducted over two nights for up to 30 minutes or the entire survey site, whichever occurred first. Spotlighting was either completed on foot and/or from the hi-rail vehicle depending on the size of the site using 30 watt Lightforce hand-held spotlights and head torch. Spotlighting was undertaken generally between 9.00 pm and 2.00 am, commencing approximately one hour after dusk. In addition, opportunistic spotlighting was undertaken from a slow-moving hi-rail vehicle while travelling between fauna survey locations at night. Spotlighting surveys for koala were conducted at all sites except Site 8 due to no trees occurring within the Development Site boundary at this site (refer to **Appendix A**).

Opportunistic observations were also recorded throughout the survey period.

2.4.3.7 Black-striped Wallaby Surveys

The black-striped wallaby was targeted using nocturnal spotlighting surveys in December 2015. Spotlighting for this species was conducted over two nights for up to 30 minutes or the entire survey site, whichever occurred first. Spotlighting was either completed on foot and/or from the hi-rail vehicle depending on the size of the site using 30 watt Lightforce hand-held spotlights and head torch. Spotlighting was undertaken generally between 9.00 pm and 2.00 am, commencing approximately one hour after dusk. In addition, opportunistic spotlighting was undertaken from a slow-moving hi-rail vehicle while travelling between fauna survey locations at night.

The black-striped wallaby surveys were conducted at all sites (except Site 8) (refer to **Appendix A**). Opportunistic observations were also recorded throughout the survey period.

2.4.3.8 Sloane's Froglet Surveys

Diurnal searches for Sloane's froglet were conducted in two locations across the Development Site, in potential habitat along the Gwydir River in July 2015, targeting land within 50 metres of ephemeral wetlands or periodically inundated areas within grasslands and disturbed environments (refer to **Appendix A**). During the search, likely micro-habitats were examined including around waterbodies, beneath rocks, around culverts, and areas of inundation. Each survey consisted of approximately 15-30 minutes for one person, depending on the size and complexity of the habitat.

Nocturnal spotlighting surveys, each consisting of 30 minute person hours over one night, were also undertaken in the two survey locations (refer to **Appendix A**). Each survey consisted of a 5 minute period of call playback for the species followed by 25 minutes of spotlighting. Spotlighting was conducted on foot using a head torch. Spotlighting was undertaken generally between 6:00 pm and 1:00 am, commencing approximately one hour after dusk and targeted relevant habitat features identified during the diurnal surveys, such as farm dams, riparian zones, culverts and areas of inundation.

Opportunistic observations were also recorded throughout the survey period.

2.4.3.9 Grey-headed Flying-fox Survey

The grey-headed flying-fox was targeted using nocturnal spotlighting surveys in December 2015. Spotlighting for this species was conducted over two nights for up to 30 minutes or the entire survey site, whichever occurred first. Spotlighting was either completed on foot and/or from the hi-rail vehicle depending on the size of the site using 30 watt Lightforce hand-held spotlights and head torch. Spotlighting was undertaken generally between 9.00 pm and 2.00 am, commencing approximately one hour after dusk. In addition, opportunistic spotlighting was undertaken from a slow-moving hi-rail vehicle while travelling between fauna survey locations at night.

Drainage lines were specifically targeted during surveys to identify any camp sites (breeding habitat).

The grey-headed flying-fox surveys were conducted at all sites (except Site 8) (refer to **Appendix A**).

Opportunistic observations were also recorded throughout the survey period.

2.4.3.10 Bristle-faced Free-tailed Bat and Large-eared Pied Bat (Breeding Habitat) Surveys

The bristle-faced free-tailed bat and large-eared pied bat were targeted using Anabat SD1 recorders. The large-eared pied bat is a species-credit species for breeding habitat only in the Border Rivers/Gwydir and Namoi CMA. In accordance with the TSPD, breeding habitat for the large-eared pied bat includes land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels. These specific geographic and habitat features were not identified in the Disturbance Site and breeding habitat is not expected to occur.

At each site, the Anabat was positioned at an approximate 30 degree angle one metre above the ground in waterproof housing. Each detector was positioned towards potential micro-bat flight paths or over waterbodies to increase the likelihood of detecting micro-bat species. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise for at least two nights per site.

All micro-bat species were identified by Anna McConville of Echo Ecology Pty Limited (a recognised expert in the identification of micro-bat calls). Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being definite, probable, possible, species group or unknown. For the purposes of this assessment, definite and probable levels of confidence were treated as positive identifications. All species recorded as Possible during call analysis were also recorded as either probable, definite or both.

As part of the ecological constraint investigation, targeted inspections of timber, steel and concrete bridges were undertaken in September 2014 (Umwelt 2014). Inspections included using a head torch to check any cavities and expansion joints for fauna species and an Anabat echolocation recording unit (hereafter referred to as an 'Anabat') was used to record the echolocation calls of micro-bats. The Anabat was directed at cavities within the bridges and set to record after lightly knocking the bridge structure to elicit a response from any potential micro-bat species.

The bristle-faced free-tailed bat and large-eared pied bat were targeted at all sites except 8, 9, 12, 13 and 14 (refer to **Appendix A**).

3.0 Results

3.1 Landscape Value

As outlined in **Section 2.1**, while the BioBanking Assessment has been split into five assessments to cover the different CMAs and IBRA subregions, the landscape assessment was undertaken holistically across the entire Development Site as per consultation with OEH.

3.1.1 Landscape Features

The 550 metre buffer area from the centre line of the Development Site contains some prominent landscape features including 5th order streams and a range of Mitchell landscapes. This area also covers multiple IBRA Bioregions, IBRA Subregions and CMAs.

Landscape features that were included in the determination of the connectivity value scores for the Development Site are outlined in **Table 3.1** below.

Table 3.1 Landscape Features in the Development Site

Landscape Feature	Development Site
Mitchell Landscapes	Belata Sands
	Croppa Clay Plains
	Croppa Creek Channels and Floodplains
	Gwydir Alluvial Plains
	Gywdir Channels and Floodplains
	Kaputar Slopes
	Liverpool Alluvial Plains
	Namoi Channels and Floodplains
	Yallaroi Basalts

Landscape Feature	Development Site
Rivers, Streams, Estuaries	5th order streams: • Bobbiwaa Creek • Ten Mile Creek • Gurley Creek • Gwydir River • Mehi River • Bunna Bunna Creek • Gil Gil Creek • Croppa Creek 4th order streams: • Spring Creek • Gehan Creek • Millie Creek • Yallaroi Creek
Wetlands	None identified
Native Vegetation (in buffer area)	1,897 hectares
Connecting Links	Regionally Significant Biodiversity Link (refer to **Section 3.1.2.3**).

3.1.2 Landscape Value Scores

3.1.2.1 Percent Native Vegetation Cover

Table 3.2 details the percent native vegetation cover before and after the proposed disturbance in the Development Site and the native vegetation per cent class entered into the BioBanking Calculator as per Table 16 of Appendix 5 of the FBA (OEH 2014a).

Table 3.2 Native Vegetation Cover in Buffer Area

	Pre-Development			Post-Development		
	Area of Native Veg (ha)	Native Veg Cover (%)	Native Veg Percent Class	Area of Native Veg (ha)	Native Veg Cover (%)	Native Veg Percent Class
Development Site	1,897	9.26	6-10	1,783	8.71	6-10

3.1.2.2 Area to Perimeter Ratio

The area to perimeter ratio for the development site was calculated as 0, in accordance with the FBA methodology (refer to Appendix 5 Assessing Landscape Value for Linear Shaped Developments, or Multiple Fragmentation Impacts).

3.1.2.3 Connectivity Value

Determining the connectivity value score is derived from identifying the highest scoring connecting link to be impacted by the proposal as per Table 17 of Appendix 5 of the FBA (OEH 2014a).

The highest connecting links occurring within the Development Site are seven 5th order streams being Bobbiwaa Creek, Ten Mile Creek, Gurley Creek, Gwydir River, Bunna Bunna Creek, Gil Gil Creek and Croppa Creek. A range of 4th order streams also occur in the north of the site.

No State significant biodiversity links were identified within a plan approved by the Chief Executive of OEH and no 6th order or higher streams or important wetlands occur within the Development Site. The closest 6th order stream, being the Namoi River, occurs approximately 3.6 kilometres to the southwest of the Development Site near Narrabri, outside the buffer area.

Details of the connectivity value scores applicable for entry to the BBCC for this proposal are shown in bold in **Table 3.3** below.

Table 3.3 Highest Value Connecting Links

Highest Category of Connecting Link	Connectivity Score	Definition	Description
Regionally Significant Biodiversity Link	**10**	An area identified by the assessor as being part of a regionally significant biodiversity link in a plan approved by the Chief Executive of OEH OR	Not identified

Highest Category of Connecting Link	Connectivity Score	Definition	Description
		A riparian buffer 20m either side of a 4th or 5th order stream OR	5th order streams: • Bobbiwaa Creek • Ten Mile Creek • Gurley Creek • Gwydir River • Mehi River • Bunna Bunna Creek • Gil Gil Creek • Croppa Creek 4th order streams: • Spring Creek • Gehan Creek • Millie Creek • Yallaroi Creek
		A riparian buffer 30m around a regionally significant wetland	Not identified

Note: Connectivity score is based on definition in bold text.

3.1.2.4 Patch Size

Table 3.4 below details the parameters that determined the Patch Size score as per Table 18 of Appendix 5 of the FBA (OEH 2014a).

Table 3.4 Patch Size Score Parameters

Mitchell Landscape	Patch Size	Patch Size Score
Belata Sands	1001	12.5
Croppa Clay Plains	1001	12.5
Croppa Creek Channels and Floodplains	1001	12.5
Gwydir Alluvial Plains	1001	12.5
Gywdir Channels and Floodplains	1001	12.5
Kaputar Slopes	1001	12.5
Liverpool Alluvial Plains	0	0
Namoi Channels and Floodplains	1001	12.5
Yallaroi Basalts	0	0

3.1.2.5 Landscape Value Score

The landscape value score for the Development Site is 19.70, as calculated by the BBCC.

3.2 Native Vegetation within the Development Site

3.2.1 Biometric Vegetation Types and Vegetation Zones

Surveys of the Development Site identified nine Plant Community Types (PCTs) across 10 condition classes being:

- PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
    - *Moderate to Good Condition*
- PCT 35 (BR120, NA117) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
    - *Moderate to Good Condition*
- PCT 39 (BR130, NA129) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
    - *Moderate to Good Condition*
- PCT 52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
    - *Moderate to Good Condition*
- PCT 56 (BR186, NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
    - *Moderate to Good Condition*
    - *Moderate to Good Condition – Derived Native Grasslands*
- PCT 71 (BR127, NA126) Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
    - *Moderate to Good Condition*
- PCT 78 (BR196, NA193) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion
    - *Moderate to Good Condition*
- PCT 135 (BR284, NA271) Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion
    - *Moderate to Good Condition*

- PCT 413 (BR346, NA348) Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion

    - *Moderate to Good Condition*

These PCTs were aligned with communities described as part of the VIS Classification Database (OEH 2016c). The PCTs were then categorised into 10 vegetation zones, based on condition. The composition of these vegetation zones are outlined in **Sections 3.2.1.1** to **3.2.1.10** below and a flora species list for all plots surveyed is included in **Appendix B**.

3.2.1.1 Vegetation Zone 1 – BR233, NA219– Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion – Moderate to Good Condition

PCT Name	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	
Condition	Moderate to Good	
PCT Number	27	
BVT Number	BR233, NA219	
Formation	Semi-arid Woodlands (Grassy sub-formation)	
Class	Riverine Plain Woodlands	
No. Plots/transects	Six (P01, P02, P13, P14, P15 and P49)	
Total Area in Development Site (ha)	6.95	
General Description	This vegetation zone occurs as several small remnant or regenerating patches throughout the Development Site occupying plains and low rises on alluvial clays and loams (refer to **Appendix A**). Although widespread across the Development Site, patches are relatively isolated due to historic clearing.	
Floristic Description	This community is a mid-high open woodland with a canopy solely dominated by weeping myall (*Acacia pendula*). Some patches also contained mistletoe (*Amyema quandang*), a hemiparasitic native occurring almost exclusively on species of *Acacia*. The midstorey is sparse and includes regenerating weeping myall as well as wilga (*Geijera parviflora*), native olive (*Notelaea microcarpa* var. *microcarpa)* and western boobialla (*Myoporum montanum*). Chenopod shrubs such as ruby saltbush (*Enchylaena tomentosa*), berry saltbush (*Einadia hastata*), black roly-poly (*Sclerolaena muricata* var. *muricata*), thorny saltbush (*Rhagodia spinescens*), creeping saltbush (*Atriplex semibaccata*) and climbing saltbush (*Einadia nutans*) are also frequently present. The understorey is variable, ranging from sparse to dense and is heavily disturbed. Common native ground layer species include quena (*Solanum esuriale*), tarvine (*Boerhavia dominii*), corrugated sida (*Sida corrugata*), *Oxalis perennans*, emu-foot (*Cullen tenax*), fairy grass (*Sporobolus caroli*), sensitive plant (*Neptunia gracilis f. gracilis*), windmill grass (*Chloris truncata*), rough fuzzweed (*Vittadinia pterochaeta*) and *Pimelea microcephala* subsp. *microcephala*. Non-native species commonly include flaxleaf fleabane (*Conyza bonariensis*), spiked malvastrum (*Malvastrum americanum*), *Sida spinosa*, cat-head	

PCT Name	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
Condition	Moderate to Good
	(*Tribulus terrestris*), sorghum (*Sorghum bicolor*), Cobblers pegs (*Bidens pilosa*), and bearded oats (*Avena barbata*). Weeds of National Significance (WoNS) occurring in this community include African boxthorn (*Lycium ferocissimum*) and common prickly pear (*Opuntia stricta*). Belson's Panic (*Homopholis belsonii*), a perennial grass listed as vulnerable under the EPBC Act and as endangered under the TSC Act was recorded in some Weeping Myall Woodland patches north of Moree.
Structure	Upper – 3-12m/5-40% Midstorey – 0.5-1m/1-40% Lower – <0.5m/25-70%
TSC Act Status	This vegetation zone is consistent with the *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions EEC* listed under the TSC Act (refer to **Section 3.2.3.1**).
EPBC Act Status	A total of 2.61 hectares of this vegetation zone is consistent with *Weeping Myall Woodlands* listed as an EEC under the EPBC Act. The remaining 3.34 hectares of this zone does not meet the EPBC listing criteria due to small patch sizes (<0.5 hectares) in the Development Site (refer to **Appendix D**).

3.2.1.2 Vegetation Zone 2 – BR120, NA117– Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion – Moderate to Good Condition

PCT Name	Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion	
Condition	Moderate to Good	
PCT Number	35	
BVT Number	BR120, NA117	
Formation	Semi-arid Woodlands (Grassy sub-formation)	
Class	Brigalow Clay Plain Woodlands	
No. Plots/transects	Three (P18, P19 and P47).	
Total Area in Development Site (ha)	4.75	

PCT Name	Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
Condition	**Moderate to Good**
General Description	This vegetation zone predominantly occurs in the southern portion of the Development Site between Bellata and Gurley, with occurrences in the north towards North Star (refer to **Appendix A**). This community primarily occurs on gilgaied clay and loams of the Development Site primarily on alluvial plains and valley flats.
Floristic Description	This community is open woodland dominated by brigalow (*Acacia harpophylla*). Other tree species typically include bimble box (*Eucalyptus populnea* subsp. *bimbil*) and belah (*Casuarina cristata*). The midstorey is generally sparse containing budda (*Eremophila mitchellii*), native olive (*Notelaea microcarpa* var. *microcarpa*), wilga (*Geijera parviflora*), desert jasmine (*Jasminum lineare*) and western boobialla (*Myoporum montanum*). The ground layer contains grasses, forbs, sedges and chenopods. Dominant ground cover species include slender panic (*Paspalidium gracile*), curly windmill grass (*Enteropogon acicularis*), ruby saltbush (*Enchylaena tomentosa*), thorny saltbush (*Rhagodia spinescens*), blue trumpet (*Brunoniella australis*), slender flat-sedge (*Cyperus gracilis*), New Zealand spinach (*Tetragonia tetragonoides*), *Solanum parvifolium* subsp. *parvifolium* and quena (*Solanum esuriale*). Non-native species include common peppercress (*Lepidium africanum*), urochloa grass (*Urochloa panicoides*) and *Sida spinosa*. WoNS being common prickly pear (*Opuntia stricta*) and African boxthorn (*Lycium ferocissimum*) occur in this community.
Structure	Upper – 6-25m/5-35% Midstorey – 2-5m/6.5-15% Lower – <1m/40-50%
TSC Act Status	This vegetation zone is consistent with the *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC* listed under the TSC Act (refer to **Appendix D**).
EPBC Act Status	This vegetation zone is consistent with *Brigalow (Acacia harpophylla dominant and co-dominant) EEC* under the EPBC Act (refer to **Appendix D**).

3.2.1.3 Vegetation Zone 3 – BR130, NA129 - Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion – Moderate to Good Condition

PCT Name	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	
Condition	Moderate to Good	
PCT Number	39	
BVT Number	BR130, NA129	
Formation	Semi-arid Woodlands (Grassy sub-formation)	
Class	North-west Floodplain Woodlands	
No. Plots/transects	Two (P23 and P62)	
Total Area in Development Site (ha)	1.19	
General Description	This vegetation zone occurs as small, isolated patches within the Development Site due to historic clearing (refer to **Appendix A**). The vegetation zone occupies alluvial loams and clays of drainage depressions and streambanks within the Development Site.	
Floristic Description	This community is open woodland dominated by coolabah (*Eucalyptus coolabah* subsp. *coolabah*) often with river red gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*). The midstorey is generally sparse and dominated by river cooba (*Acacia stenophylla*). Other midstorey species include rosewood (*Alectryon oleifolius*), mimosa bush (*Vachellia farnesiana*), desert jasmine (*Jasminum lineare*), native olive (*Notelaea microcarpa* var. *microcarpa*) and western boobialla (*Myoporum montanum*). The ground layer is dominated by tufted grasses, chenopods and forbs including *Leptochloa asthenes*, slender panic (*Paspalidium gracile*), early spring grass (*Eriochloa pseudoacrotricha*), New Zealand spinach (*Tetragonia tetragonioides*), ruby saltbush (*Enchylaena tomentosa*), black roly-poly (*Sclerolaena muricata* var. *muricata*), *Rhynchosia minima* and *Brachyscome dentata*. Non-native species include urochloa grass (*Urochloa panicoides*), cobbler's pegs (*Bidens pilosa*) and black-berry nightshade (*Solanum nigrum*). African boxthorn (*Lycium ferocissimum*), a WoNS, occurs in this community.	
Structure	Upper – 2-10m/20-35% Midstorey – 2-5m/5-30% Lower – <0.5m/30-60%	
TSC Act Status	This vegetation zone is consistent with the *Coolibah - Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions EEC* listed under the TSC Act (refer to **Appendix D**).	
EPBC Act Status	This vegetation zone is consistent with *Coolibah – Black Box Woodland of the Darling Riverine Plains and the Brigalow Belt South Bioregion EEC* under the EPBC Act (refer to **Appendix D**).	

3.2.1.4 Vegetation Zone 4 – BR191, NA187– Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion – Moderate to Good Condition

PCT Name	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	
Condition	**Moderate to Good**	
PCT Number	52	
BVT Number	BR191, NA187	
Formation	Grasslands	
Class	Semi-arid Floodplain Grasslands	
No. Plots/transects	Fourteen (P03, P16, P20, P21, P22, P22A,P23B,P44, P50, P51, P52, P54, P55, P56 and P57)	
Total Area in Development Site (ha)	268.64	
General Description	This vegetation zone primarily occurs south of Moree chiefly between Gurley and Bellata, with isolated occurrences between Moree and North Star (refer to **Appendix A**). It is limited to alluvial loams and clays on alluvial plains and floodplains throughout the Development Site.	
Floristic Description	This mixed tussock grassland is dominated by Queensland bluegrass (*Dichanthium sericeum* subsp. *sericeum*) with mimosa bush (*Vachellia farnesiana*) and/or river cooba (*Acacia stenophylla*) often present in the midstorey. Other native grasses include plains grass (*Austrostipa aristiglumis*), white speargrass (*Aristida leptopoda*), curly windmill grass (*Enteropogon acicularis*), umbrella grass (*Digitaria divaricatissima*), curly Mitchell grass (*Astrebla lappacea*), wallaby grass (*Rytidosperma fulva*), slender panic (*Paspalidium gracile*), warrego grass (*Paspalidium jubiflorum*), early spring grass (*Eriochloa pseudoacrotricha*) and button grass (*Dactyloctenium radulans*). Common native herbs and forbs generally include quena (*Solanum esuriale*), sensitive plant (*Neptunia gracilis f. gracilis*), flat Billy buttons (*Leiocarpa brevicompta*), *Rhynchosia minima* and emu-foot (*Cullen tenax*). Less common native herbs and forbs include tarvine (*Boerhavia dominii*), pigweed (*Portulaca oleracea*), common nardoo (*Marsilea drummondii*), rough fuzzweed (*Vittadinia pterochaeta*), maloga pea (*Vigna lanceolata*) and caustic weed (*Chamaesyce drummondii*). In some patches, chenopod shrubs such as black roly-poly (*Sclerolaena muricata*) and knotweed goosefoot (*Einadia polygonoides*) occur sporadically. Non-native species occurring within the midstorey is limited to coffee senna (*Senna occidentalis*). The common non-native grasses, herbs and forbs are bearded oats (*Avena barbata),* coolatai grass (*Hyparrhenia hirta*), urochloa grass (*Urochloa panicoides*), flaxleaf fleabane (*Conyza bonariensis*), *sida spinosa*, maynes pest (*Glandularia aristigera*), and cat-head (*Tribulus terrestris*). Two threatened plants are also often affiliated with this community: namely, finger panic grass (*Digitaria porrecta*) and creeping tick-trefoil (*Desmodium campylocaulon*).	

PCT Name	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
Condition	Moderate to Good
Structure	Midstorey – 0.5-1m/0-25% Lower – <0.5m/75-95%
TSC Act Status	This vegetation zone does not conform to a TEC listed under the TSC Act. This vegetation community was compared to the Native Vegetation on Cracking Clay Soils of the Liverpool Plains EEC under the TSC Act, however was determined to not meet the known distribution. This EEC is found within the Liverpool Plains Catchment, the Mooki River, Coxs Creek and their tributaries drain this catchment into the Namoi River (refer to **Appendix D**).
EPBC Act Status	This vegetation zone is consistent with *Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC* under the EPBC Act (refer to **Appendix D**).

3.2.1.5 Vegetation Zone 5 – BR186, NA182– Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW – Moderate to Good Condition

PCT Name	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	
Condition	Moderate to Good	
PCT Number	56	
BVT Number	BR186, NA182	
Formation	Grassy Woodlands	
Class	Floodplain Transition Woodlands	
No. Plots/transects	Eight (P05, P06, P07, P09, P26, P33 and P45)	
Total Area in Development Site (ha)	71.95	
General Description	This vegetation zone primarily occurs on the alluvial plains consisting of red clay loams within the Development Site (refer to **Appendix A**).	
Floristic Description	This open woodland is dominated by bimble box (*Eucalyptus populnea* subsp. *bimbil*) and/or belah (*Casuarina cristata*). The midstorey is sparse and includes western boobialla (*Myoporum montanum*), native olive (*Notelaea microcarpa* var. *microcarpa*), wilga (*Geijera parviflora*) and native orange (*Capparis mitchellii*). In some patches, white cypress pine (*Callitris glaucophylla*) may also be present. The ground layer varies from sparse to mid-dense and is dominated by native grasses such as windmill grass (*Chloris truncata*), Queensland bluegrass (*Dichanthium sericeum* subsp *sericeum*), rough speargrass (*Austrostipa scabra*) and slender bamboo grass (*Austrostipa verticillata*). Native chenopods, such as galvanized burr (*Sclerolaena birchii*), berry saltbush (*Einadia hastata*), climbing saltbush (*Einadia nutans*), ruby saltbush (*Enchylaena tomentosa*), thorny saltbush (*Rhagodia spinescens*), black roly-poly (*Sclerolaena muricata*) are common. Native herbs and forbs occur	

PCT Name	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
Condition	Moderate to Good
	sporadically and frequently include yellow burr-daisy (*Calotis lappulacea*), *Rhynchosia minima*, caustic weed (*Chamaesyce drummondii*) and sensitive plant (*Neptunia gracilis f. gracilis*). Non-native species include black-berry nightshade (*Solanum nigrum*), cobbler's pegs (*Bidens pilosa*), Gomphrena weed (*Gomphrena celosioides*), mayne's pest (*Glandularia aristigera*) and common peppercress (*Lepidium africanus*). Common prickly pear (*Opuntia stricta*), a WoNS, occurs in this community.
Structure	Upper – 15-20m/5-10% Midstorey – 3-6m/3-10% Lower – <1m/45-85%
TSC Act Status	This vegetation zone does not conform to a TEC listed under the TSC Act.
EPBC Act Status	This vegetation zone does not conform to a TEC listed under the EPBC Act.

3.2.1.6 Vegetation Zone 6 – BR186, NA182– Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW – Moderate to Good Condition – Derived Native Grasslands

PCT Name	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	
Condition	Moderate to Good – Derived Native Grassland	
PCT Number	56	
BVT Number	BR186, NA182	
Formation	Grassy Woodlands	
Class	Floodplain Transition Woodlands	
No. Plots/transects	Seven (P31, P34, P41, P46, P58, P59 and P61)	
Total Area in Development Site (ha)	108.20	
General Description	This vegetation zone typically lacks an upper storey and primarily occurs on the alluvial plains consisting of red clay loams within the Development Site (refer to **Appendix A**). Often these derived native grassland exist adjacent Vegetation Zone 5 – BR186, NA182– Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW – Moderate to Good Condition remnants.	

PCT Name	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
Condition	Moderate to Good – Derived Native Grassland
Floristic Description	This native grassland is derived from Vegetation Zone 5 – BR186, NA182– Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW – Moderate to Good Condition and dominated by tussock grasses, namely windmill grass (*Chloris truncata*), plains grass (*Austrostipa aristiglumis*), rough speargrass (*Austrostipa scabra*), paddock lovegrass (*Eragrostis leptostachya*), kangaroo grass (*Themeda triandra*) and *Panicum buncei.* Chenopods including galvanized burr (*Sclerolaena birchii*), berry saltbush (*Einadia hastata*), climbing saltbush (*Einadia nutans*), ruby saltbush (*Enchylaena tomentosa*), thorny saltbush (*Rhagodia spinescens*) and black roly-poly (*Sclerolaena muricata*) are also common. Native forbs and herbs occur sporadically and include yellow burr-daisy (*Calotis lappulacea*), *Rhynchosia minima* and sensitive plant (*Neptunia gracilis f. gracilis*). Non-native species include Bathurst burr (*Xanthium spinosum*), *Sida spinosa,* cat-head (*Tribulus terrestris*) and turnip weed (*Rapistrum rugosum*) common prickly pear (*Opuntia stricta*), a WoNS, occurs in this community.
Structure	Upper – 2-5/0-5% Midstorey – 1-2m/2-10% Lower – <0.5m/30-70%
TSC Act Status	This vegetation zone does not conform to a TEC listed under the TSC Act.
EPBC Act Status	This vegetation zone does not conform to a TEC listed under the EPBC Act.

3.2.1.7 Vegetation Zone 7 – BR127, NA126 Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion– Moderate to Good Condition

PCT Name	Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	
Condition	Moderate to Good	
PCT Number	71	
BVT Number	BR127, NA126	
Formation	Semi-arid Woodlands (Shrubby sub-formation)	
Class	North-west Alluvial Sand Woodlands	
No. Plots/transects	One (P25)	
Total Area in Development Site (ha)	0.04	

PCT Name	Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
Condition	Moderate to Good
General Description	This vegetation zone occurs as one remnant patch within the Development Site (refer to **Appendix A**). The community is found on Aeolian sediments as well as alluvial clay loams on floodplain flats and gentle rises.
Floristic Description	This mid-high open woodland is dominated by carbeen (*Corymbia tessellaris*) with river red gum (*Eucalyptus camaldulensis*) occurring sporadically. The midstorey is sparsely dominated by mimosa bush (*Vachellia farnesiana*), cooba (*Acacia salicina*), native olive (*Notelaea microcarpa* var. *microcarpa*) and the non-native WoNS, African boxthorn (*Lycium ferocissimum*). The understorey is dominated by chenopods, grasses, herbs and forbs. Chenopods include thorny saltbush (*Rhagodia spinescens*), fishweed (*Einadia trigonos*) and berry saltbush (*Einadia hastata*). Native grasses, herbs and forbs include Queensland bluegrass (*Dichanthium sericeum*), slender panic (*Paspalidium gracile*), *Aristida personata*, umbrella grass (*Digitaria divaricatissima*), New Zealand spinach (*Tetragonia tetragonoides*), emu-foot (*Cullen tenax*) and native wandering Jew (*Commelina cyanea*). Non-native species include Cobblers pegs (*Bidens pilosa*), panic veldtgrass (*Ehrharta erecta*), urochloa grass (*Urochloa panicoides*), cat-head (*Tribulus terrestris*) and turnip weed (*Rapistrum rugosum*).
Structure	Upper – 10-20m/15-20% Midstorey – 0.5-5m/10-15% Lower – <0.5-1m/70-85%
TSC Act Status	This vegetation zone is consistent with the *Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC* listed under the TSC Act (refer to **Section 3.2.3.8**).
EPBC Act Status	This vegetation zone does not conform to a TEC listed under the EPBC Act.

3.2.1.8 Vegetation Zone 8 – BR196, NA193 River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion – Moderate to Good Condition

PCT Name	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	
Condition	Moderate to Good	
PCT Number	78	
BVT Number	BR196, NA193	
Formation	Forested Wetlands	
Class	Inland Riverine Forests	
No. Plots/transects	Five (P24, P30, P35, P48 and P60)	
Total Area in Development Site (ha)	14.70	
General Description	This vegetation zone occupies alluvial loam soils of the Development Site, primarily along the banks of watercourses and on adjoining alluvial flats (refer to **Appendix A**).	
Floristic Description	This community is a tall open woodland dominated by river red gum (*Eucalyptus camaldulensis*). Generally the community is heavily disturbed and is characterised by a predominantly native upper storey and highly diverse and exotic understorey. The midstorey varies from sparse to mid-dense and includes native olive (*Notelaea microcarpa* var. *microcarpa*), cooba (*Acacia salicina*), wilga (*Geijera parviflora*), budda (*Eremophila mitchellii*) and western boobialla (*Myoporum montanum*). In most patches, the invasive shrub and WoNS, African boxthorn (*Lycium ferocissimum*) is also present. The ground cover is generally dominated by grasses, herbs and forbs including Queensland bluegrass (*Dichanthium sericeum* subsp. *sericeum*), weeping grass (*Microlaena stipoides*), barbed wire grass (*Cymbopogon refractus*), common couch (*Cynodon dactylon*), button grass (*Dactyloctenium radulans*), native carrot (*Daucus glochidiatus*), native wandering Jew (*Commelina cyanea*), berry saltbush (*Einadia hastata*), *tarvine* (*Boerhavia dominii*) and native pennyroyal (*Mentha satureioides*). Non-native species are abundant and include Bathurst burr (*Xanthium spinosum*), Rhodes grass (*Chloris gayana*), black-berry nightshade (*Solanum nigrum*), lippia (*Phyla canescens*), Bishops weed (*Ammi majus*) and curled dock (*Rumex crispus*). WoNS being tiger pear (*Opuntia aurantiaca*), common prickly pear (*Opuntia stricta*), also occur in this community.	
Structure	Upper – 10-20m/10-20% Midstorey –1.5-15m/5-35% Lower – <1m/25-95%	
TSC Act Status	This vegetation zone does not conform to a TEC listed under the TSC Act.	
EPBC Act Status	This vegetation zone does not conform to a TEC listed under the EPBC Act.	

3.2.1.9 Vegetation Zone 9 – BR284, NA271– Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion – Moderate to Good Condition

PCT Name	Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion	
Condition	Moderate to Good	
PCT Number	135	
BVT Number	BR284, NA271	
Formation	Semi-arid Woodlands (Shrubby sub-formation)	
Class	Western Peneplain Woodlands	
No. Plots/transects	Three (P10, P11 and P12)	
Total Area in Development Site (ha)	3.79	
General Description	This vegetation zone mostly occurs as linear patches on the black loam soils including basalt derived soils on the low hills near Bellata (refer to **Appendix A**).	
Floristic Description	This community is a low open woodland dominated by cooba (*Acacia salicina*). The midstorey is generally absent with the exception of regenerating cooba (*Acacia salicina*) and the non-native shrub and WoNS, African boxthorn (*Lycium ferocissimum*). The understorey is heavily disturbed and is generally dominated by a variety of native and non-native grasses, herbs and forbs such as emu-foot (*Cullen tenax*), *Rhynchosia minima*, slender panic (*Paspalidium gracile*) and umbrella grass (*Digitaria divaricatissima*). Non-native species include Cobblers pegs (*Bidens pilosa*), Johnson grass (*Sorghum halepense*), buffel grass (*Cenchrus pennisetiformis*) and urochloa grass (*Urochloa panicoides*).	
Structure	Upper – 10-20m/20-35% Midstorey – 1-10m/1-5% Lower – <1m/30-90%	
TSC Act Status	This vegetation zone does not conform to a TEC listed under the TSC Act.	
EPBC Act Status	This vegetation zone does not conform to a TEC listed under the EPBC Act.	

3.2.1.10 Vegetation Zone 10 – BR346, NA348 Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion –Moderate to Good Condition

PCT Name	Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion	
Condition	**Moderate to Good**	
PCT Number	413	
BVT Number	BR346, NA348	
Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)	
Class	North-west Slopes Dry Sclerophyll Woodlands	
No. Plots/transects	Three (P08, P27 and P53)	
Total Area in Development Site (ha)	2.59	
General Description	This vegetation zone occurs as small remnant patches throughout the Development Site (refer to **Appendix A**). The community occupies red sandy loam and clay loam soils on the slight rises and low hills within the Development Site.	
Floristic Description	This tall open woodland is dominated by silver-leaved ironbark (*Eucalyptus melanophloia*). In some patches, white cypress pine (*Callitris glaucophylla*) may be co-dominant and bimble box (*Eucalyptus populnea* subsp. *bimbil*) and/or belah (*Casuarina cristata*) may occur as a subdominant species. The midstorey varies from sparse to mid-dense and is dominated by wilga (*Geijera parviflora*), green wattle (*Acacia deanei*), *western* boobialla (*Myoporum montanum*), native orange (*Capparis mitchellii*) and native olive (*Notelaea microcarpa* var. *microcarpa*). The ground cover is generally dense and dominated by native and non-native grasses, herbs and forbs. Native grasses predominantly include common couch (*Cynodon dactylon*), slender rat's tail grass (*Sporobolus creber*), umbrella grass (*Digitaria divaricatissima*) and rough speargrass (*Austrostipa scabra* subsp. *falcata*). Native herbs and forbs typically include yellow burr-daisy (*Calotis lappulacea*), climbing saltbush (*Einadia nutans*), bindweed (*Evolvulus alsinoides*) and corrugated sida (*Sida corrugata*). Non-native grasses typically include red natal grass (*Melinis repens*), Rhodes grass (*Chloris gayana*) and Johnsons grass (*Sorghum halepense*) while non-native herbs and forbs generally includes Maynes pest (*Glandularia aristigera*). WoNS occurring in this community include common prickly pear (*Opuntia stricta*) and African boxthorn (*Lycium ferocissimum*).	
Structure	Upper – 10-25m/5-40% Midstorey – 3-10m/5-10% Lower – <1m/30-80%	
TSC Act Status	This vegetation zone does not conform to a TEC listed under the TSC Act.	
EPBC Act Status	This vegetation zone does not conform to a TEC listed under the EPBC Act.	

3.2.1.11 Cleared/Non-native Vegetation

Cleared/non-native vegetation occupies the majority of the rail corridor within the Development Site. The community is dominated by non-native species and is frequently subjected to disturbances from surrounding land uses, weed spraying and frequent mowing regimes.

This community is characterised by a predominantly dense understorey of non-native grasses, forbs and herbs. Dominant grasses typically include Johnson grass (*Sorghum halepense*), paspalum (*Paspalum dilatatum*), bearded oats (*Avena barbata*), *Setaria parviflora* and urochloa grass (*Urochloa panicoides*). Dominant non-native forbs and herbs typically include paddy's lucerne (*Sida rhombifolia*), Cobblers pegs (*Bidens pilosa*), *Centaurium tenuiflorum*, flaxleaf fleabane (*Conyza bonariensis*), cat-head (*Tribulus terrestris*), Bathurst burr (*Xanthium spinosum*), spiked malvastrum (*Malvastrum americanum*), tiger pear (*Opuntia aurantiaca*) and prickly pear (*Opuntia stricta*). Native species occur sporadically and in low abundance. The common native species encountered include button grass (*Dactyloctenium radulans*), rough fuzzweed (*Vittadinia pterochaeta*), emu-foot (*Cullen tenax*), berry saltbush (*Einadia hastata*), black roly-poly (*Sclerolaena muricata* var. *muricata*) and fine sida (*Sida filiformis*).

Cleared/non-native vegetation in the Development Site does not meet the definition of 'native vegetation' under the *Native Vegetation Act 2003* and therefore could not be aligned with a BVT or vegetation zone and is excluded from further assessment as per Section 9.5 of the FBA (OEH 2014a).

3.2.2 Current Site Value

Table 3.5 below details the current site value scores for each of the vegetation zones in the Development Site. The raw site condition attribute data for each of the vegetation zones is provided in **Appendix C**.

3.2.3 Threatened Ecological Communities

Eight vegetation communities mapped within the Development Site conform to State and Commonwealth listed TECs, comprising:

- Weeping Myall Woodlands:
    - *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes Bioregions EEC* under the TSC Act.
    - *Weeping Myall Woodlands EEC* under the EPBC Act
- Brigalow Woodlands:
    - *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC* under the TSC Act
    - *Brigalow (Acacia harpophylla dominant and co-dominant) EEC* under the EPBC Act
- Coolibah Woodlands:
    - *Coolibah - Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions EEC* under the TSC Act
    - *Coolibah – Black Box Woodland of the Darling Riverine Plains and the Brigalow Belt South Bioregion EEC* under the EPBC Act

- Natural Grasslands:
    - *Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC* under the EPBC Act
- Carbeen Open Woodlands:
    - *Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC* under the TSC Act.

Analysis of consistency with the scientific determinations for each TEC was undertaken, with consideration of the advice provided by the NSW Scientific Committee and/or the Commonwealth Threatened Species Scientific Committee guidelines for interpreting listings for species, populations and ecological communities under the TSC Act and EPBC Act respectively. The vegetation zones described in Section 3.2.1 conform to the listing advice provided for each of the TECs, except where minimum patch sizes are required or when the TEC is excluded on the basis of bioregion. Detailed analysis of the vegetation zones with respect to the NSW Scientific Committee and/or the Commonwealth Threatened Species Scientific Committee determinations is provided in **Appendix D**.

Table 3.5 Vegetation Zone Site Value Scores

Veg Zone	PCT Name	Current Site Value Score				
		Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion
1	PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	Not present	60.29	60.29	Not present	60.29
2	PCT35 (BR120, NA117) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion *Moderate to Good*	Not present	Not present	87.61	Not present	Not present
3	PCT39 (BR130, NA129) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion *Moderate to Good*	Not present	Not present	64.48	Not present	Not present
4	PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion *Moderate to Good_Natural Grassland*	Not present	Not present	64.00	64.00	64.00

Veg Zone	PCT Name	Current Site Value Score				
		Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion
5	PCT56 (BR186, NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good*	75.41	75.41	75.41	Not present	75.41
6	PCT56 (BR186; NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good_DNG*	37.70	37.70	37.70	Not present	37.70
7	PCT71 (BR127, NA126) Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion *Moderate to Good*	Not present	Not present	52.60	Not present	Not present
8	PCT78 (BR196, NA193) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	Not present	55.19	55.19	55.19	55.19
9	PCT135 (BR284, NA271) Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion *Moderate to Good*	Not present	41.32	43.75	Not present	Not present

Veg Zone	PCT Name	Current Site Value Score				
		Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion
10	PCT413 (BR346, NA348) Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion *Moderate to Good*	51.56	51.56	51.56	Not present	Not present

3.3 Threatened Species within the Development Site

3.3.1 Ecosystem-credit Species

3.3.1.1 Predicted Species

Table 3.6 below identifies the ecosystem-credit species predicted to occur by the BioBanking Calculator within each of the five assessment areas. Although targeted surveys for ecosystem-credit species are not required in accordance with the FBA methodology, some of these species were incidentally identified during the surveys undertaken within the Development Site. The ecosystem-credit species recorded in the Development Site are listed in **Table 3.6**.

Table 3.6 Predicted Ecosystem-credit Species

Species Name	TSC Act	EPBC Act	Predicted in the BBCC					Threatened Species Offset Multiplier	Recorded within the Develop-ment Site
			Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	Assessment 2 Namoi CMA Northern Outwash IBRA Subregion	Assessment 3 Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	Assessment 4 Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	Assessment 5 Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
Australian bustard *Ardeotis australis*	E	-	✓	✓	✓	✓	×	2.6	No
Australian painted snipe *Rostratula australis*	E	E	×	✓	×	✓	✓	1.3	No
barking owl *Ninox connivens*	V	-	✓	✓	✓	✓	✓	3.0	No
black-chinned honeyeater *Melithreptus gularis* subsp. *gularis*	V	-	✓	✓	✓	✓	✓	1.3	No
Brolga *Grus rubicunda*	V	-	×	✓	×	✓	×	1.3	No
brown treecreeper *Climacteris picumnus* subsp. *victoriae*	V	-	✓	✓	×	×	✓	2.0	No
bush stone curlew *Burhinus grallarius*	E	-	×	✓	✓	✓	×	2.6	No
Corben's long-eared bat *Nyctophilus corbeni*	V	V	✓	✓	✓	✓	✓	2.1	No

Species Name	TSC Act	EPBC Act	Predicted in the BBCC					Threatened Species Offset Multiplier	Recorded within the Develop-ment Site
			Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	Assessment 2 Namoi CMA Northern Outwash IBRA Subregion	Assessment 3 Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	Assessment 4 Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	Assessment 5 Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
diamond firetail *Stagonopleura guttata*	V	-	✓	✓	✓	✓	✓	1.3	No
freckled duck *Stictonetta naevosa*	V	-	×	✓	×	×	×	1.3	No
eastern grass owl *Tyto longimembris*	V	-	×	×	✓	✓	×	1.3	No
glossy black-cockatoo *Calyptorhynchus lathami*	V	-	✓	✓	✓	✓	✓	1.8	No
grey-crowned babbler *Pomatostomus temporalis* subsp. *temporalis*	V	-	✓	✓	✓	✓	✓	1.3	Yes
hooded robin *Melanodryas cucullata* subsp. *Cucullata*	V	-	✓	✓	✓	✓	✓	1.7	No
little eagle *Hieraaetus morphnoides*	V	-	✓	✓	✓	✓	✓	1.4	No
little lorikeet *Glossopsitta pusilla*	V	-	✓	✓	×	×	×	1.8	No

Species Name	TSC Act	EPBC Act	Predicted in the BBCC					Threatened Species Offset Multiplier	Recorded within the Develop-ment Site
			Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	Assessment 2 Namoi CMA Northern Outwash IBRA Subregion	Assessment 3 Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	Assessment 4 Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	Assessment 5 Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
little pied bat *Chalinolobus picatus*	V	-	✓	✓	✓	✓	✓	2.1	Yes
magpie goose *Anseranas semipalmata*	V	-	×	✓	×	✓	×	1.3	No
masked owl *Tyto novaehollandiae*	V	-	✓	✓	×	×	✓	3.0	No
painted honeyeater *Grantiella picta*	V	V	✓	✓	✓	×	✓	1.3	No
Pilliga mouse *Pseudomys pilligaensis*	V	V	×	✓	×	×	×	2.6	No
red-tailed black-cockatoo *Calyptorhynchus banksii* subsp. *samueli*	V	-	×	×	×	✓	×	1.8	No
scarlet robin *Petroica boodang*	V	-	×	✓	×	×	×	1.3	No
speckled warbler *Chthonicola sagittata*	V	-	✓	✓	✓	✓	✓	2.6	No

Species Name	TSC Act	EPBC Act	Predicted in the BBCC					Threatened Species Offset Multiplier	Recorded within the Develop-ment Site
			Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	Assessment 2 Namoi CMA Northern Outwash IBRA Subregion	Assessment 3 Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	Assessment 4 Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	Assessment 5 Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
spotted harrier *Circus assimilis*	V	-	✓	✓	✓	✓	✓	1.4	No
spotted-tailed quoll *Dasyurus maculatus*	V	E	✓	✓	×	×	×	2.6	No
square-tailed kite *Lophoictinia isura*	V	-	×	✓	✓	✓	✓	1.4	No
stripe-faced dunnart *Sminthopsis macroura*	V	-	×	✓	✓	✓	✓	2.6	No
swift parrot *Lathamus discolour*	E	CE	✓	✓	×	×	✓	1.3	No
turquoise parrot *Neophema pulchella*	V	-	✓	✓	✓	✓	✓	1.8	No
varied sittella *Daphoenositta chrysoptera*	V	-	✓	✓	✓	✓	✓	1.3	Yes
yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	V	-	✓	✓	✓	✓	✓	2.2	Yes

3.3.1.2 Survey Results

Five ecosystem- credit species were recorded in the Development Site during the surveys undertaken for this assessment. These were the:

- grey-crowned babbler (*Pomatostomus temporalis temporalis*)
- varied sittella (*Daphoenositta chrysoptera*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) (not predicted in the BBCC)
- little pied bat (*Chalinolobus picatus*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*).

No other records of ecosystem-credit species are known to occur within the Development Site. A discussion relating to these records is provided below and a full fauna species list from the surveys undertaken by Umwelt is included in **Appendix E**.

Grey-crowned babbler – *Pomatostomus temporalis temporalis*

The grey-crowned babbler (eastern subspecies) is listed as vulnerable under the TSC Act. This species occurs within Queensland, NSW and Victoria. Within NSW, this species generally occurs on the western slopes of the Great Dividing Range.

The grey-crowned babbler was recorded on five occasions within the Development Site during the surveys undertaken for this assessment:

- One individual was recorded on 5 February 2016 at approximately KP 647.5 km
- One individual was recorded on 29 September 2014 at approximately KP 722.5 km
- Five individuals were recorded on 23 February 2016 at approximately KP 741.5 km
- Ten individuals were recorded on 23 February 2016 at approximately KP 758 km
- Two individuals were recorded on 24 April 2016 at approximately KP 628 km.

The grey-crowned babbler inhabits open box-gum woodlands on the slopes, and Box-cypress-pine and open box woodlands on alluvial plains. The Development Site contains known habitat for the species.

Varied sittella – *Daphoenositta chrysoptera*

The varied sittella is listed as vulnerable under the TSC Act. This species is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west.

The varied sittella was recorded on one occasion within the Development Site during the surveys undertaken for this assessment at KP 619.5 km on 22 April 2016 in Poplar Box - Belah Woodland.

The varied sittella inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. The Development Site contains known habitat for the species.

Eastern bentwing-bat - *Miniopterus schreibersii oceanensis*

The eastern bentwing-bat is listed as vulnerable under the TSC Act. This species occurs along the east and north-west coasts of Australia.

The eastern bentwing-bat was recorded at one location within the Development Site during the echolocation surveys undertaken for this assessment:

- Site 16a – within Poplar Box - Belah woodland north of Bunna Bunna Creek at approximately KP 712.5 km on 10 December 2015.

The species roost in caves, derelict mines, storm-water tunnels and man-made structures and forage in forested areas. The Development Site contains known foraging habitat for the species. This species is also a species-credit species for breeding habitat, however potential breeding habitat was not recorded during the surveys undertaken for this assessment.

Little pied bat - *Chalinolobus picatus*

The little pied bat is listed as vulnerable under the TSC Act. This species is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria.

The little pied bat was recorded at four locations within the Development Site during the echolocation surveys undertaken for this assessment:

- Site 15 – within riparian flyaway habitat associated with the Gwydir River at approximately KP 676.3 km
- Site 16 – within woodland habitats at approximately KP 696.4 km
- Site 16a – within woodland habitats north of Bunna Bunna Creek at approximately KP 712.5 km
- Site 18 – within riparian flyaway habitat associated with the Croppa Creek at approximately KP 735.1 km.

This species occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and bimble box woodlands and roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. The Development Site contains known habitat for the species.

Yellow-bellied sheathtail-bat - *Saccolaimus flaviventris*

The yellow-bellied sheathtail-bat is listed as vulnerable under the TSC Act. It is found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia – it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.

The yellow-bellied sheathtail-bat was recorded at six locations within the Development Site during the echolocation surveys undertaken for this assessment:

- Site 10 - within woodland habitats at approximately KP 644.2 km
- Site 15 - within riparian flyaway habitat associated with the Gwydir River at approximately KP 676.3 km
- Site 16 - within woodland habitats at approximately KP 696.4 km
- Site 16a – within woodland habitats north of Bunna Bunna Creek at approximately KP 712.5 km

- Site 18 – within riparian flyaway habitat associated with the Croppa Creek at approximately KP 735.1 km

- Site 20 – within riparian flyaway habitat associated with the Tackinbri Creek at approximately KP 744.5 km.

This species roosts in tree hollows and buildings, and mammal burrows in treeless areas. They forage in most habitats across their range. The Development Site contains known habitat for the species.

3.3.2 Species-credit Species

3.3.2.1 Geographic and Habitat Features

Twelve geographic and habitat features (refer to **Table 3.7**) were chosen in the BioBanking Credit Calculator as having broad features that match site habitats at the Development Site. Other geographic and habitat features were considered as not having broad features that match the Development Site habitats and were therefore not relevant to the Development Site and were filtered out of the subsequent steps of the assessment.

Table 3.7 Geographic and Habitat Features in the Development Site

Geographic/Habitat Feature	Relevant Species-credit Species
land north of Gunnedah in Liverpool Plains (Part B) CMA subregion	black-striped wallaby (*Macropus dorsalis*)
suitable habitat is dominated by brigalow, *Acacia harpophylla* and Bulloak, *Casuarina cristata* on clay soils on flat to gently undulating plains, usually with scattered emergent eucalypts such as Poplar Box, *Eucalyptus populnea* and low trees of Wilga, *Geijera parviflora*	pale imperial hairstreak (*Jalmenus eubulus*)
land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber	pale-headed snake (*Hoplocephalus bitorquatus*)
land containing soil cracks or fallen timber and litter	five-clawed worm-skink (*Anomalopus mackayi*)
land within 40 m of freshwater or saline wetlands (eg saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)	black-necked stork (*Ephippiorhynchus asiaticus*)
land within 100 m of riparian woodland on inland rivers containing mature living eucalypts or isolated paddock trees overhanging water or dry watercourses	grey falcon (*Falco hypoleucos*)
land within 40 m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts	Black-breasted buzzard (*Hamirostra melanosternon*)
land within 100 m of watercourses or dams surrounded by eucalypts containing hollows	bristle-faced free-tailed bat (*Mormopterus eleryi*)
wetlands and wet run on areas	*Cyperus conicus*

Geographic/Habitat Feature	Relevant Species-credit Species
dry woodland on poor soils or areas of basalt capping over sandstone	Belson's panic (*Homopholis belsonii*)
on ridges of gilgai clays	spiny peppercress (*Lepidium aschersonii*)
coastal headlands, grassland, grassy open forest or woodland on fertile or moderately fertile soils	Austral toadflax (*Thesium australe*)

3.3.2.2 Predicted Species

Table 3.8 below outlines the species-credit species predicted to occur by the BioBanking Credit Calculator and whether they are considered to occur in the Development Site. **Table 3.8** also includes species not predicted by the BBCC, but specifically surveyed for in accordance with the literature review and methods outlined in **Section 2.0** where potential habitat for these additional species was identified.

Table 3.8 Predicted Species-credit Species

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
austral toadflax *Thesium australe* (Vulnerable under the TSC and EPBC Acts)	×	✓	×	×	×	No	Austral toadflax was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition. The nearest record of this species occurs over 50 kilometres to the east of the Development Site (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
Belson's panic *Homopholis belsonii* (Endangered under the TSC Act and vulnerable under the EPBC Act)	✓	✓	✓	✓	✓	Yes	Belson's panic was recorded within the Development Site during the surveys undertaken for this assessment. 73 individuals at four locations were recorded on alluvial clay soils within the understorey weeping myall open woodlands (refer to **Section 3.3.2.3**).

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
Bluegrass *Dichanthium setosum* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	×	✓	No	Bluegrass was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are highly disturbed, and the species is not expected to occur and is not likely to be impacted by the proposal.
creeping tick-trefoil *Desmodium campylocaulon* (Endangered under the TSC Act)	×	×	✓	✓	✓	Yes	Creeping tick-trefoil was recorded within the Development Site during the surveys undertaken for this assessment. 2559 individuals were recorded within and immediately adjacent to the Development Site in naturally-occurring native grasslands (refer to **Section 3.3.2.3**).
Cyperus conicus (Endangered under the TSC Act)	×	×	✓	×	✓	No	*Cyperus conicus* was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are highly disturbed. The closest record of the species occurs northwest of Narrabri approximately 20 km from

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							the Development Site (OEH 2016d). This species is unlikely to occur in the Development Site and is not likely to be impacted by the proposal.
finger panic grass *Digitaria porrecta* (Endangered under the TSC Act)	✓	✓	✓	✓	✓	Yes	Finger panic grass was recorded within the Development Site during the surveys undertaken for this assessment. 28 individuals were recorded within the Development Site in naturally-occurring native grasslands (refer to **Section 3.3.2.3**).
pine donkey orchid *Diuris tricolor* (Vulnerable under the TSC Act)	×	×	×	×	✓	No	Pine donkey orchid was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition. A population is known to occur in the Pilliga conservation reserves approximately 30km south of the Development Site (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
native milkwort *Polygala linariifolia* (Endangered under the TSC Act)	✓	✓	✓	×	×	No	Native milkwort was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition. Populations are known to occur in the Pilliga conservation reserves approximately 30km south of the Development Site and east of Narrabri and Moree (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
scant Pomaderris *Pomaderris queenslandica* (Endangered under the TSC Act)	×	✓	×	×	✓	No	Scant Pomaderris was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition. Populations are known to occur in the Pilliga conservation reserves approximately 30km south of the Development Site east of Narrabri (OEH 2016d). This species is not likely to occur in the Development Site is not likely to not be impacted by the proposal.
slender darling pea *Swainsona murrayana* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	✓	×	No	Slender darling pea was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition. One old record made in 1968 of this species occurs within the Development Site at approximately 638km near Gurley. Despite searching

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							this location during September 2014, this species was not found. This record also has a very low accuracy (within 10 kilometres). The closest recent record of the species occurs near the rail corridor 10km south of Moree (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
spiny peppercress *Lepidium aschersonii* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	×	✓	No	Spiny peppercress was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition. The closest recent record of the species occurs approximately 10km to the east of the Development Site in Bobbiwaa State Forest (OEH 2016d). A population is also known from Brigalow SCA and Brigalow Park Nature Reserve 15km southwest of Narrabri (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							impacted by the proposal.
Ooline *Cadellia pentastylis* (Vulnerable under the TSC and EPBC Acts)	×	×	✓	×	×	No	Ooline was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition. Many records occurring near the Development Site are over 30 years old (OEH 2016d). The closest recent records of the species occur near Mount Kaputar National Park (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
Tylophora linearis (Vulnerable under the TSC Act and Endangered under the EPBC Act)	×	×	✓	×	×	No	*Tylophora linearis* was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are generally highly disturbed and in low condition due to surrounding agricultural practices and disturbance from the rail corridor. Populations are known to occur in the Pilliga conservation reserves approximately 30km south of the Development Site (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
pale imperial hairstreak *Jalmenus eubulus* (Critically endangered under the TSC Act)	×	×	✓	×	×	No	Pale imperial hairstreak was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. Although there were occasional wooded areas within the Development Site, these habitats were isolated and fragmented by agricultural lands. The

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							closest most recent record of the species occurs approximately 10 km to the northwest of the Development Site near North Star (OEH 2016d). No known populations of pale imperial hairstreak occur within the Development Site and it is considered that the species is not likely to be impacted as a result of the proposal.
five-clawed worm-skink *Anomalopus mackayi* (Endangered under the TSC Act and vulnerable under the EPBC Act)	×	×	✓	✓	✓	No	Five-clawed worm-skink was not recorded within the Development Site despite targeted fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs around Bellata less than 1km to the west of the Development Site (OEH 2016d). No known populations of five-clawed worm-skink occur within the Development Site and it is considered that the species is not likely to be impacted as a result of the proposal.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
pale-headed snake *Hoplocephalus bitorquatus* (Vulnerable under the TSC Act)	✓	✓	✓	✓	✓	No	Pale-headed snake was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. Although there were occasional wooded areas within the Development Site, these habitats were isolated and fragmented by agricultural lands. The closest record of the species occurs in the Moree township less than 1km from the Development Site (OEH 2016d). No known populations occur within the Development Site and it is considered that the species is not likely to be impacted as a result of the proposal.
Dunmall's snake *Furina dunmalli* (Vulnerable under the EPBC Act)	×	×	✓	×	×	No	Dunmall's snake was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs 50km to the northeast of the Development Site from North Star (OEH 2016d). No known populations occur within the Development Site and

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							it is considered that the species is not likely to be impacted as a result of the proposal.
black-breasted buzzard *Hamirostra melanosternon* (Vulnerable under the TSC Act)	×	✓	×	×	×	No	Black-breasted buzzard was not recorded within the Development Site despite thorough fauna surveys being undertaken. The closest records of the species occurs approximately 27 km west of Moree and approximately 15 east of Narrabri (OEH 2016d). Both records are reasonably old, being recorded in 1986 and 1983, respectively. No known populations occur within the Development Site and it is considered that the species will is not likely to impacted as a result of the proposal.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
black-necked stork *Ephippiorhynchus asiaticus* (Endangered under the TSC Act)	×	✓	✓	✓	✓	No	Black-necked stock was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs near Moree along the Mehi River (OEH 2016d). The Development Site does not intersect any floodplain wetlands that are required habitat for the species. This species is not likely to occur in the Development Site and will is not likely to impacted by the proposal.
grey falcon *Falco hypoleucus* (Endangered under the TSC Act)	×	✓	×	✓	×	No	Grey falcon was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 80 km to the west of the Development Site near Gwydir Wetlands SCA (OEH 2016d). This species is not likely to occur in the Development Site and will is not likely to impacted by the proposal.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
flock bronzewing *Phaps histrionic* (Endangered under the TSC Act)	×	×	×	✓	×	No	Flock bronzewing was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 90 km to the west of the Development Site near Collarenebri (OEH 2016d). This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
Koala *Phascolarctos cinereus* (Vulnerable under the TSC and EPBC Acts)	✓	✓	✓	✓	✓	Yes	Koala was recorded within the Development Site during the surveys undertaken for this assessment. The Development Site contains three known food tree species for this species (according to Appendix 2 of the Approved Recovery Plan (DECC 2008)) for the Western Slopes and Plains Koala Management Area. The Development Site provides known habitat for the species. Further information is provided in **Section 3.3.2.3**.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
rufous bettong *Aepyprymnus rufescens* (Vulnerable under the TSC Act)	✓	✓	×	×	×	No	Rufous bettong was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 50 km to the southwest of the Development Site within Pilliga SCA (OEH 2016d). Most records of the species occur to the east of the Great Dividing Range. This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
eastern pygmy-possum *Cercartetus nanus* (Vulnerable under the TSC Act)	✓	✓	×	×	×	No	Eastern pygmy-possum was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 25km to the south of the Development Site within Pilliga East State Forest (OEH 2016d). Most records of the species occur to the east of the Great Dividing Range. This species is not likely to occur in the Development

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							Site and is not likely to be impacted by the proposal.
squirrel glider *Petaurus norfolcensis* (Vulnerable under the TSC Act)	✓	✓	×	×	✓	No	Squirrel glider was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 10 km to the east of the Development Site within Bobbiwaa National Park (OEH 2016d). Other populations in the locality appear to be restricted to conservation areas. This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
black-striped wallaby *Macropus dorsalis* (Endangered under the TSC Act)	×	✓	×	×	×	No	Black-striped wallaby was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest recent record of the species occurs approximately 10 km to the east of the Development Site within Bullala State Forest (OEH 2016d). Other known populations in the locality appear to be

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							restricted to conservation areas. This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
grey-headed flying-fox *Pteropus poliocephalus* (Vulnerable under the TSC and EPBC Acts) (breeding habitat only)	×	×	×	×	×	No	Grey-headed flying-fox was recorded on one occasion within the Development Site. The nearest known roost camp site of the grey-headed flying-fox to the Development Site is at Blair Athol, near Inverell, approximately 120 kilometres south-east of the Development Site. No breeding habitat (camp sites) occurs within the Development Site and breeding habitat is not likely to be impacted by the proposal.

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
bristle-faced free-tailed bat *Mormopterus eleryi* (Endangered under the TSC Act)	×	×	✓	×	✓	No	Bristle-faced free-tailed bat was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 40 km to the east of the northern-most portion of the Development Site within Dthinna Dthinnawan National Park (OEH 2016d). Other populations in the locality appear to be restricted to conservation areas. This species is not likely to occur in the Development Site and is not likely to be impacted by the proposal.
large-eared pied bat *Chalinolobus dwyeri* (Vulnerable under the TSC and EPBC Acts) (Breeding habitat)	✓	✓	×	×	×	No	Large-eared pied bat was not recorded within the Development Site despite thorough fauna surveys undertaken in accordance with the seasonal requirements for this species. The closest record of the species occurs approximately 30 km to the east of the Development Site near Narrabri within Mount Kaputar National Park (OEH 2016d). Populations in the locality

Species Name	Location by Assessment and CMA/IBRA Subregion					Impacted by the proposal^	Justification
	Assessment 1 Namoi CMA Northern Basalts IBRA Subregion	**Assessment 2** Namoi CMA Northern Outwash IBRA Subregion	**Assessment 3** Border Rivers/Gwydir CMA Northern Outwash IBRA Subregion	**Assessment 4** Border Rivers/Gwydir CMA Castlereagh-Barwon IBRA Subregion	**Assessment 5** Border Rivers/Gwydir CMA Northern Basalts IBRA Subregion		
							appear to be restricted to conservation areas. This species is not likely to occur in the Development Site and breeding habitat is not likely to be impacted by the proposal.

^ As entered into the 'Threatened Species Survey Results' tab in the BBCC.

3.3.2.3 Survey Results

Five species-credit species were recorded in the Development Site during the surveys undertaken for this assessment, being:

- Belson's panic (*Homopholis belsonii*)
- creeping tick-trefoil (*Desmodium campylocaulon*)
- finger panic grass (*Digitaria porrecta*)
- koala (*Phascolarctos cinereus*)
- grey-headed flying-fox (*Pteropus poliocephalus*).

The grey-headed flying-fox generates species-credits for impacts on breeding habitat only. The nearest known roost camp site of the grey-headed flying-fox to the Development Site is at Blair Athol, near Inverell, approximately 120 kilometres south-east of the Development Site. A currently un-used camp site was formerly known at Barraba, approximately 75 kilometres east of Narrabri. The Development Site does not contain known camp sites of the grey-headed flying-fox. The population estimate for the grey-headed flying-fox population at Inverell is estimated at between 16000 and 49000 individuals (DoE 2016c). As no camp sites (i.e. breeding habitat) were recorded in the Development Site, species credits were not generated as part of this assessment and further discussion is not provided. The remaining species are discussed below.

Belson's panic - *Homopholis belsonii*

Belson's panic is listed as endangered under the TSC Act and vulnerable under the EPBC Act. It occurs on the northwest slopes and plains of NSW, mostly between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion.

Belson's panic was recorded on alluvial clay soils primarily within the understorey of remnant patches of PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (Moderate to Good condition) within the Development Site. A total of 73 individuals at four locations were recorded on 23 February 2016 south of North Star, between Crooble and Croppa Creek.

Creeping tick-trefoil - *Desmodium campylocaulon*

Creeping tick-trefoil is listed as endangered under the TSC Act. It occurs chiefly in the Collarenebri and Moree districts in the north-western plains of NSW. It also occurs in the Northern Territory and Darling Downs districts of south-eastern Queensland.

Creeping tick-trefoil was recorded on black clay soils in areas mapped as PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (Moderate to Good condition).

One individual was recorded on 9 April 2015 during the Ecological Constraints Assessment, while a further 2558 individuals were recorded between 2 February 2016 and 26 February 2016 during targeted species-credit species searches in the Development Site. Individuals were also mapped adjacent to the Development Site. The highest concentration of creeping tick-trefoil occurred south of Moree between Gurley and Bellata, however all patches of PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (Moderate to Good condition) were found to support the species.

According to the FBA methodology (OEH 2014), threatened flora species impacts are calculated using the number of individual plants to be removed. However the recently released NSW Guide to Surveying Threatened Plants (OEH 2016e) details the minimum standards assessors of development or conservation sites should adopt to identify threatened plants under the BioBanking Assessment Methodology, FBA and Biodiversity Certification Assessment Methodology. This guide states that impacts to a threatened species can be assessed as area of habitat as long as the surveyor considers the history of land use and/or disturbance and previous surveys of the species at the site.

Creeping tick-trefoil was found to be occur throughout PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (Moderate to Good condition) in high densities, particularly at the edges of this community where disturbances associated with railway corridor maintenance had occurred. Many of the individuals in the disturbed areas were young plants and likely to have recently recruited. Given the large size of the Development Site and the high density of this species, it became impractical to count or accurately extrapolate the population size of this species. Instead the area of habitat occupied by this species within the Development Site was considered to be a more reasonable and accurate approach. A total of 268.64 hectares of suitable habitat is present within the Development Site for this species which corresponds to the extent of PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (Moderate to Good condition).

Finger panic grass - *Digitaria porrecta*

Finger panic grass is listed as endangered under the TSC Act. It occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran.

Finger panic grass was recorded on rich black soils in areas mapped south of Moree as PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (Moderate to Good condition). Nine individuals were recorded between 1 April 2015 and 2 April 2015 during the Ecological Constraints Assessment, while a further 19 individuals were recorded between 5 February 2016 and 24 February 2016 during targeted species-credit species searches on the Development Site.

Koala - *Phascolarctos cinereus*

The koala is listed as Vulnerable under both the TSC and EPBC Acts. This species occurs within North-east Queensland, NSW, Victoria and South Australia. Within NSW, it primarily occurs on the north and central coasts with some populations to the west of the Great Dividing Range.

Koalas were recorded at fauna survey sites 15 and 16, as well as four other opportunistic locations along the Development Site. Furthermore, koala scats were found at an additional two locations:

- Six koalas were recorded at Site 16 on 10 December 2015. Two of these were juveniles still confined to their mother. The first female and juvenile were located at approximately KP 695.3 and within the 30 m buffer area of the Development Site. Another female and juvenile were spotted at approximately KP 697 within the buffer area. Another koala (potentially a male) was located outside of the buffer area at approximately KP 695.4, while another male koala was seen in proximity to the Development Site on the opposite side of the rail line within the fence line.

- Two koalas (a mother and juvenile) were recorded on 11 December 2015 at the KP 706.5 crossing over Country Boundary Road near Milguy Silo.

- One individual was sighted opportunistically at Site 15 on the Gwydir River on 11 December 2015 at approximately KP 676.3.

- One individual was spotlighted opportunistically at KP 704.4 km within a Brigalow dominated patch on 13 December 2015.

- One individual was spotlighted opportunistically at KP 730 km on 13 December 2015.

- One individual was spotlighted opportunistically close to Moree on the 16 December 2015 at KP 680.6. This individual was located at least 50 metres from the rail line.

- Koala scats were located at two additional locations, at approximately KP 711.6 and KP 716.8.

- One individual was opportunistically recorded at KP 676 on 10 February 2016.

- One individual was opportunistically recorded at KP 695 on 24 April 2016.

A further 72 records exist within 10 kilometres of the Development Site on the OEH Atlas of NSW Wildlife (OEH 2016d). The majority of the records from the OEH Atlas of NSW Wildlife also occur within this northern portion of the alignment but tend to be located in larger patches of woodland habitat in reserves such as Bullala State Forest (40 Kilometres north-east of Moree).

The Development Site contains three known food tree species preferred by the koala (according to Appendix 2 of the Approved Recovery Plan (DECC 2008)) for the Western Slopes and Plains Koala Management Area, being:

Primary Food Tree Species

- river red gum (*Eucalyptus camaldulensis*)

- coolibah (*Eucalyptus coolabah*)

Secondary Food Tree Species

- bimble box (*Eucalyptus populnea*)

These food tree species occur in the following PCTs within the Development Site:

- PCT39 (BR130, NA129) - Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion (Moderate to Good Condition)

- PCT78 (BR196, NA193) - River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Moderate to Good Condition)

- PCT56 (BR186, NA182) - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (Moderate to Good Condition) – in part (only those portions with contain Poplar Box)

The Development Site is considered to contain 62.77 hectares of known habitat for the species in accordance with the TSPD.

3.3.2.4 Species Habitat Polygons

Species habitat polygons have been prepared for all the species recorded or assumed present at the site as per **Table 3.8** above and summarised in **Table 3.9** below.

Table 3.9 Species-credit Species Recorded or Assumed Present at the Development Site

Species	Area of Species Polygons / Individuals	Able to Withstand Further Loss (according to the TSPD)	
		Border Rivers/Gwydir CMA	Namoi CMA
finger panic grass *Digitaria porrecta*	28	Yes, up to 5% loss where population on the property is >500 mature plants.	5% loss acceptable for populations >500 plants
creeping tick-trefoil *Desmodium campylocaulon*	237.41 ha	Yes, up to 5% loss where population on the property is >500 mature plants.	N/A
Belson's panic *Homopholis belsonii*	73 individuals	No, few known populations	No, few known populations
koala *Phascolarctos cinereus*	62.77 ha	No clearing of Core Habitat within the meaning of SEPP 44 (i.e. within an approved koala PoM). Up to 5% of foraging habitat provided clearing does not result in any increase in fragmentation of existing habitat that affects species dispersal	No clearing of Core Habitat within the meaning of SEPP 44 (i.e. within an approved koala PoM). Up to 5% of foraging habitat provided clearing does not result in any increase in fragmentation of existing habitat that affects species dispersal

The species polygons were prepared:

- using the unit of measurement identified for those species in the Threatened Species Profile Database
- including the location of the species or areas likely occupied by the species
- containing the specific habitat feature associated with the species at the Development Site.

Due to the large scale of the proposal species polygons have not been presented in **Appendix A** however, the shape files for these polygons will be submitted to OEH.

3.4 Jones Avenue Bridge and North Star Extension Area – Additional Area Assessment

Following the completion of field surveys and calculation of ecosystem and species credits in accordance with the FBA (OEH 2014a), two additional impact areas associated with the Jones Avenue Bridge and extension of the proposal area at North Star were added to the Development Site. A review of the adjacent vegetation mapping, nearby flora survey points, regional vegetation mapping and aerial photography interpretation found that the impacts associated with the installation of this bridge and extension of the proposal area at North Star are likely to be confined to exotic grasslands. As a result this impact area is not further assessed in this report. In addition, no threatened species are known to occur in these additional impact areas based on the results of a search of the BioNet Atlas of NSW Wildlife and consequently, amendments to species-credit polygons described in **Section 3.3.2.4** are not required.

4.0 Avoidance and Minimisation of Impacts

4.1 Avoidance

4.1.1 Site Selection

ARTC has commissioned a range of studies to guide the site selection for the proposal. Two major studies have been undertaken in relation to the development of an inland rail route between Melbourne and Brisbane. The first study, completed in 2006, considered potential corridors for the rail line to determine which route would deliver the best economic and financial outcome.

The Melbourne-Brisbane Inland Rail Alignment Study (ARTC 2010) was finalised in 2010 and was prepared to determine the optimum alignment of the entire route in terms of operational, engineering and environmental factors. At each stage the options were analysed in sufficient detail to enable key decisions to be made and finally narrow the rail corridor options down to a single rail alignment. The successive stages of route analysis included:

- Inland rail route options – identification of a range of available route options. Environmental and land use assessments were undertaken along each route section.

- Identification of the route – evaluation of the route options and preliminary analysis of: Melbourne to Parkes; Parkes to Moree; and Moree to Brisbane.

- Analysis of the route – the route was analysed in terms of capital cost, environmental impacts and journey times as well as its preliminary economic and financial viability. Environmental constraints mapping was produced and survey data was obtained to assist with the alignment development.

- Development of the rail alignment – the rail alignment was developed considering environmental and engineering factors. Environmental risks were eliminated or minimised through consideration of local alternatives and moving the alignment to avoid significant constraints were possible.

For the Narrabri to North Star section of the Inland Rail, the proposal primarily includes upgrades to existing tracks as opposed to the construction of new track or work in greenfield sites. As a result, the overall disturbance footprint of the proposal is reduced through the use of the existing corridor. As the proposed works occur along or adjacent to the existing track, further positioning works to avoid native vegetation and habitat areas would only be possible in some cases. Conversely, these works would be primarily undertaken in the existing rail corridor that is regularly subject to disturbances relating to the rail corridor and surrounding agricultural activities and with relatively few important biodiversity features and habitats.

Further information on proposal alternatives and options is outlined in Chapter 6 of the EIS.

4.1.2 Planning Phase

Ecological investigations were also undertaken during the constraints analysis phase to help to determine the potential impacts of the proposal. This facilitated the amendment of the design, where possible, to minimise potential impacts on threatened species, communities and their habitats.

The ecological investigations undertaken by Umwelt (2014) identified a range of key biodiversity constraints in the Narrabri to North Star section of the proposal. These investigations included database and literature reviews and rapid ecological field surveys of the rail corridor that included vegetation assessments, targeted inspections of bridge structures for micro-bats and rapid aquatic assessments. The investigations identified the presence of multiple threatened ecological communities (TECs) under the TSC and EPBC Acts occurring within and adjacent to the rail corridor. Fauna habitats, however, were found to be relatively limited due to the previous and ongoing disturbances within the rail corridor and extensive agricultural lands surrounding the Development Site.

Following these investigations, where works could be relocated outside of native vegetation (such as the placement of site offices and storage bunds) these were to be located in primarily disturbed or exotic landscapes. However, in most cases there was little scope for further avoidance of ecological impacts for the construction of the proposal itself as the location of works is constrained by the existing rail line and the existing rail corridor.

Further mitigation measures are described below with the aim of further minimising impacts.

4.1.3 Avoidance Summary

Table 4.1 below outlines a summary of the avoidance measures that have been or will be implemented to minimise the impacts of the proposal.

Table 4.1 Avoidance Measures

Action	Outcome	Timing	Responsibility
The Melbourne-Brisbane Inland Rail Alignment Study	• Identification of a preliminary proposal route • Avoidance of native vegetation and habitat areas, where practicable	Site Selection	ARTC
Ecological constraints investigations	• Identification of areas of high conservation value • Relocation of works outside native vegetation and habitat areas, where practicable • Maximising disturbances within areas of low conservation value (exotic grasslands, disturbed areas)	Planning Phase	ARTC
Demarcation of areas approved for clearing, where practicable	• Minimisation of accidental clearing/disturbance of surrounding native vegetation	Construction	Construction contractor

4.2 Mitigation Measures

4.2.1 Construction Phase

It is recommended that a strategy to mitigate adverse biodiversity impacts is implemented during the construction phase of the proposal. This includes specific measures to manage potential impacts on fauna species in the Development Site during vegetation clearing and construction of the proposal. Mitigation measures relative to the construction phase are outlined below and should be further detailed in a Construction Environmental Management Plan (CEMP) prepared for the proposal.

4.2.1.1 Management of Fauna Species and Habitat

A pre-clearance survey and tree-felling procedure should be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow-bearing trees and to avoid impacts on koalas. These management measures are designed to minimise impacts to hollow-dependent and roosting fauna, and koalas.

The pre-clearance survey and tree-felling procedure are described below and should be documented in the CEMP.

Pre-clearance Surveys

Pre-clearance surveys should be implemented within areas of woody native vegetation that are to be cleared. Pre-clearance surveys should be undertaken by suitably qualified person and involve the following:

- the demarcation of areas approved for clearing to reduce risk of accidental clearing/disturbance of surrounding native vegetation
- the likely habitat resources and habitat trees should be identified and marked. Habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs and burrows
- in areas of koala habitat, visual inspection of trees for koalas prior to clearing.

Tree-felling Supervision

Tree clearing should be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built), with the clearing of habitat resources and habitat trees to be supervised by a suitably qualified person after pre-clearance surveys have identified potential threatened species habitat. The suitably qualified person will be licensed by the relevant field survey and ethics authorities to allow for capture, housing, transport and possibly ethical euthanizing of injured fauna. The tree-felling procedure should include the following:

- the felling of non-habitat trees would be completed prior to the felling of habitat trees. All habitat trees would be vigorously shaken with heavy machinery the day prior to clearing. Note that the clearing of non-habitat trees does not require supervision by an ecologist or fauna handler
- on the day of habitat tree felling, the following is to be undertaken:
    - all habitat trees will be subject to a visual inspection to survey for threatened species
    - trees previously identified as containing fauna or fauna habitat (such as hollows or nests) will be shaken and then felled, providing no threatened species are identified

- all reasonable attempts will be made to reduce the impact of felling on all fauna species.
- the lowering of hollow-bearing trees will be done as gently as possible with heavy machinery
- if a native fauna species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include further shaking to encourage the animal to vacate the tree, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats
- uninjured animals should be released on the day of capture into nearby suitable adjacent habitat and should not be held for extended periods of time
- injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment. If required, the suitably qualified person may ethically euthanize fauna

- following felling, habitat trees will be inspected for remaining or injured fauna species and to ensure that no hollows are blocked against the ground. This may require the tree to be rolled to ensure adequate access
- all felled habitat trees should remain in place for a least one night to allow any fauna still present to move on.

4.2.1.2 Management of Micro-bat Species and Habitat

Culvert and Bridge Works Pre-clearance Surveys

All culverts and bridges that are proposed to be removed should be subject to a pre-clearance survey to determine if they provide habitat for micro-bats.

Where potential habitat is identified, on the day prior to the disturbance of bridges or culverts with the potential to provide roosting habitat for micro-bats, a suitably qualified person should undertake an inspection of the bridge to search for potential micro-bat roost sites under and within the culvert or bridge. If roosting bats are identified under and/or within the culvert or bridge, the bats should be left undisturbed until dusk. At dusk roosting bats can be captured and released nearby. Following removal or departure of all roosting bats the culvert or bridge crevices should be removed or blocked off (for example cover the entrance with shade cloth) prior to dawn the following morning.

Pre-clearance surveys should record the:

- roosting species (if identifiable)
- count/estimate of the number of roosting individuals
- location and time of relocation (if applicable) or other actions taken to discourage the roosting of micro-bat species under (or in) the culvert or bridge.

4.2.1.3 Weed Control

Weed species could be inadvertently brought into the Development Site with imported materials, or could invade naturally through removal of native vegetation. The increased presence of weed species within the Development Site has the potential to decrease the value of retained extant vegetation to native species, particularly threatened species.

The following management measures should be undertaken to minimise the potential impacts and spread of weeds during the construction of the proposal:

- any vehicles or equipment being brought onto the Development Site to be involved in ground disturbance activities and/or travelling around the site must be inspected and cleaned prior to commencing work to limit the spread of seeds and plant material between sites
- regular inspections will be undertaken in the Development Site to monitor the spread of weed species
- training of environmental personnel on the identification of target weed species.

Any outbreak of noxious weeds will be controlled and eradicated as required under the *Noxious Weeds Act 1993*, and as required by the Local Land Services and other relevant authorities. Weed control and eradication techniques may include:

- spraying with herbicides
- physical removal e.g. chipping, and/or
- minimisation of area available for weed infestation, through prompt revegetation of bare areas.

4.2.1.4 Sediment and Erosion Control

When work is required within or adjacent to watercourses, appropriate erosion and sediment controls will be put in place in accordance with a soil and water management sub-plan (SWMP) to be developed for the proposal as outlined in the Inland Rail Narrabri to North Star Water Quality assessment report (GHD 2017).

There will also be specific erosion sedimentation control plans developed throughout all stages of construction.

Designs for works within or near water bodies will be designed to provide for the retention of natural functions and maintenance of fish passage in accordance with NSW Fisheries Guidelines (2004) *Fish Friendly Waterway Crossings,* and *Why do fish need to cross the road? Fish passage requirements for waterway crossings*.

4.2.1.5 General Biodiversity Mitigation Measures

A range of general biodiversity mitigation measures are recommended across the Development Site during the construction phase to minimise impacts to biodiversity values, including:

- employee education and training including inductions for staff, contractors and visitors to the site will be conducted to inform personnel of the biodiversity issues present at the site and so they know their role and responsibilities in relation to the protection and/or minimisation of impacts to native biodiversity

- areas of biodiversity value outside the Development Site will be fenced or signposted, where appropriate, to prevent the unnecessary disturbance during the construction phase

- noise, vibration and dust control as per Chapters 11, 12 and 13 of the EIS.

4.2.2 Operational Phase

It is recommended that a strategy to mitigate the adverse biodiversity impacts is implemented during the operational phase of the proposal. This includes specific measures to minimise the potential impacts on the biodiversity of the Development Site and the locality.

4.2.2.1 Ongoing Weed Management

As part of regular maintenance of the rail corridor, regular inspections of the Development Site should be undertaken for weed infestations and to assess the need for control measures. These inspections will identify any weed infestations, the need for any control measures and the effectiveness of past weed control activities. Rehabilitated areas will also be regularly inspected to reduce the potential for weed infestations in these areas.

As outlined in **Section 4.2.2**, any outbreak of noxious weeds will be controlled and eradicated as required under the *Noxious Weeds Act 1993*, and as required by the Local Land Services and other relevant authorities. Noxious and other undesirable weed species (including WoNS) within the Development Site, such as African boxthorn (*Lycium ferocissimum*) and tiger pear (*Opuntia aurantiaca*), will be controlled to an acceptable level, and where possible eliminated. Weed control and eradication techniques may include:

- spraying with herbicides

- physical removal e.g. chipping or

- minimisation of area available for weed infestation, through prompt revegetation of bare areas.

4.2.3 Mitigation Measures Summary

Table 4.2 below provides a summary of the mitigation measures that are recommended before, during and after construction to minimise the impacts of the proposal.

Table 4.2 Mitigation Measures

Action	Outcome	Timing	Responsibility
Demarcation of areas approved for clearing	• Minimisation of accidental clearing/disturbance of surrounding native vegetation	Construction	Construction contractor
Pre-clearance surveys	• Reduction of impacts to hollow-dependant fauna species • Minimisation of impacts to koala • Minimisation of impacts to micro-bat species • Identification of habitat resources for translocation or salvage	Construction	Construction contractor

Action	Outcome	Timing	Responsibility
Tree-felling and bridge/culvert replacement supervision	• Relocation of captured fauna individuals into nearby suitable secure habitat • Injured fauna individuals taken to a veterinary clinic or wildlife carer • Translocation or salvage of habitat resources	Construction	Construction contractor
Weed control	• Minimisation of the spread of weeds within native vegetation (management of noxious weeds)	Construction Operation	Construction contractor ARTC
Erosion and sedimentation control	• Minimisation of erosion and sediment laden runoff into adjacent watercourses	Construction Operation	Construction contractor
Fencing and impact site delineation	• Prevention of unnecessary disturbance of native vegetation and habitats	Construction	Construction contractor
Employee education and training	• Communication to employees on their role and responsibilities as it relates to biodiversity	Construction Operation	Construction contractor ARTC

4.3 Direct Impacts unable to be Avoided

The construction and operation of the proposal will result in a range of direct impacts on biodiversity values within the Development Site. Direct impacts include the loss of native vegetation and fauna habitats as a result of direct and permanent clearance works and track upgrades and the location and extent of direct (permanent) impacts is shown on **Figure 4.1** and **Figure 4.1A** to **4.1I**.

The proposal would involve upgrading the existing rail line between Narrabri and North Star, including:

- upgrading the track, track formation, and culverts within the existing rail corridor
- realigning the track where required within the existing rail corridor to minimise the radius of tight curves
- providing five new crossing loops within the existing rail corridor, at Bobbiwaa, Waterloo Creek, Tycannah Creek, Coolleearllee, and Murgo
- providing a new section of rail line at Camurra, about 1.6 kilometres long, to bypass the existing hairpin curve
- providing three new rail bridges over the Mehi and Gwydir rivers and Croppa Creek
- realigning about 1.5 kilometres of the Newell Highway near Bellata, and providing a new road bridge over the existing rail corridor
- providing a new road bridge over the existing rail corridor at Jones Avenue in Moree.

Ancillary work would include works to level crossings, signalling and communications, signage and fencing, and services and utilities.

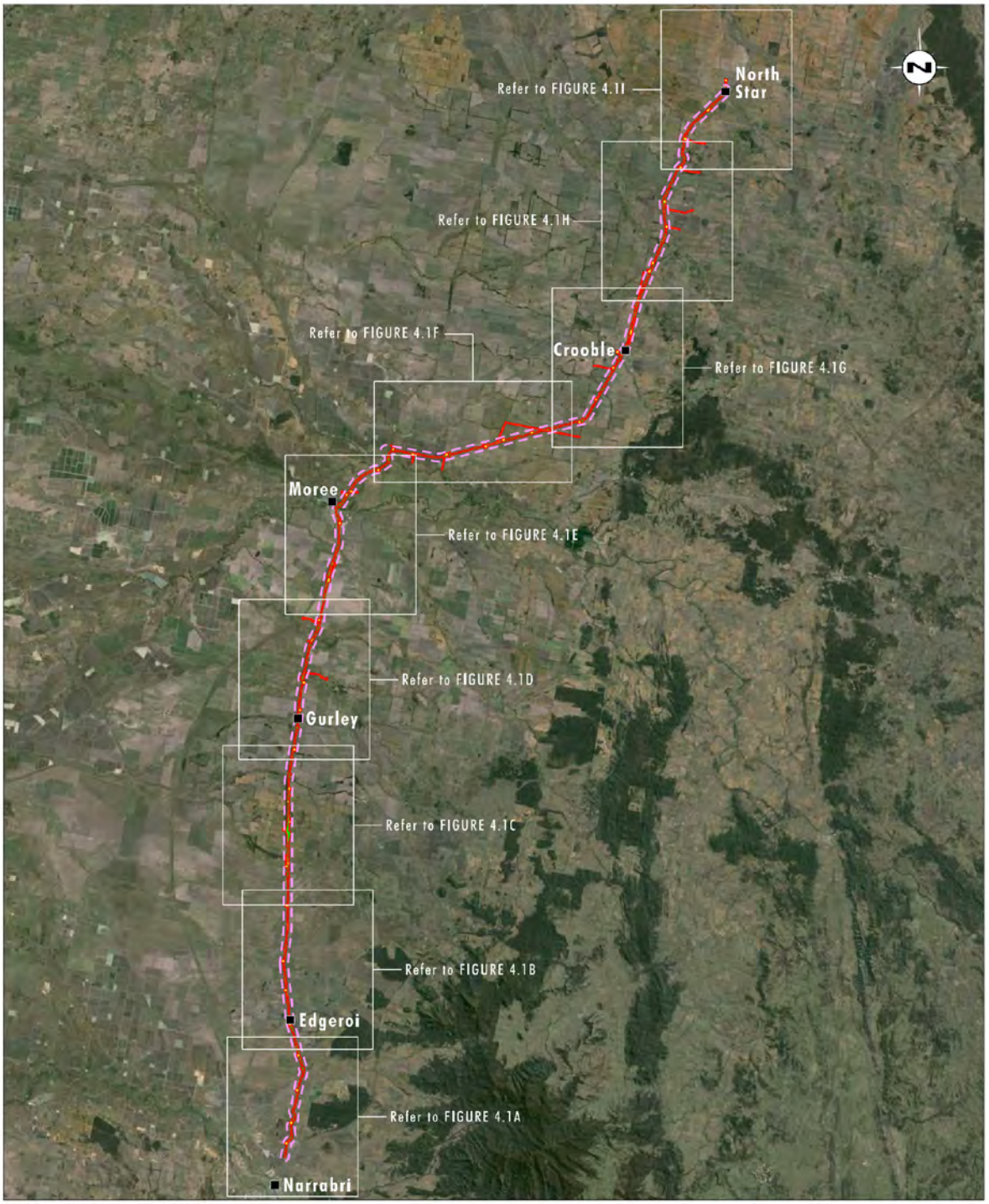

Image Source: Google Earth (2013)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 10 20 40km
1:750 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1

Development Site Impact Narrabri to North Star

umwelt

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1A

Development Site Impact
Narrabri to North Star

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1B

Development Site Impact
Narrabri to North Star

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1C

Development Site Impact
Narrabri to North Star

File Name (A4): R05/3607_076.dgn
20170503 13.21

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1D

Development Site Impact
Narrabri to North Star

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1E

Development Site Impact
Narrabri to North Star

Image Source: Google Earth/DigitalGlobe (Jan 2016)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area

FIGURE 4.1F

Development Site Impact
Narrabri to North Star

File Name (A4): R05/3607_079.dgn
20170503 13.35

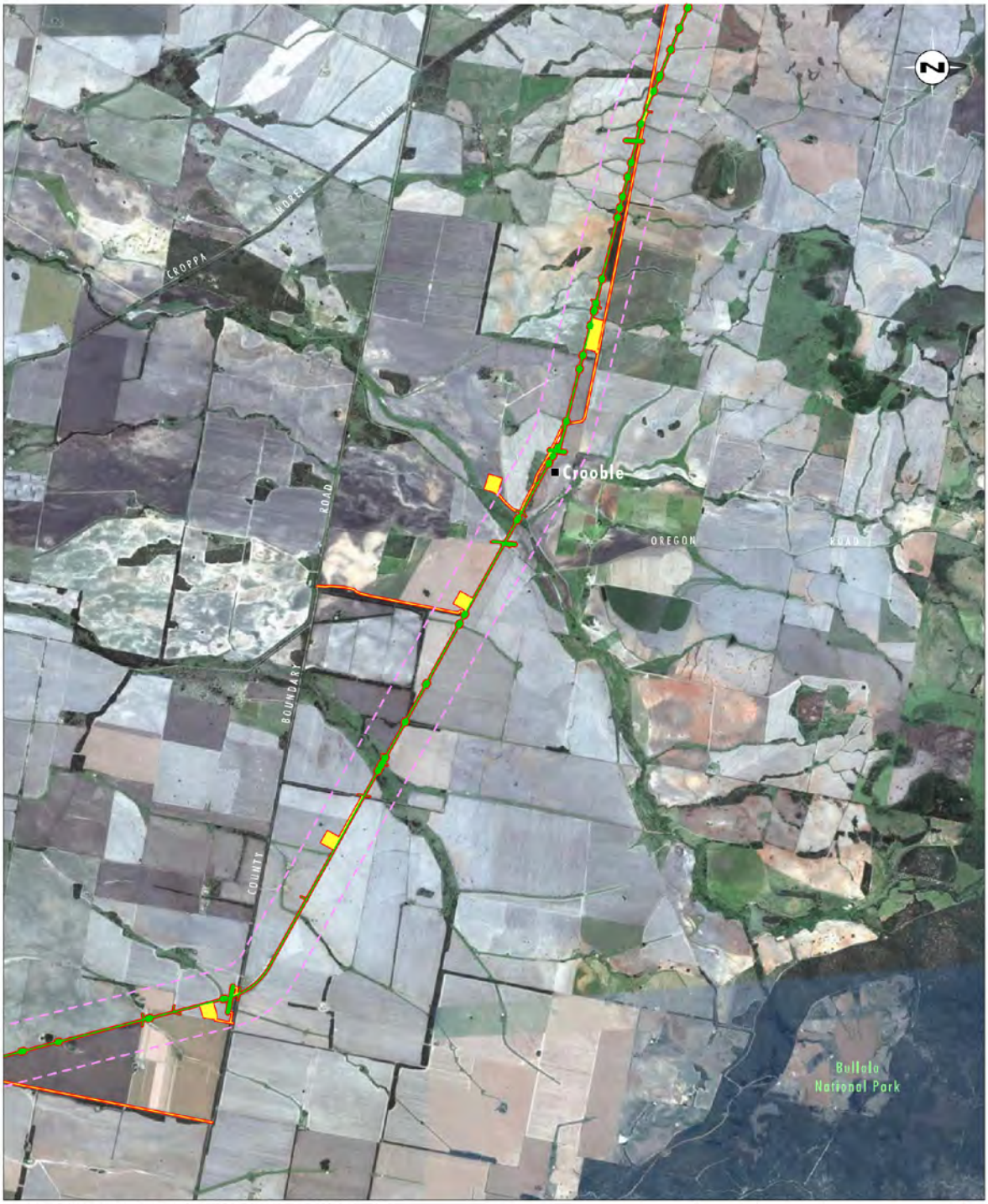

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1G

Development Site Impact
Narrabri to North Star

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.1H

Development Site Impact
Narrabri to North Star

Image Source: Google Earth/DigitalGlobe (Nov 2015)
Data Source: Geoscience Australia (2009), Parsons Brinckerhoff (2014)

0 1.0 2.5 5.0km
1:100 000

Legend

- Development Site
- Temporary Impact Zone
- Permanent Impact Zone
- 550m Buffer Area
- Town

FIGURE 4.11

Development Site Impact
Narrabri to North Star

File Name (A4): R05/3607_082.dgn
20170503 13.36

Table 4.3 below outlines the impacts associated with the proposal as they were entered into the BBCC, totalling 410.62 hectares of direct impacts to native vegetation communities. Direct impacts have been focused, where possible, outside of native vegetation communities, with 635.08 hectares of cleared/non-native vegetation subject to direct impacts.

Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Sections 4.1** and **4.2** above.

Table 4.3 Direct and Permanent Impacts of the Proposal on Native Biodiversity Features

Ecological Feature	Area/Number within the Development Footprint
Plant Community Type	
PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	5.05 ha
PCT35 (BR120, NA117) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion *Moderate to Good*	3.54 ha
PCT39 (BR130, NA129) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion *Moderate to Good*	1.19 ha
PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion *Moderate to Good_Natural Grassland*	237.41 ha
PCT56 (BR186, NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good*	55.07 ha
PCT56 (BR186; NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good_DNG*	87.87 ha
PCT71 (BR127, NA126) Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion *Moderate to Good*	0.04 ha
PCT78 (BR196, NA193) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	14.59 ha
PCT135 (BR284, NA271) Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion *Moderate to Good*	3.57 ha

Ecological Feature	Area/Number within the Development Footprint
PCT413 (BR346, NA348) Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion *Moderate to Good*	2.29 ha
Total	**410.62**
Species-credit Species and Habitats	
finger panic grass (*Digitaria porrecta*) individuals	28 individuals
creeping tick-trefoil (*Desmodium campylocaulon*) habitat	237.41 ha
Belson's panic (*Homopholis belsonii*) individuals	73 individuals
Vegetation containing koala feed trees and vegetation types (as per the TSPD) for koala (*Phascolarctos cinereus*)	62.77 ha

4.4 Indirect and Temporary Impacts

4.4.1 Indirect Impacts

The proposal is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands during the construction or operational phases of the proposal with the proposed controls in place (e.g. erosion and sediment controls, dust controls, noise controls). However, some minor indirect impacts associated with fugitive light emissions, dust, noise, weeds and feral animals may occur during the construction and operational phase of the proposal. This is further discussed in the sections below.

4.4.1.1 Dust Impacts

Dust impacts associated with the proposal are expected to be minor and include dust covering vegetation thereby reducing vegetation health and growth.

Appropriate dust controls would be implemented during the construction phase of the proposal to minimise dust generation and thereby minimise the potential for adverse dust impacts on biodiversity. These would include:

- the minimisation of vegetation clearance where it is not required
- timely rehabilitation of disturbed areas once construction works are complete and
- dust suppression on access tracks and other construction areas to reduce vehicle generated dust emissions.

With the planned controls in place and considering the nature of the construction program, dust impacts associated with both the construction and operation phases of the proposal are considered unlikely to result in significant impacts on biodiversity.

4.4.1.2 Noise Impacts

Construction and operational noise impacts have the potential to adversely impact native species. Potential impacts include noise disturbing the roosting and foraging behaviour of fauna species and reducing the occupancy of areas of suitable habitat. It is noted that many native species are nocturnal and the potential noise impact on these species is therefore reduced based on construction work hours. The proposed increase in rail movement would also increase noise generation along the rail corridor.

The design of the proposal would include measures to minimise the potential for adverse noise impacts. These include:

- the use of physical barriers such as earthen bunds and noise walls, where deemed required to attenuate operational noise and
- equipment selection and maintenance to manage noise generation.

With the planned controls in place and considering the nature of the likely noise generation associated with the construction and operational phases of the proposal, noise impacts are considered unlikely to result in significant impacts on biodiversity.

4.4.1.3 Increased Train Movements

Increased train movements during the operation of the proposal may result in adverse impacts on locally occurring fauna species, particularly terrestrial mobile species. Passenger train numbers are not predicted to increase in the future, however grain and freight train numbers are expected to increase from an existing approximate two trains per day to up to approximately 16 trains per day by 2040.

The increased train movements have the potential to result in an increase in train strikes on fauna species resulting in injury and death of native fauna. The rail corridor is managed in some places by agricultural fencing, however this is unlikely to impede fauna movement through the Development Site. Furthermore, the inclusion of fauna exclusion fencing to minimise train strike is not desirable due to the likely reduction in fauna movement and connectivity in the broader landscape.

The increase in train movements and train speed as a result of the operation of the proposal is likely to result in greater train strike impacts to terrestrial fauna species. However this impact is considered unlikely to result in the extinction of the local population of any threatened species likely to be affected by the increased train movements.

4.4.1.4 Weed Encroachment

Weed species could be inadvertently brought into the Development Site with imported materials, or could invade naturally through removal of native vegetation. The presence of weed species within the Development Site has the potential to decrease the value of extant vegetation to native species, particularly threatened species. Mitigation measures outlined in **Sections 4.2.1.3** and **4.2.2.1** will minimise the potential for weed encroachment into surrounding areas around the Development Site.

4.4.2 Temporary Impacts

The construction of the proposal will result in temporary impacts relating to construction impacts associated with construction facilities such as laydown areas, temporary access tracks and vehicle parking areas. Native vegetation occurring in these areas is not expected to be fully impacted (i.e. will not be cleared) but will be subject to some disturbance and is expected to recover. While the vegetation and habitats in these areas will be impacted in the short term, it is considered that these areas will regenerate

following the completion of the construction phase of the proposal. As a result, these impacts have not been included in the BBCC assessment. The location and extent of temporary impacts is shown on **Figure 4.1A** to **4.1I.**

To facilitate the regeneration of temporary impact locations, a rehabilitation strategy will be prepared as part of the CEMP.

Temporary impacts on native vegetation communities are outlined in **Table 4.4** below and total 72.18 hectares. Temporary impacts have been focused, where possible, outside of native vegetation communities, with 442.83 hectares of cleared/non-native vegetation subject to temporary impacts. It should be noted that while some temporary impacts occur in areas outside derived native grassland communities, no trees or shrubs in these areas will be cleared as a result of these impacts. As a result, temporary impacts will not affect any fauna species-credit species habitats.

Table 4.4 Temporary Impacts of the Proposal on Native Vegetation

Plant Community Type	Area within the Development Site (ha)
PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	1.90
PCT35 (BR120, NA117) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion *Moderate to Good*	1.21
PCT39 (BR130, NA129) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion *Moderate to Good*	0.0
PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion *Moderate to Good_Natural Grassland*	31.23
PCT56 (BR186, NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good*	16.88
PCT56 (BR186; NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good_DNG*	20.34
PCT71 (BR127, NA126) Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion *Moderate to Good*	0.0

Plant Community Type	Area within the Development Site (ha)
PCT78 (BR196, NA193) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	0.10
PCT135 (BR284, NA271) Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion *Moderate to Good*	0.22
PCT413 (BR346, NA348) Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion *Moderate to Good*	0.30
Total	**72.18**

5.0 Impact Summary

5.1 Impacts Not Requiring Further Assessment

Impacts not requiring further assessment under the FBA include areas of land without native vegetation. The Development Site contains 635.08 hectares of cleared land/non-native vegetation that will be removed as a result of the proposal that does not meet the definition of 'native vegetation' under the *Native Vegetation Act 2003*. This impact does not require further assessment under the FBA.

Due to the large scale of the proposal a map of areas not requiring further assessment have not been presented in the report, however the shape files for these areas will be submitted to OEH.

5.2 Impacts Not Requiring Offset

Impacts on native vegetation not requiring offsets under the FBA include native vegetation that has a site value score of less than 17 and are not identified as an endangered or critically endangered ecological community, and/or associated with threatened species habitat (as represented by ecosystem credits).

Impacts on species and populations not requiring offsets under the FBA include threatened species habitat associated with a PCT that has a site value score of less than 17 or species or populations that are not threatened and do not form part of a EEC or CEEC.

A range of non-threatened flora and fauna species were recorded within the Development Site during the surveys undertaken for this assessment. These species do not require offsets under the FBA. Additionally, as no PCTs within the Development Site have a site value score of less than 17 and are predicted to be habitat for threatened ecosystem species, all will require offsetting as discussed in **Section 5.3**.

5.3 PCTs and Threatened Species Requiring Offset

A range of PCTs, ecosystem-credit species and species-credit species were found to require offsetting as discussed in the sections below.

5.3.1 Ecosystem Credits

Table 5.1 outlines the ecosystem-credit species requiring offset as a result of the proposal. These species are offset through the retirement of ecosystem credits (see **Table 5.2**) and do not generate individual offsetting requirements. The highest threatened species offset multiplier will determine the credit requirements for the vegetation zones these species are predicted to occur in.

Table 5.1 Ecosystem-credit species requiring offset as a result of the proposal

Common Name	Species Name	Threatened Species Offset Multiplier
barking owl	*Ninox connivens*	3.0
masked owl	*Tyto novaehollandiae*	3.0
Australian bustard	*Ardeotis australis*	2.6
bush stone curlew	*Burhinus grallarius*	2.6

Common Name	Species Name	Threatened Species Offset Multiplier
speckled warbler	*Chthonicola sagittata*	2.6
spotted-tailed quoll	*Dasyurus maculatus*	2.6
Pilliga mouse	*Pseudomys pilligaensis*	2.6
stripe-faced dunnart	*Sminthopsis macroura*	2.6
yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	2.2
Corben's long-eared bat	*Nyctophilus corbeni*	2.1
little pied bat	*Chalinolobus picatus*	2.1
brown treecreeper	*Climacteris picumnus* subsp. *victoriae*	2.0
glossy black-cockatoo	*Calyptorhynchus lathami*	1.8
little lorikeet	*Glossopsitta pusilla*	1.8
red-tailed black-cockatoo	*Calyptorhynchus banksii* subsp. *samueli*	1.8
turquoise parrot	*Neophema pulchella*	1.8
hooded robin	*Melanodryas cucullata* subsp. *cucullata*	1.7
little eagle	*Hieraaetus morphnoides*	1.4
spotted harrier	*Circus assimilis*	1.4
square-tailed kite	*Lophoictinia isura*	1.4
Australian painted snipe	*Rostratula australis*	1.3
black-chinned honeyeater	*Melithreptus gularis* subsp. *gularis*	1.3
Brolga	*Grus rubicunda*	1.3
diamond firetail	*Stagonopleura guttata*	1.3
eastern grass owl	*Tyto longimembris*	1.3
grey-crowned babbler	*Pomatostomus temporalis* subsp. *temporalis*	1.3
magpie goose	*Anseranas semipalmata*	1.3
painted honeyeater	*Grantiella picta*	1.3
swift parrot	*Lathamus discolor*	1.3
varied sittella	*Daphoenositta chrysoptera*	1.3
freckled duck	*Stictonetta naevosa*	1.3
scarlet robin	*Petroica boodang*	1.3

Table 5.2 below outlines the PCTs to be impacted as a result of the proposal and the ecosystem credits required to offset those impacts. Maps of these PCTs are presented in **Appendix A**. The full Credit Calculator reports are included in **Appendix F**.

Table 5.2 Plant Community Types Requiring Offset and the Total Ecosystem Credits Required

Veg Zone	Plant Community Type	Total Area to be Impacted (ha)	Highest Threatened Species Offset Multiplier	Total Ecosystem Credits Required
1	PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	5.05	3.0	254
2	PCT35 (BR120, NA117) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion *Moderate to Good*	3.54	3.0	250
3	PCT39 (BR130, NA129) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion *Moderate to Good*	1.19	3.0	63
4	PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion *Moderate to Good_Natural Grassland*	237.41	2.6	11,046
5	PCT56 (BR186, NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good*	55.07	3.0	3,386
6	PCT56 (BR186; NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW *Moderate to Good_DNG*	87.87	3.0	2,917

Veg Zone	Plant Community Type	Total Area to be Impacted (ha)	Highest Threatened Species Offset Multiplier	Total Ecosystem Credits Required
7	PCT71 (BR127, NA126) Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion *Moderate to Good*	0.04	3.0	2
8	PCT78 (BR196, NA193) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion *Moderate to Good*	14.59	3.0	675
9	PCT135 (BR284, NA271) Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion *Moderate to Good*	3.57	3.0	133
10	PCT413 (BR346, NA348) Silver-leaved Ironbark - White Cypress Pine - box dry shrub grass woodland of the Pilliga Scrub - Warialda region, Brigalow Belt South Bioregion *Moderate to Good*	2.29	3.0	100
TOTAL		**410.62**	**-**	**18,826**

5.3.2 Species Credits

Table 5.3 below outlines the species-credit species to be impacted as a result of the proposal and the species credits required to offset those impacts. A full Credit Calculator report is included in **Appendix F**.

Due to the large scale of the proposal, species polygons have not been presented in **Appendix A**, however the shape files for these polygons will be submitted to OEH.

Table 5.3 Species-credit Species Requiring Offset and the Species Credits Required

Common Name	Species Name	Threatened Species Offset Multiplier	Species Credits Required
finger panic grass	*Digitaria porrecta*	1.3	364
creeping tick-trefoil	*Desmodium campylocaulon*^	1.1	2,607
Belson's panic	*Homopholis belsonii*	2.6	1,898
koala	*Phascolarctos cinereus*	2.6	1,632
TOTAL			**6,501**

^Due to the high number of individuals of creeping tick-trefoil (*Desmodium campylocaulon*) present within the Development Site and the species association with natural grassland communities, it was determined to be more suitable to calculate species credits based on the area of habitat as opposed to the number of individual plants, as per the NSW Guide to Surveying Threatened Plants (OEH 2016e).

5.4 Impacts on Biodiversity that Require Further Consideration

Under the FBA, certain impacts on biodiversity values may require further consideration by the consent authority. These are impacts that are considered to be complicated or severe and include:

- impacts on landscape features, being:
    - impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas, or
    - impacts that will prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state, and
- impacts on native vegetation that are likely to cause the extinction of an EEC/CEEC from an IBRA subregion or significantly reduce its viability, and
- impacts on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA subregion or significantly reduce its viability.

The proposal will not have an impact on any biodiversity features that would result in one or more of the above severe impacts.

Despite this, a range of threatened species and communities have been identified in OEH's submission of the SEARs that require further consideration. These are outlined in **Sections 5.4.1** and **5.4.2** below.

5.4.1 Impacts on Native Vegetation that Require Further Consideration

The following TECs were specifically identified in the SEARs as requiring further consideration in the BAR:

- *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC* under the TSC Act and *Brigalow (Acacia harpophylla dominant and co-dominant) EEC* under EPBC Act
- *Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South Bioregions EEC* under the TSC Act
- *Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC* under the TSC Act
- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions EEC* under the TSC Act
- *Marsh Club-rush sedgeland in the Darling Riverine Plains Bioregion CEEC* under the TSC Act
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions EEC* under the TSC Act and *Weeping Myall Woodland EEC* under EPBC Act
- *Native Vegetation on Cracking Clay Soils of the Liverpool Plains EEC* under the TSC Act and *Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC* under the EPBC Act
- *White Box Yellow Box Blakely's Red Gum Woodland EEC* under the TSC Act and *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC* under the EPBC Act.

Of the above TECs, the following were recorded within the Development Site during the surveys undertaken for this assessment:

- *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC* under the TSC Act and *Brigalow (Acacia harpophylla dominant and co-dominant) EEC* under EPBC Act
- *Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC* under the TSC Act
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions EEC* under the TSC act and *Weeping Myall Woodland EEC* under EPBC Act
- *Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC* under the EPBC Act (note that the TSC Act equivalent *Native Vegetation on Cracking Clay Soils of the Liverpool Plains EEC* was not recorded within the Development Site based on known distribution detailed in the scientific determination).

Table 5.4 below provides further information for the threatened ecological communities identified in the SEARs and mapped within the Development Site in accordance with Section 9.2.4 of the FBA (OEH 2014a).

Table 5.4 Impacts on Native Vegetation that Require Further Consideration as per the SEARs and Recorded in the Development Site

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC under the TSC Act and Brigalow (Acacia harpophylla dominant and co-dominant) EEC under the EPBC Act	***Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC under the TSC Act***	***Myall Woodland EEC* under the TSC Act and *Weeping Myall Woodlands EEC* under the EPBC Act**	***Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC under the EPBC Act***
(a) the area and condition of the CEEC or EEC to be impacted directly and indirectly by the proposed development			
• 4.75 hectares (comprising 3.54 ha permanent disturbance and 1.21 ha temporary disturbance) of *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC* under the TSC Act would be impacted by the proposal. • 4.75 hectares (comprising 3.54 ha permanent disturbance and 1.21 ha temporary disturbance) of *Brigalow (Acacia harpophylla dominant and co-dominant) EEC* under the EPBC Act would be impacted by the proposal. • This EEC occurs in small remnant patches in the Development Site in Moderate to Good condition with a predominately native groundcover and minor occurrences of some exotic species likely due to existing disturbances in the rail corridor (refer to (refer to **Section 3.2.1.2**).	• 0.04 hectares (comprising permanent disturbance) would be impacted by the proposal. • This TEC occurs as a small remnant patch within the Development Site in moderate to good condition with a predominately native groundcover with moderate occurrences of exotic species likely due to existing disturbances in the rail corridor (refer to **Section 3.2.1.7**).	• 6.95 hectares (comprising 5.05 ha permanent disturbance and 1.90 ha temporary disturbance) of *Myall Woodland EEC* under the TSC Act would be impacted by the proposal. • 2.61 hectares (comprising 1.99 ha permanent disturbance and 0.62 ha temporary disturbance) of *Weeping Myall Woodlands EEC* under the EPBC Act would be impacted by the proposal. • These TECs occur as several small remnant or regenerating patches within the Development Site in Moderate to Good condition. There are varying levels of disturbance in these EECs due to the heavily disturbed rail corridor, historic clearing, infrastructure maintenance, mowing and weed spraying regimes as well as adjacent land uses (refer to **Section 3.2.1.1**).	• 268.64 hectares (comprising 237.41 ha permanent disturbance and 31.23 ha temporary disturbance) would be impacted by the proposal. • This TEC primarily occurs south of Moree between Gurley and Bellata, with isolated occurrences between Moree and North Star. Within the Development Site this TEC is in moderate to good condition with a predominately native groundcover with minor to moderate occurrences of exotic species (particularly on the edges of this community) likely due to existing disturbances in the rail corridor (refer to **Section 3.2.1.4**).

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC under the TSC Act and Brigalow (Acacia harpophylla dominant and co-dominant) EEC under the EPBC Act	***Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC under the TSC Act***	***Myall Woodland EEC* under the TSC Act and *Weeping Myall Woodlands EEC* under the EPBC Act**	***Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC under the EPBC Act***
(b) the extent and overall condition of the CEEC or EEC within an area of 1000 ha and then 10,000 ha surrounding the proposed development footprint.			
According to the regional vegetation map Border Rivers Gwydir/Namoi Regional Native Vegetation Mapping (OEH 2015) the vegetation community Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion (likely equivalent to the both EEC listings under the TSC Act and EPBC Act) mapped surrounding the Development Sites, comprising: • 9 hectares in 1000 ha buffer area. • 103 hectares in the 10,000 ha buffer area. The remnant patches of this EEC/CEEC are generally scattered isolated occurrences in a largely agricultural landscape. The small and narrow patch sizes represent remnants with large edge affects and are likely to be in moderately disturbed condition.	According to the regional vegetation map Border Rivers Gwydir/Namoi Regional Native Vegetation Mapping (OEH 2015) no vegetation communities equivalent to this EEC occur within a 1000 ha or 10,000 ha buffer area surrounding the Development Site.	According to the regional vegetation map Border Rivers Gwydir/Namoi Regional Native Vegetation Mapping (OEH 2015) the vegetation community Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (likely equivalent to the both EEC listings under the TSC Act and EPBC Act) mapped surrounding the Development Sites, comprising: • 18 hectares in 1000 ha buffer area. • 147 hectares in the 10,000 ha buffer area. The remnant patches of this EEC/CEEC are generally scattered isolated occurrences in a largely agricultural landscape. The small and narrow patch sizes represent remnants with large edge affects and are likely to be in moderately disturbed condition.	According to the regional vegetation map Border Rivers Gwydir/Namoi Regional Native Vegetation Mapping (OEH 2015) no vegetation communities equivalent to this CEEC occur within a 1000 ha or 10,000 ha buffer area surrounding the Development Site. This mapping project includes a Candidate Native Grasslands community, however it doesn't differentiate between natural and derived native grasslands. The candidate Native Grassland comprises: • 269 hectares in 1000 ha buffer area. • 1,614 hectares in the 10,000 ha buffer area.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC under the TSC Act and Brigalow (Acacia harpophylla dominant and co-dominant) EEC under the EPBC Act	***Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC under the TSC Act***	***Myall Woodland EEC* under the TSC Act and *Weeping Myall Woodlands EEC* under the EPBC Act**	***Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC under the EPBC Act***
(c) an estimate of the extant area and overall condition of the CEEC or EEC remaining in the IBRA subregion after the impact of the proposed development has been taken into consideration			
• Current mapping and literature does not provide an accurate estimate of the extant area of this TEC in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions. • The estimated total current NSW extent of the *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC* under the TSC Act is 142,950 hectares (TSSC 2001). • The estimated total current national extent of the *Brigalow (Acacia harpophylla dominant and co-dominant) EEC* under the EPBC Act is 804,264 hectares (TSSC 2001).	• Current mapping and literature does not provide an accurate estimate of the extant area of this TEC in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions. • Less than 500 ha of the Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions is found within Boomi, Boomi West and Boronga Nature Reserves). • It is expected that the overall condition of this TEC in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions is likely to be fragmented and subject to disturbances such as grazing and weed invasion.	• Current mapping and literature does not provide an accurate estimate of the extant area of this TEC in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions. • Both the current and pre-European national extent of the ecological community is poorly known (TSSC 2008). Weeping Myall Woodlands have declined from an original extent in NSW of between 1,900, 000 ha and 3,300,000 ha to a current extent of between 190,000 ha and 330,000 ha.	• Current mapping and literature does not provide an accurate estimate of the extant area of this TEC in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions. • The estimated total current national extent of Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland is 29,318 hectares (TSSC 2008). With over 90% of the original extent of these grasslands being removed from Moree Plains and at least a 95% reduction of the total original extent of this ecological community any notable further impacts to the extent of this community is likely to have the potential to be significant.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC under the TSC Act and Brigalow (Acacia harpophylla dominant and co-dominant) EEC under the EPBC Act	***Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC under the TSC Act***	***Myall Woodland EEC* under the TSC Act and *Weeping Myall Woodlands EEC* under the EPBC Act**	***Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC under the EPBC Act***
• It is expected that the overall condition of *Brigalow EEC* in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions is likely to be fragmented and subject to disturbances such as grazing and weed invasion. • The impact of 4.75 hectares of this community represents a reduction of approximately 0.003% of the community across its NSW extent.	• The impact of 0.04 hectares of this community represents a negligible reduction of the community across its NSW extent.	• It is expected that the overall condition of these TECs in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions would range from small fragmented areas of good condition to highly degraded, and subject to disturbances such as overgrazing, weed invasion and pest outbreaks. • The impact of up to 6.95 hectares of these TECs represents a negligible reduction of the community across its NSW extent.	• It is expected that the overall condition of this TEC in the Northern Basalts, Northern Outwash or Castlereagh-Barwon IBRA subregions is likely to be fragmented and subject to disturbances such as grazing and weed invasion. • The permanent loss of approximately 237.41 hectares and the temporary disturbance of 31.23 hectares of the community is likely to result in a significant impact on the community.
(d) the development proposal's impact on: ***(i) abiotic factors critical to the long-term survival of the CEEC or EEC. For example, will the impact lead to a reduction of groundwater levels or substantial alteration of surface water patterns?***			
The proposal would be unlikely to adversely modify or destroy abiotic factors necessary for the long-term survival of these TECs in the locality.			

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC under the TSC Act and Brigalow (Acacia harpophylla dominant and co-dominant) EEC under the EPBC Act	***Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC under the TSC Act***	***Myall Woodland EEC* under the TSC Act and *Weeping Myall Woodlands EEC* under the EPBC Act**	***Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC under the EPBC Act***
(ii) characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants			
The proposal would result in the removal of areas of *Brigalow EEC* within the Development Site as described in the sections above. Where this disturbance will occur, the proposal will remove characteristic and functionally important species to the EEC. These include, but are not limited to, brigalow (*Acacia harpophylla*) and native groundcover species. The proposal would be unlikely to impact these characteristic and functionally important species for these TECs outside the Development Site in the wider locality.	The proposal would result in the removal of areas of *Carbeen Open Forest EEC* within the Development Site as described in the sections above. Where this disturbance will occur, the proposal will remove characteristic and functionally important species to the EEC. These include, but are not limited to, carbeen (*Corymbia tessellaris*) and white cypress Pine (*Callitris glaucophylla*) and native groundcover species. The proposal would be unlikely to impact these characteristic and functionally important species for this EEC outside the Development Site in the wider locality.	The proposal would result in the removal of areas of these TECs within the Development Site as described in the sections above. Where this disturbance will occur, the proposal will remove characteristic and functionally important species to the EEC. These include, but are not limited to, weeping myall (*Acacia pendula*) and native shrub and groundcover species. The proposal would be unlikely to impact these characteristic and functionally important species for this EEC outside the Development Site in the wider locality.	The proposal would result in the removal of areas of *Natural Grassland CEEC* within the Development Site as described in the sections above. Where this disturbance will occur, the proposal will remove characteristic and functionally important species to the CEEC. These include, but are not limited to, native shrubs, tussock grasses and native herb and forb species. The proposal would be unlikely to impact these characteristic and functionally important species for this TEC outside the Development Site in the wider locality.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC under the TSC Act and Brigalow (Acacia harpophylla dominant and co-dominant) EEC under the EPBC Act	***Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC under the TSC Act***	***Myall Woodland EEC* under the TSC Act and *Weeping Myall Woodlands EEC* under the EPBC Act**	***Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC under the EPBC Act***
(iii) the quality and integrity of an occurrence of the CEEC or EEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the CEEC or EEC.			
Weed invasion is one of the key mechanisms and indicators of degradation of this EEC. Weeds are known to be common in areas of *Brigalow EEC* (DoE 2016d). Although this EEC within the Development Site contains a predominantly native understorey, all sites recorded include some exotic groundcover. The rail corridor is currently subject to the invasion of weed species. There is potential for the proposal to cause edge effects into these TECs surrounding the Development Site and facilitate the spread of invasive weed species. The proposal is not expected to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the surrounding extent of the TECs.	Weed invasion is one of the key mechanisms and indicators of degradation of these TECs. Weeds have invaded most of the remaining areas of the *Carbeen Open Forest EEC*. Although these TECs within the Development Site contain a predominantly native understorey, all sites include some exotic groundcover. The rail corridor is currently subject to the invasion of weed species. There is potential for the proposal to cause edge effects into these TECs surrounding the Development Site and facilitate the spread of invasive weed species. The proposal is not expected to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the surrounding extent of these TECs.	Weed invasion is one of the key mechanisms and indicators of degradation of these TECs. These TECs are threatened by clearing and fragmentation associated with cropping, overgrazing by feral and domestic animals, pest outbreaks and weed invasion (NSWSC 2005). Although these TECs within the Development Site contain a predominantly native understorey, all sites include some exotic groundcover. The rail corridor is currently subject to the invasion of weed species. There is potential for the proposal to cause edge effects into these TECs surrounding the Development Site and facilitate the spread of invasive weed species. The proposal is not expected to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the surrounding extent of these TECs.	Weed invasion is one of the key mechanisms and indicators of degradation of this CEEC. Weeds are k*nown to be common in areas of this CEEC* (TSSC 2008).Although this EEC within the Development Site contains a predominantly native understorey, the majority of sites recorded include some exotic groundcover. The rail corridor is currently subject to the invasion of weed species. There is potential for the proposal to cause edge effects into this TEC surrounding the Development Site and facilitate the spread of invasive weed species. The proposal is not expected to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the surrounding extent of the TEC.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC under the TSC Act and Brigalow (Acacia harpophylla dominant and co-dominant) EEC under the EPBC Act	*Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC under the TSC Act*	*Myall Woodland EEC* under the TSC Act and *Weeping Myall Woodlands EEC* under the EPBC Act	*Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC under the EPBC Act*
(e) direct or indirect fragmentation and isolation of an important area of the CEEC or EEC.			
It is not considered that any of these TECs in the Development Site consists of an important area of the EEC or CEEC as defined by FBA (OEH 2014a). An important area is an area of the CEEC or EEC that is necessary for the entities' long-term persistence and recovery. This may include areas identified in recovery plans, and/or an area large in comparison to other stands of the CEEC or EEC or occurrences of the CEEC or EEC at the limit of the community's range. The occurrence of the EEC within the Development Site is unlikely to be necessary for the EEC's or CEEC long-term persistence and recovery. These areas occur as already fragmented and disturbed patches within the rail corridor and do not constitute a large area in comparison with other stands of the EEC or CEEC, or this location specifically listed in any recovery plans. While the proposal will result in an increase in the level of fragmentation of the EECs and CEEC at the local scale, the level of increase is considered negligible given the already highly fragmented nature of this EECs and CEEC across the Development Site.			
(f) the measures proposed to contribute to the recovery of the CEEC or EEC in the IBRA subregion.			
As part of the proposal, a Biodiversity Offset Strategy will be prepared in accordance with the NSW *Biodiversity Offsets Policy for Major proposals* (OEH 2014a). This will require the identification of suitable land-based or non-land based offsets as outlined in this Policy. In the case of land-based offsets, these may be located in the same or any adjoining IBRA subregion in which the development occurs. The establishment of a BioBank site, as per BBAM (OEH 2014b), will include specific management actions that must be carried out to maintain and improve these communities at the BioBank Site. The proposed offset strategy for the proposal is described in **Section 6.0**.			

5.4.2 Impacts on Threatened Species that Require Further Consideration

5.4.2.1 Threatened Fauna Species

The following threatened fauna species were specifically identified in the SEARs as requiring further consideration in the BAR:

- large-eared pied bat (*Chalinolobus dwyeri*) - vulnerable under the TSC and EPBC Acts
- five-clawed worm-skink (*Anomalopus mackayi*) - endangered under the TSC Act and vulnerable under the EPBC Acts
- pale imperial hairstreak (*Jalmenus eubulus*) - critically endangered under the TSC Act.

None of these species were recorded within the Development Site during the surveys undertaken for this assessment as the habitats within the Development Site are highly disturbed and generally in low condition due to surrounding agricultural practices and disturbance from the rail corridor. However, it is acknowledged that these species have the potential to occur due to the identification of historic local records, the mobility of these species and the availability of marginal habitat in the Development Site. While marginally suitable foraging habitat exists within the Development Site for some of these species, this habitat if used at all is likely to only be sporadically used for short periods of time and the proposal is not likely to affect the extent of any local populations of the threatened fauna species listed in the SEARs as requiring further consideration.

Table 5.5 below provides further information for the threatened fauna species outlined above and identified in the SEARs as requiring further consideration as per Section 9.2.5 of the FBA (OEH 2014a).

Table 5.5 Impacts on Threatened Fauna Species that Require Further Consideration as per the SEARs

large-eared pied bat ***Chalinolobus dwyeri***	**five-clawed worm-skink** ***Anomalopus mackayi***	**pale imperial hairstreak** ***Jalmenus eubulus***
(a) the size of the local population directly and indirectly impacted by the development		
Large-eared pied bat was not recorded within the Development Site despite targeted fauna surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are highly disturbed and generally in low condition due to surrounding agricultural practices and disturbance from the rail corridor. The closest records of the species occur around Mount Kaputar National Park approximately 20 km to the east of the Development Site near Narrabri (OEH 2016d). No known populations of large-eared pied bat occur within the Development Site and it is considered that the species is not likely to be impacted as a result of the proposal.	Five-clawed worm-skink was not recorded within the Development Site despite targeted fauna surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are highly disturbed and generally in low condition due to surrounding agricultural practices and disturbance from the rail corridor. The closest record of the species occurs around Bellata less than 1km to the west of the Development Site (OEH 2016d). No known populations of five-clawed worm-skink occur within the Development Site and it is considered that the species is not likely to be impacted as a result of the proposal.	Pale imperial hairstreak was not recorded within the Development Site despite targeted fauna surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are highly disturbed and generally in low condition due to surrounding agricultural practices and disturbance from the rail corridor. The closest most recent record of the species occurs approximately 10 km to the north-west of the Development Site near North Star (OEH 2016d). No known populations of pale imperial hairstreak occur within the Development Site and it is considered that the species is not likely to be impacted as a result of the proposal.

large-eared pied bat ***Chalinolobus dwyeri***	**five-clawed worm-skink** ***Anomalopus mackayi***	**pale imperial hairstreak** ***Jalmenus eubulus***
(b) the likely impact (including direct and indirect impacts) that the development will have on the habitat of the local population, including but not limited to: ***(i) an estimate of the change in habitat available to the local population as a result of the proposed development***		
Large-eared pied bat occurs in areas containing extensive cliffs and caves as well as surrounding well-timbered areas with gullies. The species is known to roost in caves, overhangs, mine tunnels and disused fairy martin nests (DERM 2011). The species is not known to roost in tree hollows (DERM 2011). The Development Site contains potential marginal foraging habitat for the species. No known populations of large-eared pied bat occur within the Development Site and no change in known habitat will occur as a result of the proposal.	Five-clawed worm-skink occurs on the lower slopes of slight rises in grassy White Box woodland, open woodland and River Red Gum–Coolibah-Bimble Box woodland. The species lives in permanent deep tunnel-like burrows and deep soil cracks, using fallen logs and timber as sheltering sites on the surface (TSSC 2008). No known populations of five-clawed worm-skink occur within the Development Site and no change in known habitat will occur as a result of the proposal.	Pale imperial hairstreak occurs in brigalow (*Acacia harpophylla*) and Buloke (*Casuarina cristata*) on clay soils on flat to gently undulating plains, usually with scattered emergent eucalypts such as poplar box (*Eucalyptus populnea*) and low trees of Wilga (*Geijera parviflora*). No known populations of pale imperial hairstreak occur within the Development Site and no change in known habitat will occur as a result of the proposal.
(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and		
The proposal will remove a range of native vegetation communities within the Development Site including fragmented woodlands and derived native and natural grasslands. The majority of impacts will occur in cleared and non-native vegetation associated within the rail corridor. No known habitat for large-eared pied bat occurs within the Development Site and the proposal will not result in the loss, modification, destruction for isolation of habitat for the species.	The proposal will remove a range of native vegetation communities within the Development Site including fragmented woodlands and derived native grassland. The majority of impacts will occur in cleared and non-native vegetation associated within the rail corridor. Some potential habitat for five-clawed worm-skink occurs within the Development Site, however the proposal will not result in the loss, modification, destruction for isolation of known habitat for the species.	The proposal will remove a range of native vegetation communities within the Development Site including fragmented woodlands and derived native grassland. The majority of impacts will occur in cleared and non-native vegetation associated within the rail corridor. Some potential habitat for pale imperial hairstreak occurs within the Development Site in the brigalow dominated native vegetation, however the proposal will not result in the loss, modification, destruction or isolation of known habitat for the species.

large-eared pied bat ***Chalinolobus dwyeri***	**five-clawed worm-skink** ***Anomalopus mackayi***	**pale imperial hairstreak** ***Jalmenus eubulus***
(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.		
Large-eared pied bat breeds in maternity caves in selected locations including Copeton, Coonabarabran and Barraba (DERM 2011). High fertility forests or woodlands adjacent to breeding and roosting sites are important for the species. No known breeding or roosting habitat for large-eared pied bat occurs within the Development Site and the proposal will not result in the modification of habitat important to the species life cycle.	Very little is known about the biology of the five-clawed worm-skink. Average clutch size or mortality rates for newborns is unknown. One specimen was observed laying three eggs in spring. Some potential habitat for five-clawed worm-skink occurs within the Development Site, however the proposal will not result in the modification of habitat important to the species life cycle.	Pale imperial hairstreak only breeds in old-growth forest or woodland and does not appear to colonise regrowth habitats following clearing or other major disturbance. Some potential habitat for pale imperial hairstreak occurs within the Development Site in the Brigalow dominated native vegetation, however this has been previously disturbed as a result of the rail corridor and surrounding clearing for agriculture. The proposal will not result in the modification of habitat important to the species life cycle.
(c) the likely impact on the ecology of the local population: ***(i) for fauna:*** ***– breeding*** ***– foraging*** ***– roosting, and***		
No known breeding or roosting habitat for large-eared pied bat occurs within the Development Site. Roosting habitat may be available in the bridge structures within the Development Site and native woodland vegetation in the Development Site may provide some marginal foraging habitat for the species, although this has not been recorded. The proposal is unlikely to affect the ecology and biology of any residual population in the locality following the proposal.	Some potential habitat for five-clawed worm-skink occurs within the Development Site, however the proposal is unlikely to affect the ecology and biology of any residual population in the locality following the proposal.	Some potential habitat for pale imperial hairstreak occurs within the Development Site in the Brigalow dominated native vegetation, however this has been previously disturbed as a result of the rail corridor and surrounding clearing for agriculture and is unlikely to provide breeding habitat for the species. The proposal is unlikely to affect the ecology and biology of any residual population in the locality following the proposal.

large-eared pied bat *Chalinolobus dwyeri*	five-clawed worm-skink *Anomalopus mackayi*	pale imperial hairstreak *Jalmenus eubulus*
(d) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development		
Large-eared pied bat is not known to occur within the Development Site and is not expected to be impacted by the proposal. As a result the proposal will not fragment or isolate any known populations of this species.	Five-clawed worm-skink is not known to occur within the Development Site and is not expected to be impacted by the proposal. As a result the proposal will not fragment or isolate any known populations of this species.	Pale imperial hairstreak is not known to occur within the Development Site and is not expected to be impacted by the proposal. As a result the proposal will not fragment or isolate any known populations of this species.
(e) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range		
Local populations of large-eared pied bat are known to the east of Narrabri in Mount Kaputar National Park (OEH 2016d). The Development Site would be at the north-western extent of the species known range, however large-eared pied bat has not been recorded in the Development Site. It is unlikely that the proposal will impede the ability of other populations to interact for dispersal and genetic viability or diversity.	The five-clawed worm-skink has been recorded south of Narrabri and near Bellata near the Development Site (OEH 2016d). The Development Site would not be at the limit of the species known range. It is unlikely that the proposal will impede the ability of other populations to interact for dispersal and genetic viability or diversity given the current fragmentation caused by the existing rail corridor.	Local populations of pale imperial hairstreak occur approximately 10 km to the north-west of the Development Site near North Star (OEH 2016d). The Development Site would not be at the limit of the species known range. It is unlikely that the proposal will impede the ability of other populations to interact for dispersal and genetic viability or diversity given the current fragmentation caused by the existing rail corridor.
(f) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population		
Key threats for large-eared pied bat include the clearing of woodland near cliffs and caves, damage to roost and breeding sites, use of pesticides and disturbance to roosting areas by goats. The proposal will not result in any of the above threats. No known habitat for large-eared pied bat occurs within the Development Site.	Key threats for five-clawed worm-skink include the clearing and fragmentation of habitat by agriculture and development, removal of fallen timber and weed invasion. The proposal will result in the removal of a range of native vegetation communities and is likely to exacerbate these threats. No known habitat for five-clawed worm-skink occurs within the Development Site.	Key threats for pale imperial hairstreak include the loss of old-growth Brigalow woodland. The proposal will result in the removal of a range of native vegetation communities, including Brigalow woodlands and is likely to exacerbate these threats. No known habitat for pale imperial hairstreak occurs within the Development Site.

large-eared pied bat *Chalinolobus dwyeri*	five-clawed worm-skink *Anomalopus mackayi*	pale imperial hairstreak *Jalmenus eubulus*
(g) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.		
As part of the proposal, a Biodiversity Offset Strategy will be prepared in accordance with the NSW *Biodiversity Offsets Policy for Major proposals* (OEH 2014a). This will require the identification of suitable land-based or non-land based offsets as outlined in this Policy. In the case of land-based offsets, these may be located in the same or any adjoining IBRA subregion in which the development occurs. The establishment of a BioBank site, as per BBAM (OEH 2014b), will include specific management actions that must be carried out to maintain and improve these communities at the BioBank Site. The proposed approach to the offset strategy for the proposal is described in **Section 6.0**.		

5.4.2.2 Threatened Flora Species

The following threatened flora species were specifically identified in the SEARs as requiring further consideration in the BAR:

- ooline (*Cadellia pentastylis*) - vulnerable under the TSC and EPBC Acts
- *Cyperus conicus* - endangered under the TSC Act
- creeping tick-trefoil (*Desmodium campylocaulon*) - endangered under the TSC Act
- bluegrass (*Dichanthium setosum*) - vulnerable under the TSC and EPBC Acts
- finger panic grass (*Digitaria porrecta*) - endangered under the TSC Act
- Belson's panic (*Homopholis belsonii*) - endangered under the TSC Act and vulnerable under the EPBC Act
- spiny peppercress (*Lepidium aschersonii*) - vulnerable under the TSC and EPBC Acts
- native milkwort (*Polygala linariifolia*) - endangered under the TSC Act
- scant Pomaderris (*Pomaderris queenslandica*) - endangered under the TSC Act
- *Tylophora linearis* - vulnerable under the TSC Act and endangered under the EPBC Act.

Of the above threatened species, only the following were recorded within the Development Site during the surveys undertaken for this assessment:

- finger panic grass (*Digitaria porrecta*) - endangered under the TSC Act
- Belson's panic (*Homopholis belsonii*) - endangered under the TSC Act and vulnerable under the EPBC Act
- creeping tick-trefoil (*Desmodium campylocaulon*) - endangered under the TSC Act.

There is also potential for bluegrass (*Dichanthium setosum*) to occur in the Development Site based on suitable habitat and nearby records.

Table 5.6 below provides further information for the threatened flora species recorded within the Development Site and identified in the SEARs as requiring further consideration as per Section 9.2.5 of the FBA (OEH 2014a).

Table 5.6 Impacts on Threatened Flora Species that Require Further Consideration as per the SEARs

creeping tick-trefoil ***Desmodium campylocaulon***	**finger panic grass** ***Digitaria porrecta***	**Belson's panic** ***Homopholis belsonii***	**bluegrass** ***Dichanthium setosum***
(a) the size of the local population directly and indirectly impacted by the development			
Creeping tick-trefoil was recorded within the Development Site primarily on black clay soils in areas containing naturally-occurring native grasslands. 2559 individuals were identified during the surveys undertaken for this assessment. It is considered that this species occurs widely within areas mapped as PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion, with the accurate number of individuals in this area difficult to record. A total of 268.64 hectares of suitable habitat is present within the Development Site for this species. A large population of creeping tick-trefoil is known to occur within the Development Site and the species will be impacted as a result of the proposal.	Finger panic grass was recorded on rich black soils primarily south of Moree in areas containing naturally-occurring native grasslands. Up to 28 individuals were recorded in the Development Site during the surveys undertaken for this assessment. A small population of finger panic grass is known to occur within the Development Site and the species will be impacted as a result of the proposal.	Belson's panic was recorded on alluvial clay soils primarily within the understorey of remnant patches of weeping myall woodlands. 73 individuals at four locations were recorded in the Development Site during the surveys undertaken for this assessment south of North Star, and between Crooble and Croppa Creek. A small population of Belson's panic is known to occur within the Development Site and the species will be impacted as a result of the proposal.	Bluegrass was not recorded within the Development Site despite thorough vegetation surveys undertaken in accordance with the seasonal requirements for this species. The habitats within the Development Site are highly disturbed and generally in low condition due to surrounding agricultural practices and disturbance from the rail corridor. The closest record of the species occurs near the Newell Highway south of Moree less than 1 km from the Development Site (OEH 2016d). No known populations of bluegrass occur within the Development Site and it is considered unlikely that the species will be impacted as a result of the proposal.

creeping tick-trefoil ***Desmodium campylocaulon***	**finger panic grass** ***Digitaria porrecta***	**Belson's panic** ***Homopholis belsonii***	**bluegrass** ***Dichanthium setosum***
(b) the likely impact (including direct and indirect impacts) that the development will have on the habitat of the local population, including but not limited to: ***(i) an estimate of the change in habitat available to the local population as a result of the proposed development***			
Creeping tick-trefoil is confined to clay soils and in particular, cracking black soils around Narrabri and Moree local government areas. In the Development Site, the species was associated with occurrences of naturally-occurring native grasslands within PCT52. The proposal will result in permanent impacts of 237.41 hectares and temporary impacts of 31.23 hectares of known habitat for the species. These impacts will result in a minor reduction in known habitat for creeping tick-trefoil in the locality.	Finger panic grass occurs in native grassland, woodlands or open forest with a grassy understorey, on richer soils to clay soils in association with canopy species such as white box (*Eucalyptus albens*) and weeping myall (*Acacia pendula*) In the Development Site, the species was recorded on rich black soils primarily south of Moree in areas containing naturally-occurring native grasslands. The proposal will result in permanent impacts to 28 individuals and will impact known and potential habitat of the species. These impacts will result in a minor reduction in known habitat for finger panic grass in the locality.	Belson's panic grows in dry woodland often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. In the Development Site, the species was associated with remnant patches of weeping myall woodlands. The proposal will result in permanent impacts to 73 individuals at four locations and will impact known and potential habitat of the species. These impacts will result in a minor reduction in known habitat for Belson's panic in the locality.	Bluegrass is associated with heavy basaltic black soils and red-brown loams with clay subsoil. This species is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. No known populations of bluegrass occur within the Development Site and no change in known habitat is expected to occur as a result of the proposal.

creeping tick-trefoil ***Desmodium campylocaulon***	**finger panic grass** ***Digitaria porrecta***	**Belson's panic** ***Homopholis belsonii***	**bluegrass** ***Dichanthium setosum***
(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and			
The proposal will remove a range of native vegetation communities within the Development Site including fragmented woodlands and derived native grassland. The majority of impacts will occur in cleared and non-native vegetation associated with the rail corridor. A large population of creeping tick-trefoil is known to occur within the Development Site and the species and its habitat will be impacted as a result of the proposal.	The proposal will remove a range of native vegetation communities within the Development Site including fragmented woodlands and derived native grassland. The majority of impacts will occur in cleared and non-native vegetation associated with the rail corridor. A small population of finger panic grass is known to occur within the Development Site and the species will be impacted as a result of the proposal.	The proposal will remove a range of native vegetation communities within the Development Site including fragmented woodlands and derived native grassland. The majority of impacts will occur in cleared and non-native vegetation associated with the rail corridor. A small population of Belson's panic is known to occur within the Development Site and the species will be impacted as a result of the proposal.	The proposal will remove a range of native vegetation communities within the Development Site including fragmented woodlands and derived native grassland. The majority of impacts will occur in cleared and non-native vegetation associated with the rail corridor. No known habitat for bluegrass occurs within the Development Site and the proposal is unlikely to result in the loss, modification, destruction for isolation of habitat for the species.

creeping tick-trefoil ***Desmodium campylocaulon***	**finger panic grass** ***Digitaria porrecta***	**Belson's panic** ***Homopholis belsonii***	**bluegrass** ***Dichanthium setosum***
(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.			
Creeping tick-trefoil flowers in summer and autumn. The species is said to be hardy, but often grazed where sheep have regular access. Plants are strongly stoloniferous and well-cropped by cattle. The proposal is likely to modify known and potential habitat for this species within the Development Site. This will result in a reduction of the species extent, however it is expected that this species occurs in association with naturally-occurring native grasslands that extend beyond the Development Site in the locality. The proposal will impact up to 237.41 hectares of habitat that supports the processes important to the species life cycle in the locality.	Finger panic grass flowers from mid-January to late February with seeds maturing and falling from the plant soon after. This species is a perennial tussock-forming grass that can vegetatively reproduce. The proposal is likely to modify known and potential habitat for this species within the Development Site. This will result in a reduction of the species extent, however it is expected that this species occurs in association with rich soils and naturally-occurring native grasslands that extend beyond the Development Site in the locality. The proposal will impact a small population of the species in the Development Site, however this is unlikely to impact the processes important to the species life cycle in the locality.	Belson's panic flowers between February and May. Dispersal of seed occurs when the panicle dries after seed formation and breaks off in the wind. The wind causes the panicle to migrate forward in a continuous rolling motion until an obstacle is encountered. The proposal is likely to modify known and potential habitat for this species within the Development Site. This will result in a reduction of the species extent, however it is expected that this species occurs in association with fragmented woodland areas that extend beyond the Development Site in the locality. The proposal will impact a small population of the species in the Development Site however this is unlikely to impact the processes important to the species life cycle in the locality.	Bluegrass is a warm season perennial, the species commences growing in spring, flowers in summers and becomes dormant in late autumn. No known habitat for bluegrass occurs within the Development Site and the proposal is unlikely to result in the modification if habitat important to the species life cycle.

creeping tick-trefoil ***Desmodium campylocaulon***	**finger panic grass** ***Digitaria porrecta***	**Belson's panic** ***Homopholis belsonii***	**bluegrass** ***Dichanthium setosum***
(c) the likely impact on the ecology of the local population: ***(ii) for flora, address how the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available:*** ***– pollination cycle*** ***– seedbanks*** ***– recruitment, and*** ***– interactions with other species (e.g. pollinators, host species, mycorrhizal associations)***			
The proposal will impact up to 237.41 hectares of habitat that supports creeping tick-trefoil in the Development Site. It is expected that this species occurs in association with naturally-occurring native grasslands that extend beyond the Development Site in the wider locality. The impact of the proposal is likely to reduce the remaining local population's availability for pollination, seedbanks and success of recruitment.	The proposal will impact a small population and potential habitat that supports finger panic grass in the Development Site. It is expected that this species occurs in association with naturally-occurring native grasslands that extend beyond the Development Site in the wider locality. The impact of the proposal may result in a minor reduction in the remaining local population's availability for pollination, seedbanks and success of recruitment.	The proposal will impact a small population and potential habitat that supports Belson's panic in the Development Site. It is expected that this species occurs in association with fragmented woodland areas that extend beyond the Development Site in the wider locality. The impact of the proposal is may result in a minor reduction in the remaining local population's availability for pollination, seedbanks and success of recruitment.	No known habitat for bluegrass occurs within the Development Site. The proposal is unlikely to affect the ecology and biology of any residual population in the locality following the proposal.

creeping tick-trefoil ***Desmodium campylocaulon***	**finger panic grass** ***Digitaria porrecta***	**Belson's panic** ***Homopholis belsonii***	**bluegrass** ***Dichanthium setosum***
(d) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development			
The proposal will impact up to 237.41 hectares of habitat that supports creeping tick-trefoil in the Development Site. This reduction will result in some fragmentation of the wider local population of the species outside the Development Site. It is considered unlikely that this will result in substantial isolation for the species which is known to be associated with naturally-occurring native grasslands that extend beyond the Development Site in the wider locality.	The proposal will impact a small population and potential habitat that supports finger panic grass in the Development Site. This reduction will result in some minor fragmentation of the wider local population of the species outside the Development Site. It is considered unlikely that this will result in substantial isolation for the species which is known to be associated with naturally-occurring native grasslands that extend beyond the Development Site in the wider locality.	The proposal will impact a small population and potential habitat that supports Belson's panic in the Development Site. This reduction will result in some minor fragmentation of the wider local population of the species outside the Development Site. It is considered unlikely that this will result in substantial isolation for the species which is known to be associated with fragmented woodland areas that extend beyond the Development Site in the wider locality.	Bluegrass is not known to occur within the Development Site and is not expected to be impacted by the proposal. As a result the proposal will not fragment or isolate any known populations of this species.

creeping tick-trefoil *Desmodium campylocaulon*	finger panic grass *Digitaria porrecta*	Belson's panic *Homopholis belsonii*	bluegrass *Dichanthium setosum*
(e) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range			
Local populations of creeping tick-trefoil are known north and south of Moree in disturbed habitats near and along the Newell Highway (OEH 2016d). The Development Site near Bellata would be at the southern extent of the species known range. The species is known to persist in disturbed habitats including road reserves and grazed land. It is unlikely that the proposal will impede the ability of other populations to interact for dispersal and genetic viability or diversity.	Local populations of finger panic grass occur sporadically on either side of the Development Site between Narrabri and Moree (OEH 2016d). The Development Site near Bellata would be at the southern extent of the species known range. The species is known to persist in disturbed habitats including road reserves and grazed land. The Development Site would not be at the limit of the species known range. It is unlikely that the proposal will impede the ability of other populations to interact for dispersal and genetic viability or diversity.	Local populations of Belson's panic occur to the east of the Development Site from Narrabri to North Star (OEH 2016d). The Development Site near Narrabri would be at the southern extent of the species core range. It is unlikely that the proposal will impede the ability of other populations to interact for dispersal and genetic viability or diversity.	Historic local populations of bluegrass are known to occur around Narrabri and Gurley with a range of regional populations to the east of the Development Site (OEH 2016d). The Development Site would be at the western limit of the species known range. It is unlikely that the proposal will impede the ability of other populations to interact for dispersal and genetic viability or diversity.
(f) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population			
Key threats for creeping tick-trefoil include continuous grazing and habitat depletion. The proposal will result in the removal of a range of native vegetation communities and is likely to exacerbate the habitat depletion for the species.	Key threats for finger panic grass include clearing of habitat, heavy grazing, disturbance due to roadside maintenance, frequent fires, urban expansion, competition with invasive grasses and pesticide use. The proposal will result in the removal of a range of native vegetation communities and is likely to exacerbate some of these threats.	Key threats for Belson's panic include clearing of habitat, heavy grazing, invasion of weeds, inappropriate roadside management and the encroachment of native vegetation such as mimosa bush. The proposal will result in the removal of a range of native vegetation communities and is likely to exacerbate some of these threats.	Key threats for bluegrass include heavy grazing, clearing of habitat, frequent fires, invasion of introduced grasses and slashing regimes. The proposal will result in the removal of a range of native vegetation communities and is likely to exacerbate some of these threats. No known habitat for bluegrass occurs within the Development Site.

creeping tick-trefoil *Desmodium campylocaulon*	finger panic grass *Digitaria porrecta*	Belson's panic *Homopholis belsonii*	bluegrass *Dichanthium setosum*
(g) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.			
As part of the proposal, a Biodiversity Offset Strategy will be prepared in accordance with the NSW *Biodiversity Offsets Policy for Major proposals* (OEH 2014a). This will require the identification of suitable land-based or non-land based offsets as outlined in this Policy. In the case of land-based offsets, these may be located in the same or any adjoining IBRA subregion in which the development occurs. The establishment of a BioBank site, as per BBAM (OEH 2014b), will include specific management actions that must be carried out to maintain and improve these communities at the BioBank Site. The proposed approach to the offset strategy for the proposal is described in **Section 6.0**.			

5.5 Seven Part Tests of Significance

Threatened species impact assessment is an integral part of environmental impact assessment. The objective of s. 5A of the EP&A Act, the *assessment of significance*, is to improve the standard of consideration afforded to threatened species, populations and ecological communities, and their habitats through the planning and assessment process, and to ensure that the consideration is transparent.

Although it is understood that the preparation of a BioBanking Assessment under the FBA supersedes the requirement to prepare Seven Part Tests, the Department of Planning and Environment (DPE) has advised that the requirements of Section 5A of the EP&A Act are to be considered in the BAR. The preparation of a BAR under the FBA addresses the components of the Seven Part Tests through application of the BBCC. A summary of the requirements of the Seven Part Tests of Significance and where they are addressed in the FBA Assessment is outlined in **Table 5.7** below.

Table 5.7 Seven Part Tests of Significance and the FBA

Seven Part Test of Significance	Where Addressed in the FBA Process
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;	Threatened species (ecosystem-credit and species-credit) are predicted in the BBCC by the landscape features of the Development Site (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features. Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014a) identify impacts on critically endangered threatened species, impacts that may cause the extinction of a species in a IBRA subregion and impacts that significantly reduce the viability of a species.
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	Endangered populations are predicted in the BBCC by the landscape features of the Development Site (native vegetation cover, IBRA regions, patch sizes, condition and plant community types) and assessed by the impact on these features. Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014a) identify impacts that may cause the extinction of an endangered population in a IBRA subregion and impacts that significantly reduce the viability of a population.
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; and 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;	Endangered ecological communities are predicted in the BBCC by the plant community types and biometric community types identified from the field surveys and entered into the BBCC. Impacts requiring further consideration (Section 9.2 of the FBA (OEH 2014a) are identified as impacts on any critically endangered or endangered ecological community that may cause the extinction of the EEC/CEEC in a IBRA subregion or significantly reduce the viability of an EEC/CEEC.

Seven Part Test of Significance	Where Addressed in the FBA Process
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; 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; and 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;	Habitat loss is assessed in the BBCC via the 'Site Values' tab and the loss in site value score entered for each vegetation zone. Fragmentation of habitat is addressed as part of the 'Landscape Value' score including consideration of features before and after the development including per cent native vegetation cover, connectivity value and vegetation condition. The per cent cleared scores for the dominant Mitchell Landscape is also calculated in the 'Landscape Value' score. Important habitat features are identified through determining geographic and habitat features relevant for particular species-credit species and the assessment of landscape features (such as riparian buffers, important wetlands and state or regionally significant biodiversity links). The extent of habitat loss is ultimately determined by the measure of ecosystem credits and species credits calculated in the BBCC.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);	Critical habitat is addressed under impacts that require further consideration by the consent authority (refer to Section 9.2 of the FBA (OEH 2014a)).
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and	Recovery plans are not directly addressed in the FBA. A recovery plan has been prepared for koala (*Phascolarctos cinereus*) (DECC 2008). It is likely that the proposal would be inconsistent with any recovery plans prepared for the threatened species and/or communities impacted by the proposal as it relates to habitat for the species. However the proposal will not impede the implementation of these recovery plans. If supplementary offsetting measures are used (as per Appendix B of the NSW Biodiversity Offset Policy for Major proposals) to offset species or communities impacted by projects, reference can be made to the key objectives and actions in the relevant recovery plans.

Seven Part Test of Significance	Where Addressed in the FBA Process
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.	Key threatening processes are not directly assessed under the FBA. In this case, the proposal is likely to contribute to the following key threatening processes through the clearing of vegetation: • Clearing of native vegetation (TSC Act and EPBC Acts) • Loss of hollow-bearing trees (TSC Act) • Removal of dead wood and dead trees (TSC Act) The proposal may to contribute to the following key threatening processes through clearing of vegetation, edge effects associated with the operation of the proposal: • Aggressive exclusion of birds by noisy miners (*Manorina melanocephala*) (TSC and EPBC Acts) • Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*) (TSC and EPBC Acts) • Predation by the European red fox (*Vulpes vulpes*) (TSC and EPBC Acts) • Invasion of native plant communities by exotic perennial grasses (TSC Act). While the proposal is considered likely to contribute to the function of the above key threatening processes, the proposal as a whole, or any component of the proposal would not be classified as a key threatening process.

5.6 Impacts of Matters of National Environmental Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- World Heritage properties
- National Heritage places
- nuclear actions, and

- a water resource, in relation to coal seam gas development and large coal mining development.

A Referral to the Commonwealth Environment Minister was prepared and included assessments of significance for applicable MNES in accordance with the *Significant Impact Guidelines 1.1* (DoE 2013). Assessments of significance were undertaken for the following MNES:

- *Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland CEEC*
- *Brigalow (Acacia harpophylla dominant and co-dominant) EEC*
- *Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions EEC*
- *Weeping Myall Woodland EEC*
- Belson's panic (*Homopholis belsonii*)
- koala (*Phascolarctos cinereus*) (combined population of Qld, NSW and the ACT)
- grey-headed flying-fox (*Pteropus poliocephalus*) and
- south-eastern long-eared bat (*Nyctophilus corbeni*).

The Action (that is, the proposal as described in **Section 1.1**) was deemed to comprise a 'Controlled Action' by DoEE on 20 September 2016, due to the potential for significant impacts on the following matters protected under the EPBC Act:

- listed threatened species and communities (18 and 18A).

DoEE considers the proposed action is likely to have a significant impact on MNES, including but not limited to:

- the removal of 268 ha of the critically endangered Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland reducing an already greatly reduced ecological community and increasing the fragmentation of an important population
- the removal of 159 ha of foraging habitat for the vulnerable Koala (*Phascolarctos cinereus*) combined populations of Qld, NSW and the ACT.

The DoEE also determined that the action be assessed in accordance with the Bilateral agreement made under section 45 of the EPBC Act. Supplementary SEARs were issued on 8 November 2016 and a detailed response to each of the matters raised is provided in the Assessment of Commonwealth Matters report, (Umwelt 2017) which forms an appendix to the EIS.

5.6.1 Summary of Commonwealth Matters Assessment

Based on the direct and permanent impacts associated with the proposal that are summarised in **Table 4.3** and the range of avoidance, mitigation and management measures described in **Section 4.0**, the proposal is considered likely to result in a significant impact on *Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD CEEC* and the koala. Impacts of the proposal on MNES recorded in the proposal site will be offset in accordance with the NSW FBA, as detailed in **Table 5.8**.

Table 5.8 Summary of the Impacts of the Proposal on Relevant MNES

Matter	Proposal Impact	Like-for-like Offset In accordance with NSW FBA
Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD	The proposal is likely to significantly impact this ecological community. The reduction in the extent of the CEEC within the proposal site of 146.7 hectares is likely to result in a significant impact on the ecological community.	Subject to the revision of credits as part of the detailed design process, 11,046 ecosystem credits will be retired to offset impacts to this CEEC, in accordance with the Programme Biodiversity Offset Strategy and the NSW FBA.
Brigalow (*Acacia harpophylla* dominant and co-dominant)	The proposal would result in the removal of approximately 0.6 hectares of Brigalow (*Acacia harpophylla* dominant and co-dominant) from within the proposal site.	Subject to the revision of credits as part of the detailed design process, 250 ecosystem credits will be retired to offset impacts to this EEC, in accordance with the Programme Biodiversity Offset Strategy and the NSW FBA.
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	The proposal will result in the removal of approximately 1.19 hectares of Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions from within the proposal site.	Subject to the revision of credits as part of the detailed design process, 63 ecosystem credits will be retired to offset impacts to this EEC, in accordance with the Programme Biodiversity Offset Strategy and the NSW FBA.
Weeping Myall Woodlands	The proposal will result in the permanent loss of approximately 0.43 hectares within the proposal site.	Subject to the revision of credits as part of the detailed design process, 254 ecosystem credits will be retired to offset impacts to this EEC, in accordance with the Programme Biodiversity Offset Strategy and the NSW FBA.
Koala (*Phascolarctos cinereus*)	The assessment of significance concludes that the proposal is unlikely to result in a significant impact on an important population of the koala, however the DoEE has determined that the proposal is likely to result in a significant impact on the koala. The Koala Habitat Assessment Tool as outlined in Table 3 of the Referral Guidelines was used to complete this	Subject to the revision of credits as part of the detailed design process, 1,632 species credits will be retired to offset impacts to the habitat of this threatened species, in accordance with the Programme Biodiversity Offset Strategy and the NSW FBA.

Matter	Proposal Impact	Like-for-like Offset In accordance with NSW FBA
	assessment of significance (refer to Appendix 2) and the loss of 2.18 hectares of primary habitat and 13.44 hectares of secondary habitat is not expected to significantly impact the koala and residual significant impacts are not predicted due to the range of impact minimisation and mitigation strategies that are proposed to be implemented and the offsetting of plant community types in accordance with the NSW FBA.	
Belson's panic (*Homopholis belsonii*)	Given the relatively small number of individuals recorded in the proposal site, the highly disturbed and fragmented nature of the proposal site and the reasonable number of records of this species outside the proposal site at this locality according to the OEH Atlas of NSW Wildlife, it is unlikely that a key source population either for breeding or dispersal, a population that is necessary for maintaining genetic diversity or a populations that is near the limit of its known range occurs within the proposal site. Therefore these individuals of Belson's panic within the proposal site are not considered to form part of an important population. Therefore the proposal is unlikely to result in a significant impact on an important population of Belson's panic.	Subject to the revision of credits as part of the detailed design process, 1,898 species credits will be retired to offset impacts to the habitat of this threatened species, in accordance with the Programme Biodiversity Offset Strategy and the NSW FBA.

5.7 Environmental Values not Assessed under the FBA

As per Section 2.3 of the FBA (OEH 2014a), biodiversity values not considered under the FBA include marine mammals, wandering sea birds and biodiversity that are endemic to Lord Howe Island. None of these biodiversity values occur or have the potential to occur within the Development Site and as such have not been specifically assessed as part of this assessment.

In addition, the FBA does not assess the impacts of a project that are not associated with clearing of vegetation. Examples of these impacts include, but are not limited to:

- bird and bat strike associated with wind farm developments

- vehicle strike
- subsidence and cliff falls associated with mining developments
- downstream impacts on hydrology and environmental flows on surface vegetation and groundwater dependent ecosystems
- impacts on karst ecosystems.

The proposal will not involve impacts related to wind farms, mining developments or on karst ecosystems. It is likely that vehicle (train) strike will occur along the operational rail corridor, however this impact is an existing impact of the currently operating rail corridor. The potential impacts associated with increased train movements are outlined in **Section 4.4.1.3**. The impacts on potentially groundwater dependent ecosystems and downstream impacts on hydrology and environmental flows on vegetation are outlined in the Aquatic Impact Assessment in Volume 3 of the EIS. As the proposal does not involve substantial excavations that are that likely to interfere significantly with groundwater, the risk of significant impacts to groundwater and groundwater dependent ecosystems is low.

5.8 Impacts on Aquatic Biodiversity

An assessment of the impacts of the proposal on aquatic species and communities has been prepared in Umwelt (2017) *Australian Rail Track Corporation Inland Rail – Narrabri to North Star Aquatic Ecology Assessment*. A summary of the outcomes is provided below.

Twenty-five third order or higher streams occur within the Development Site. Analysis of key fish habitat values and sensitivity typing of the watercourses in combination with a literature review of fish community analysis by NSW DPI identifies that a number of these named watercourses have moderate or higher fish community value. The Mehi River and Gwydir River have both been identified as Class 1 Key Fish Habitat in accordance with DPI (Fisheries) guidelines.

A number of state and Commonwealth listed threatened fish species, endangered populations and TECs have been recorded or are predicted to occur in major watercourses in the Development Site including the eel-tailed catfish (*Tandanus tandanus*) endangered population listed under the FM Act and the Murray cod (*Maccullochella peelii*) listed under the EPBC Act. The proposed alignment intersects watercourses that are part of the *Aquatic Ecological Community in the Natural Drainage System of the Darling River Catchment* listed under the FM Act.

An assessment of significance of impact of the proposal on aquatic communities, threatened species and endangered populations identified that the proposal is unlikely to have an adverse impact, with the adoption of appropriately designed fish friendly crossing structures and other mitigation measures to further reduce impacts.

Groundwater Dependent Ecosystems (GDEs) in the Development Site are associated with the riparian vegetation along major watercourses particularly the Weeping Myall Open Woodland (Gehan Creek), River Red Gum Riparian Tall Woodland/Open Forest Wetland (Gurly Creek, Mehi River, Gwydir River, Gil Gil Creek and Croppa Creek) and the Coolabah – River Coobah – Lignum Woodland Wetland of Frequently Flooded Floodplains And Alluvial Plains (Tycannah Creek). Clearance of riparian vegetation for proposed upgrading of watercourse structures may occur where it is not possible to undertake works within the existing disturbance area. However, works to watercourse crossings are not expected to adversely alter local surface or groundwater flow regimes and the proposal is not expected to impact these GDEs.

Further detail on this assessment is outlined in Umwelt (2017) *Australian Rail Track Corporation Inland Rail – Narrabri to North Star Aquatic Ecology Assessment*.

6.0 Biodiversity Offset Strategy

ARTC is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the proposal under the NSW *Biodiversity Offsets Policy for Major Projects* (OEH 2014a). Firstly, ARTC has, where possible, altered the proposal to avoid and minimise ecological impacts in the proposal planning stage, and a range of impact mitigation strategies have been included in the proposal to mitigate the impact on ecological values (refer to **Section 4.0**) prior to the consideration of offsetting requirements.

6.1 Biodiversity Credit Report

Full Credit Calculator reports are included in **Appendix E**.

Table 6.1 below provides a summary of the ecosystem and species credits that require offsetting as a result of this proposal based on the Development Footprint used for this assessment.

Table 6.1 Ecosystem and Species Credits Generated at the Development Site

Name	Credits Required
Ecosystem Credits	
PCT27 (BR233, NA219) Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	254
PCT35 (BR120, NA117) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion	250
PCT39 (BR130, NA129) Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion	63
PCT52 (BR191, NA187) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	11,046
PCT56 (BR186, NA182) Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	6,303
PCT71 (BR127, NA126) Carbeen - White Cypress Pine - River Red Gum - bloodwood tall woodland on sandy loam alluvial and aeolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	2
PCT78 (BR196, NA193) River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	675
PCT135 (BR284, NA271) Coobah - Western Rosewood low open tall shrubland or woodland mainly on outwash areas in the Brigalow Belt South Bioregion	133
Total	**18,826**

Name	Credits Required
Species Credits	
finger panic grass (*Digitaria porrecta*)	364
creeping tick-trefoil (*Desmodium campylocaulon*)	2,607
Belson's panic (*Homopholis belsonii*)	1,898
koala (*Phascolarctos cinereus*)	1,632
Total	**6,501**

As detailed in **Table 6.1**, a total of 18,826 ecosystem credits and 6,501 species credits are required to offset the direct impacts of the proposal. The final credit generation for the proposal will be confirmed as an outcome of the detailed design process and the biodiversity offsetting for the proposal will be based on the final credit calculations. ARTC commits to the retirement of credits in accordance with the FBA and is developing a strategy to address the above offset requirement.

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