

PART

B



Impact
assessment –
proposal
infrastructure

INLAND RAIL—NARROMINE TO NARRABRI
ENVIRONMENTAL IMPACT STATEMENT

PART B

Impact assessment
proposal infrastructure

INLAND
RAIL 



CHAPTER B1 Biodiversity



Narromine to Narrabri
Environmental Impact Statement

ARTC

The Australian Government is delivering
Inland Rail through the Australian
Rail Track Corporation (ARTC), in
partnership with the private sector.

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B1. Biodiversity

This chapter provides a summary of the potential impacts of the Narromine to Narrabri project (the proposal) on terrestrial and aquatic ecology and biodiversity. A full copy of the assessment results is provided in Technical Report 1—Biodiversity development assessment report and Technical Report 2—Aquatic ecology assessment.

B1.1 Approach

A summary of the approach to the assessments is provided in this section, including the legislation, guidelines and/or policies driving the approach and the methodology used to undertake the assessments.

A more detailed description of the approach and methodology is provided in Technical Reports 1 and 2.

B1.1.1 Legislative and policy context to the assessment

Relevant legislation, policies and guidelines

The assessments were undertaken in accordance with the SEARs and with reference to the requirements of relevant legislation, policies and/or assessment guidelines, including:

- ▶ The EP&A Act, EPBC Act, *Biodiversity Conservation Act 2016* (NSW) (BC Act), Biodiversity Conservation Regulation 2017 (NSW) (BC Regulation), *Fisheries Management Act 1994* (NSW) (FM Act), *Biosecurity Act 2015* (NSW) and associated regulations
- ▶ *Biodiversity Assessment Method* (OEH, 2017) (the Biodiversity Assessment Method)
- ▶ *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC, 2004b)
- ▶ *NSW Guide to Surveying Threatened Plants* (OEH, 2016a)
- ▶ *'Species credit' threatened bats and their habitats* (OEH, 2018)
- ▶ Australian Department of Agriculture, Water and the Environment's survey guidelines for threatened species under the EPBC Act
- ▶ *Risk assessment guidelines for groundwater dependent ecosystems* (Serov et al., 2012)
- ▶ *Matters of National Environmental Significance—significant impact guidelines 1.1* (Department of the Environment, 2013)
- ▶ *EPBC Act Condition-setting Policy* (Department of Agriculture, Water and Environment, 2020a)
- ▶ *Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries (DPI), 2013c)
- ▶ *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003).

A detailed description of the legislative and policy context for the assessment is provided in section 2 of both Technical Report 1 and Technical Report 2.

Secretary's Environmental Assessment Requirements

The SEARs relevant to biodiversity, together with a reference to where they are addressed in the EIS, are provided in Appendix A.

B1.1.2 Methodology

Study area

Terrestrial biodiversity

The study area includes the proposal site and adjoining areas, generally located within 50 metres (m) of the proposal site. The study area refers to the area that was assessed for direct or indirect impacts as a result of works undertaken in the proposal site. Further analysis was undertaken within 500 m of the proposal site, including analysis of GIS and aerial photography. This informed the assessment of potential impacts within the study area by mapping native vegetation cover, extent and connectivity.

The database searches were based on a search area within a radius of up to 20 kilometres (km) of the proposal site.

Aquatic ecology

The study area includes the proposal site and adjoining areas, generally located within 500 m of the proposal site. The database searches were based on a search area within a radius of up to 20 km of the proposal site.

Key tasks—biodiversity development assessment report

Application of the Biodiversity Assessment Method, survey limitations and offsetting calculation approach

The Biodiversity Assessment Method sets out how biodiversity values will be assessed, prescribes requirements to avoid and minimise impacts, establishes rules for calculating the number and class of credits required for unavoidable impacts, and determines the trading rules that will apply. The Biodiversity Assessment Method Calculator specifies the type and extent of surveys required for a biodiversity assessment and then processes survey data to calculate the number and type of biodiversity credits that are required to offset the impacts of a development.

The Biodiversity Assessment Method calculator calculates the 'ecosystem credits' required based on the plant community types (PCTs) present, their condition and the area that would be impacted. Detailed surveys to assess vegetation integrity are required for each PCT and vegetation zone. The Biodiversity Assessment Method identifies the minimum number of vegetation integrity plots that must be surveyed in each vegetation zone, depending on the area of the zone.

The Biodiversity Assessment Method Calculator generates a list of threatened fauna species listed under the BC Act that are predicted to use the subject site based on the bioregional context for the assessment and the PCTs, patch size, vegetation cover and habitat resources present. Targeted surveys are not required under the Biodiversity Assessment Method for these species but they contribute to calculation of ecosystem credits required. Some of these species may also be listed under the EPBC Act and targeted surveys may be required to meet the requirements of that Act.

Threatened species listed under the BC Act that cannot reliably be predicted to occur on a site based on PCT, distribution and habitat criteria are identified as 'candidate species credit species'. The credit calculator references geographic, vegetation and habitat data for the subject site to generate a list of the species credit entities likely to occur and requiring targeted survey.

All threatened flora species in NSW are species credit species and require offsetting if found in the subject site (or are considered likely to occur based on habitat values present). Credits for flora species are either calculated based on area of habitat or count of individuals. Some threatened fauna species are also species credit species. Credits for fauna may be calculated based on the total area of habitat present, an area of important habitat, or based on a buffer area around breeding sites.

Targeted surveys in appropriate seasons and conditions are required to confirm or discount the presence of candidate species credit species at a site. If present (or likely to occur), species credits must be calculated as part of any offset requirements under the BC Act.

Surveys were conducted for the assessment in suitable habitat, where practicable, with regards to access and seasonal constraints; however, targeted survey results cannot be considered a reliable indicator of their presence or absence at the proposal site due to the prolonged drought conditions and limited access to suitable potential habitat areas. In most cases, some assumption of presence has been required, based on known records, results of surveys and habitat values present. A number of species could be reliably discounted as occurring within the study area based on the habitat types present and/or the known distribution of the species. Justification for the species credit species included in calculations, and those considered not onsite, are provided in Technical Report 1.

Segmented approach

Given the scale and complexity of the proposal and the large quantity of credits required, there is a risk that the time taken to retire credits for the entire proposal (as required by the BC Act) could delay commencement of construction.

In consultation with representatives of the Biodiversity and Conservation Division of the Department of Planning, Industry and Environment, a segmented biodiversity development assessment report was prepared to group the impacts of the proposal into separate 'construction segments' or portions (a total of 11 are proposed) and determine associated required offsets for each. This approach would provide more flexibility for the construction contractor(s) during construction and allow ARTC to retire credits for each segment at different times rather than for the entire proposal at the same time. The timing and sequencing of the delivery of the construction segments would be subject to confirmation during detailed design.

Key tasks

The assessment involved:

- ▶ Background research, including reviewing previous assessments relevant to the study area, aerial photographs and maps, consultation with relevant agencies and stakeholders, and database searches, to confirm the:
 - ▶ Approach and methodology, given access constraints and ongoing drought conditions affecting the vegetation assessment and detectability of threatened species
 - ▶ Spatial patterns in vegetation, land use and landscape features
 - ▶ Land use categorisation as defined under the *Local Land Services Act 2013* (NSW)
 - ▶ Likely distribution of native vegetation and threatened ecological communities (listed under the BC Act and/or the EPBC Act)
 - ▶ Likely presence of threatened flora and fauna (listed under the BC Act and/or the EPBC Act)
 - ▶ Likely presence of migratory fauna species listed under the EPBC Act
 - ▶ Potential presence of groundwater dependent ecosystems.
- ▶ Assessing the potential for species credit species to occur in the proposal site and be impacted by the proposal
- ▶ Undertaking staged field surveys (see following page)
- ▶ Assessing the native vegetation cover, extent and connectivity, and broad condition of vegetation types within a 500 m buffer of the proposal site, using aerial photography and GIS software
- ▶ Assessing the potential impacts on native vegetation and habitats, threatened species, protected areas, key threatening processes and matters of national environmental significance
- ▶ Assessing cumulative impacts on biodiversity
- ▶ Identifying measures to mitigate and offset the impacts identified, including biodiversity offsets
- ▶ Preparing a biodiversity development assessment report to describe the results of the assessment in accordance with section 6.12 of the BC Act, clause 6.8 of the BC Regulation and the Biodiversity Assessment Method.

A detailed description of the assessment methodology is provided in section 3 of Technical Report 1.

Field surveys

A staged approach was developed in consultation with the Biodiversity and Conservation Division to confirm the approach to assessing potential impacts in areas where survey access was not available, and how to account for the effect of drought conditions on the vegetation integrity and detectability of threatened species.

Where access was not possible, a methodology was developed to determine how PCTs would be identified in the absence of field data. Where possible, plots were located to comply with the minimum number of plots required by the Biodiversity Assessment Method. Due to refinements of the proposal site, borrow pits and ancillary facilities as part of efforts to reduce impacts on native vegetation, some plots used in the Biodiversity Assessment Method calculations are located outside the final proposal site boundary. For those zones where the minimum number of plots could not be surveyed due to access restrictions, benchmark data was used to reach the minimum plot number, as agreed with the Biodiversity and Conservation Division.

Staged field surveys were undertaken across a range of seasons and years to map native and non-native vegetation and identify whether threatened flora and fauna species or communities listed under the BC Act and/or EPBC Act are present. The stages included:

- ▶ Stage 1—five days in September 2018 to map and identify the PCTs, general fauna surveys and identification of suitable habitat for threatened species of relevance
- ▶ Stage 2—numerous days during November 2018, March 2019, August 2019, September 2019, October 2019 and June 2020, to undertake vegetation integrity plots, rapid data point survey as part of random meanders through PCTs, habitat assessments and targeted flora and fauna surveys for species identified as credit species under the Biodiversity Assessment Method.

Further information is provided in Technical Report 1.

Key tasks—aquatic ecology assessment

The assessment involved:

- ▶ Background research, including reviewing previous assessments relevant to the study area and database searches, to confirm the:
 - ▶ Likely sensitive receiving environments upstream and downstream of the proposal site
 - ▶ Known key fish habitats
 - ▶ Watercourses classified as low, medium and high priority based on key factors, including key fish habitat mapping, likelihood of threatened aquatic species and stream order
 - ▶ Likely presence of threatened flora and fauna and/or threatened ecological communities (listed under the FM Act and/or the EPBC Act)
 - ▶ Potential presence of groundwater and surface water dependent ecosystems.
- ▶ Undertaking an aquatic habitat assessment for high and moderate priority watercourses (where access was permitted), in November 2018, March 2019 and October 2019, to identify key fish habitat and sensitive receiving environments (including groundwater dependent ecosystems), map riparian and aquatic vegetation, and undertake water quality monitoring, using a range of survey techniques
- ▶ Assessing the potential impacts on threatened species and sensitive receiving environments
- ▶ Assessing cumulative impacts on aquatic ecology
- ▶ Identifying measures to mitigate and offset the impacts identified
- ▶ Preparing the assessment report.

No targeted surveys were undertaken as it was determined that there was sufficient evidence available in publicly accessible databases (NSW BioNet Atlas and the Atlas of Living Australia) that indicated species sightings in the study area. In addition, the majority of watercourses crossed by the proposal site are ephemeral and dry most of the time (except for Macquarie River, Namoi River and Narrabri Creek) and therefore did not require survey effort. Regardless of the presence of water, a precautionary approach has been taken and species have been presumed to be present in watercourses (when water is available) based on distribution modelling (DPI, 2016) and recorded sightings.

B1.1.3 Risks identified

The environmental risk assessment for the proposal (see Appendix E) included consideration of potential biodiversity risks. Biodiversity risks with an overall assessed risk rating of medium or above, identified by the environmental risk assessment, included:

- ▶ Clearing of native vegetation (including vegetation in the Pilliga State forests) resulting in loss of fauna habitat, habitat fragmentation and loss of connectivity
- ▶ Direct impacts on listed threatened flora species and endangered terrestrial ecological populations and communities
- ▶ Impact on potential habitat for threatened fauna species
- ▶ Potential impacts on aquatic ecology and threatened species, including as a result of removal of riparian vegetation and fish passage blockages during construction of watercourse crossings
- ▶ Water quality impacts and changes to flow regimes affect aquatic ecosystems
- ▶ Potential impacts on protected and sensitive lands
- ▶ Impacts on connectivity (and associated impacts on population viability and genetics), particularly for terrestrial fauna in the Pilliga forests, as a result of the presence of the new rail corridor.

The biodiversity assessments considered the potential risks identified by the environmental risk assessment, in addition to potential risks and impacts identified by the scoping report (see section A9.1), the SEARs and relevant guidelines and policies (as appropriate).

B1.1.4 How potential impacts have been avoided/minimised

The option development and assessment process for Inland Rail as a whole is summarised in chapter A6. As noted in section A6.2, the shortlist of route options was subject to a detailed assessment, which included assessment of a broad study area to identify key constraints early in the design process and assist with avoiding and minimising impacts, including impacts on biodiversity, as far as practicable.

ARTC has, where practicable, altered the proposal site to avoid and minimise ecological impacts in the proposal planning stage. Areas of existing woodland and forest vegetation were avoided, where practicable. Areas of threatened ecological communities were also avoided where a wider investigation corridor allowed for this to occur. Where the proposed rail alignment was aligned with a paper road (a Crown road reserve with no made road) the alignment was preferentially located in native grassland in private land adjacent to the paper road (where practicable) to retain wooded vegetation with higher threatened species habitat value in the road reserve.

A range of impact mitigation strategies have been included in the proposal to mitigate potential impacts on ecological values prior to consideration of offsetting requirements, e.g. the need for many bridges and culverts along the alignment allows opportunities for retention of fauna connectivity. Bridges have been designed to minimise impacts on riparian habitat as far as practicable.

B1.2 Existing environment

B1.2.1 General ecological context

The study area for the biodiversity assessment is typical of the Brigalow Belt South and Darling Riverine Plains bioregions. The study area is in the Macquarie River, Castlereagh River and Namoi River catchments that form part of the larger Murray-Darling basin. The major river systems in the study area (and crossing the proposal site) are the Macquarie River, Castlereagh River and Namoi River. The proposal site also crosses a number of other watercourses. Further information on the hydrological context of the proposal site is provided in chapter B2.

Much of the southern and central portion of the proposal site is located in land cleared for agriculture. This comprises a mix of cropped land and native grassland used for livestock. Areas of native woodland are also located in agricultural land.

At the northern end, sections of the proposal site are located in areas dominated by vegetation associated with the forests of the Pilliga (see section A2.1 and Figure A2.1). The proposal site also passes through vegetated areas associated with travelling stock reserves, such as at Bohena Creek near Narrabri and the Macquarie River at Narromine.

Native vegetation cover represents about 52 per cent of the proposal site. The proposal site includes about 1,125 hectares (ha) of native woodland and forest vegetation in good condition, which contains an overstorey of mature trees. There are also about 600 ha of derived native grassland (with occasional isolated trees), and seven ha of shrubland wetland in the proposal site.

B1.2.2 Terrestrial flora

Vegetation communities

Broad vegetation communities along the proposal site (threatened native vegetation, native vegetation and non-native vegetation/cleared) are shown in Figure B1.1.

A total of 39 PCTs were identified in the proposal site. Some areas of derived native grassland have been assigned to the woodland PCTs that would have originally occurred. The most predominant PCTs within the proposal site include:

- ▶ PCT 619 Derived Wire Grass grassland of the NSW Brigalow Belt South Bioregion and Nandewar Bioregion
- ▶ PCT 398 Narrow-leaved Ironbark—White Cypress Pine—Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests in the central north Brigalow Belt South Bioregion
- ▶ PCT 88 Pilliga Box—White Cypress Pine—Buloke shrubby woodland in the Brigalow Belt South Bioregion
- ▶ PCT 49 Partly derived Windmill Grass—copperburr alluvial plains shrubby grassland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.

PCTs in the proposal site are listed in Table B1.4. A full list of PCTs identified and further descriptive information is provided in Table 5.1 of Technical Report 1. Mapping of the PCTs in the proposal site is provided in the maps in Part E.

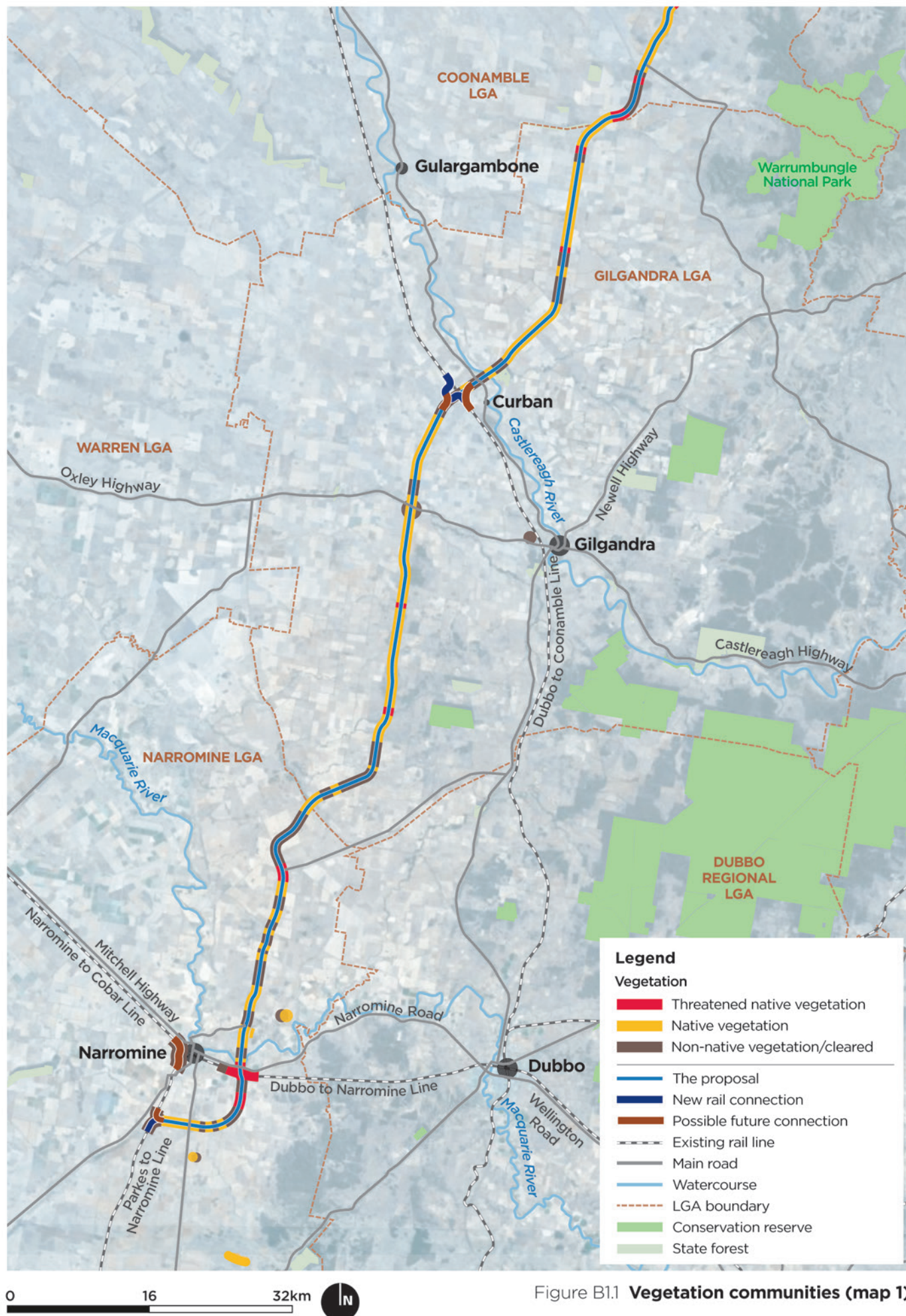


Figure B1.1 **Vegetation communities (map 1)**

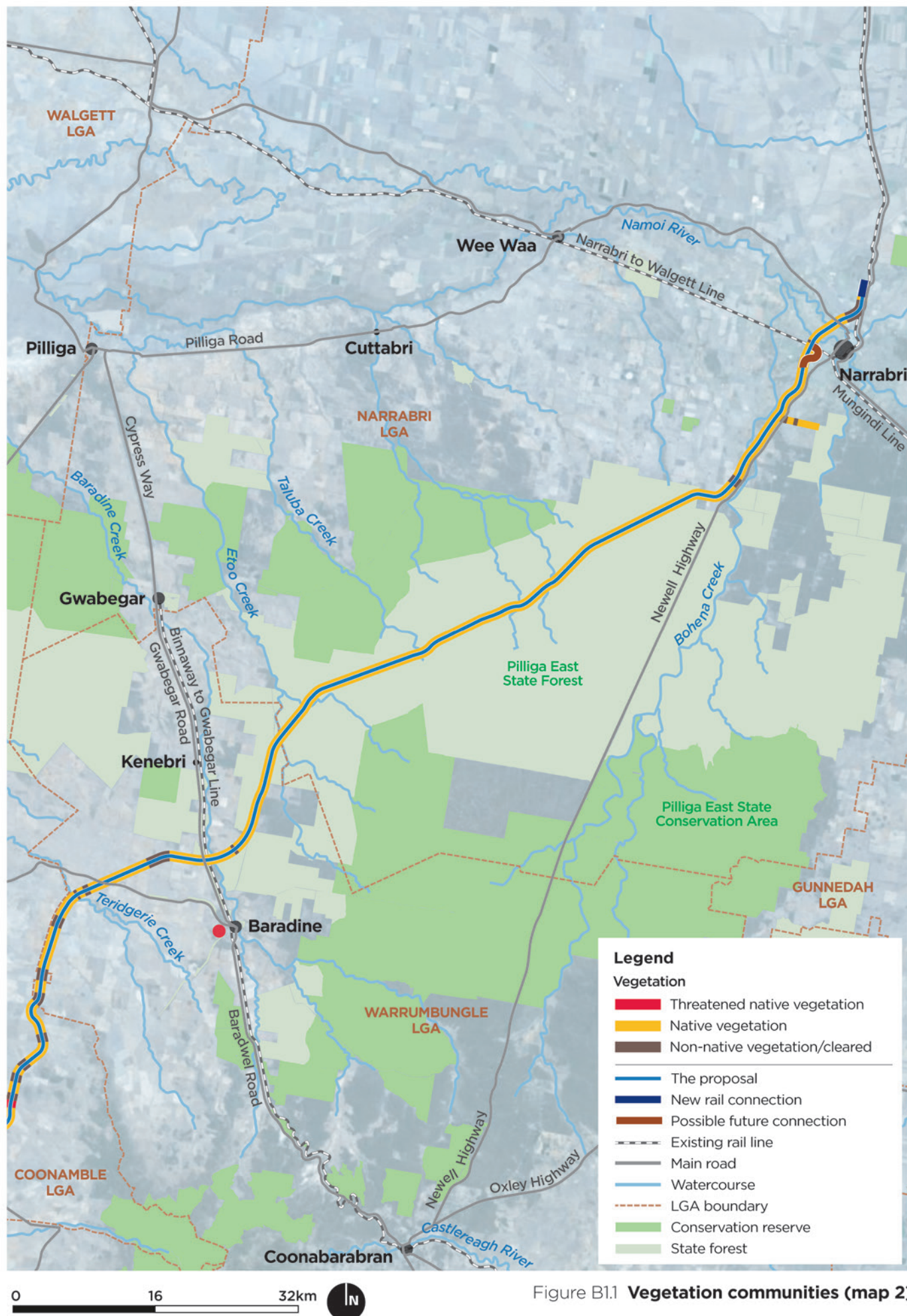


Figure B1.1 **Vegetation communities (map 2)**

Threatened ecological communities

Seven PCTs conform to five threatened ecological communities listed under the BC Act and EPBC Act. These are listed in Table B1.1 with the corresponding PCT identification number. It is noted that PCT 435 and PCT 599 both meet the definition of White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland) under the BC Act. However, only PCT 599 met the EPBC Act definition. Occurrences of PCT 619 are not located near occurrences of Box Gum Woodland and are thus not likely to be a derived form of this threatened ecological community.

TABLE B1.1 SUMMARY OF THREATENED ECOLOGICAL COMMUNITIES IDENTIFIED IN THE PROPOSAL SITE DURING SURVEY

PCT in proposal site	BC Act status	EPBC Act status
PCT 27	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (endangered)	Weeping Myall Woodlands (endangered)
PCT 35	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (endangered)	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) (endangered)
PCT 202	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (endangered)	Not listed
PCT 244	Not listed	Poplar Box grassy woodlands on alluvial plains (endangered)
PCT 248	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Belt South Bioregions (endangered)	Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (endangered)
PCT 435	White Box-Yellow Box-Blakely's Red Gum Woodland (endangered)	This patch does not meet EPBC definition
PCT 599	White Box-Yellow Box-Blakely's Red Gum Woodland (endangered)	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered)

Flora species

A total of 462 species were identified within the study area during field surveys, including 363 native species and 99 exotic species. A full list of recorded species is provided in Technical Report 1. Threatened flora species are discussed below.

Threatened flora species

One threatened flora species, Cobar greenhood (*Pterostylis cobarensis*), was identified at one location in the Pilliga East State Forest in November 2018; however, repeat surveys at this location in 2019 did not relocate any individuals. This species was not recorded during surveys elsewhere in the proposal site.

There are previous records (four individuals) of Coolabah Bertya (*Bertya opposens*) in the proposal site adjacent to the Bohena Creek rest area on the Newell Highway; however, no evidence of the species was recorded in suitable habitat areas surveyed in the proposal site. Coolabah Bertya is also listed as vulnerable under the EPBC Act.

In addition to the two known threatened flora species, seven flora species (candidate species) listed under the BC Act are assumed to be present based on previous records, suitable potential habitat and consultation with Biodiversity and Conservation Division officers. No evidence of these species was recorded in suitable habitat areas surveyed in the proposal site. These species include:

- ▶ *Commersonia procumbens* (a prostrate shrub) (also listed as vulnerable under the EPBC Act)—known to occur within the Pilliga forests within the study area
- ▶ Pine donkey orchid (*Diuris tricolor*)—known to occur within the Pilliga forests within the study area
- ▶ Slender darling pea (*Swainsona murrayana*) (also listed as vulnerable under the EPBC Act)—known to occur in the wider locality along the length of the proposal site

- ▶ Spiny peppercress (*Lepidium aschersonii*) [also listed as vulnerable under the EPBC Act]—known to occur in the study area between the northern end of the Pilliga forests and Narrabri
- ▶ Native milkwort (*Polygala linariifolia*)—known to occur within the Pilliga forests within the study area
- ▶ *Tylophora linearis* (a herbaceous climber) [also listed as endangered under the EPBC Act]—known to occur within the Pilliga forests within the study area
- ▶ Winged peppercress (*Lepidium monoplocoides*) [also listed as endangered under the EPBC Act]—known to occur to the east of the study area near Narrabri.

All threatened flora species are listed as vulnerable under the BC Act with the exception of winged peppercress (*Lepidium monoplocoides*), which is listed as endangered.

Potential habitat for threatened flora is largely predicted by PCTs and smaller micro habitats within each PCT and vegetation zone. Within the study area, most of the PCTs known and likely to support threatened flora species occur in the Pilliga forests and in derived grasslands areas north of the Pilliga forests.

Weeds

Sixteen priority weed species identified by the *Biosecurity Act 2015* were recorded in plots in the study area. The general biosecurity duty under the Act requires any person who deals with weeds to ensure that the biosecurity risk of the weed is prevented, eliminated or minimised, as far as reasonably practicable.

Weed species can also be identified as high-threat weeds that can invade and out-compete native plant species. The presence of these species in a plot affects the vegetation integrity score of a vegetation zone. Eighteen high-threat weeds were recorded in plots.

Weeds of national significance that occur in the study area include African boxthorn (*Lycium ferocissimum*), prickly pear (*Opuntia stricta*) and tiger pear (*Opuntia aurantiaca*). Weeds of national significance are weeds that have been prioritised by the Australian government based on their potential for spread, their invasiveness, and their social and economic impacts.

B1.2.3 Terrestrial fauna

A total of 232 fauna species were recorded during field surveys. This included 141 bird species, 10 amphibian species, 37 reptile species and 44 species of mammal (including 18 microbat species).

Of the fauna species recorded, 13 were introduced species. Some of these included the feral pig (*Sus scrofa*), rabbit (*Oryctolagus cuniculus*), fox (*Vulpes vulpes*), cat (*Felis catus*), brown hare (*Lepus capensis*) and common starling (*Sturnus vulgaris*).

A full list of recorded species is provided in Technical Report 1.

Terrestrial fauna habitats

Fauna connectivity is provided in the study area by:

- ▶ The Pilliga forests
- ▶ Large vegetated tracts associated with Crown land/travelling stock reserves
- ▶ Vegetated riparian corridors (e.g. Narrabri Creek, Namoi River, Castlereagh River, Macquarie River, Kickabil Creek)
- ▶ Vegetated road reserves and paper roads
- ▶ Small isolated patches of woodland within farmland
- ▶ Paddock trees.

Fauna habitats have been categorised into broad groupings made up of various PCTs. The grouped fauna habitats include:

- ▶ Grassland with scattered paddock trees—dominated by exotic crop species (e.g. oats) or derived native grassland
- ▶ Woodland patches in agricultural land—comprises a canopy of eucalypts and cypress pine, often with a sparse understory and grassy ground layer
- ▶ Forests of the Pilliga—dominated by narrow-leaved ironbark (*Eucalyptus crebra*) and white cypress pine (*Callitris glaucophylla*) with a sparse understory
- ▶ Heath and shrublands of the Pilliga—small areas of heathy vegetation in the Pilliga, including dense heath and a more open heath under woodland canopy

- ▶ Creeks of the Pilliga—generally have a canopy of Blakely’s red gum and the rough-barked apple
- ▶ Rivers and associated riparian vegetation—comprises a canopy of large old river red gums, most with hollows of various sizes
- ▶ Creeks and associated riparian vegetation in agricultural land—comprises dominant tree species of river red gums in the south and Blakely’s red gums in the north, with many hollow-bearing trees present
- ▶ Dams, roadside ditches and soaks—often vegetated with grasses and sometimes sedges
- ▶ Rocky areas—cleared agricultural land, with rocky areas occurring upslope of the proposal site.

A description of the habitat type and predicted threatened fauna species recorded or likely to occur is provided in Technical Report 1.

Threatened fauna species

During the field surveys, 18 threatened fauna species listed as vulnerable under the BC Act were recorded within the proposal site. Threatened fauna species identified during surveys are provided in Table B1.2.

Of the 18 threatened fauna species recorded, four are also listed under the EPBC Act. The Koala (*Phascolarctos cinereus*), Corben’s long-eared bat (*Nyctophilus corbeni*) and Superb parrot (*Polytelis swainsonii*) were positively identified during surveys. The Large-eared pied bat (*Chalinolobus dwyeri*) was also potentially identified based on Anabat analysis.

TABLE B1.2 SUMMARY OF THREATENED SPECIES IDENTIFIED IN THE PROPOSAL SITE DURING SURVEY

Common name	Scientific name	BC Act	EPBC Act	Credit type
Black falcon	<i>Falco subniger</i>	Vulnerable	-	Ecosystem
Black-chinned honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	Vulnerable	-	Ecosystem
Brown treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	Vulnerable	-	Ecosystem
Flame robin	<i>Petroica phoenicea</i>	Vulnerable	-	Ecosystem
Glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	Vulnerable	-	Species/ Ecosystem
Grey-crowned babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	Vulnerable	-	Ecosystem
Speckled warbler	<i>Chthonicola sagittata</i>	Vulnerable	-	Ecosystem
Spotted harrier	<i>Circus assimilis</i>	Vulnerable	-	Ecosystem
Superb parrot	<i>Polytelis swainsonii</i>	Vulnerable	Vulnerable	Species/ Ecosystem
Varied sittella	<i>Daphoenositta chrysoptera</i>	Vulnerable	-	Ecosystem
Corben’s long-eared bat	<i>Nyctophilus corbeni</i>	Vulnerable	Vulnerable	Ecosystem
Large bent-winged bat	<i>Miniopterus orianae oceanensis</i>	Vulnerable	-	Species/ Ecosystem
Large-eared pied bat	<i>Chalinolobus dwyeri</i>	Vulnerable	Vulnerable	Species
Little pied bat	<i>Chalinolobus picatus</i>	Vulnerable	-	Ecosystem
Yellow-bellied sheath-tail-bat	<i>Saccolaimus flaviventris</i>	Vulnerable	-	Ecosystem
Koala	<i>Phascolarctos cinereus</i>	Vulnerable	Vulnerable	Species (important habitat)
Squirrel glider	<i>Petaurus norfolcensis</i>	Vulnerable	-	Species
Pale-headed snake	<i>Hoplocephalus bungaroides</i>	Vulnerable	-	Species

In addition to the known threatened fauna species, seven fauna species (candidate species) listed under the BC Act are assumed to be present based on previous records, suitable potential habitat, and consultation with Biodiversity and Conservation Division officers. No evidence of these species was recorded in suitable habitat areas surveyed in the proposal site. Drought conditions, low densities and/or cryptic nature are likely to have been a large contributing factor to species absence. These species include:

- ▶ Bush stone-curlew (*Burhinus grallarius*)—11 records in the locality, mainly in the Pilliga-Narrabri area
- ▶ Square-tailed kite (*Lophoictinia isura*)—11 records in the locality, mainly in the Pilliga-Narrabri area
- ▶ Barking owl (*Ninox connivens*)—333 records in the locality, mainly in the Pilliga area
- ▶ Masked owl (*Tyto novaehollandiae*)—four records in the Pilliga area
- ▶ Little eagle (*Hieraaetus morphnoides*)—18 records in the locality, scattered along the alignment
- ▶ Rufous bettong (*Aepyprymnus rufescens*)—two records in the Pilliga area
- ▶ Eastern pygmy-possum (*Cercartetus nanus*)—seven records in the locality, predominantly from the Pilliga-Narrabri area.

An additional three fauna species listed under the EPBC Act are also predicted as likely to occur in the study area. These include the Pilliga mouse (*Pseudomys pilligaensis*), Five-clawed worm skink (*Anomalopus mackayi*) and Pink-tailed worm-lizard (*Aprasia parapulchella*). The breeding habitat for the Large-eared pied bat (*Chalinolobus dwyeri*) is identified as being subject to serious and irreversible impacts, according to the Biodiversity Assessment Method. No breeding habitat is located within, or in close proximity to, the proposal site.

Migratory species listed under the EPBC Act

No mapped important habitat for migratory waders is located in, or near, the proposal site. There is potential habitat for migratory flycatchers that breed in eastern Australian forests and non-breeding migratory birds from Asia. Of these, one migratory species—the Fork-tailed swift (*Apus pacificus*)—was recorded during surveys. The proposal site is also located within the core non-breeding range of the White-throated needletail (*Hirundapus caudacutus*) (also listed as a vulnerable species under the EPBC Act) and Rufous fantail (*Rhipidura rufifrons*).

B1.2.4 Aquatic ecology

General description of aquatic flora and fauna habitat

Watercourses that cross and/or are located near the proposal site are described in chapter B2. The majority of watercourses are intermittent with the exception of the Macquarie River and Narrabri Creek/Namoi River, which are permanently flowing. The water quality of the three catchments is generally poor across the study area (see chapter B5).

Despite the lack of water, most watercourses displayed aquatic habitat characteristics, such as large fallen logs and uprooted trees.

Threatened aquatic species

The database searches identified a number of threatened species, endangered populations, and aquatic matters of national environmental significance listed under the FM Act and/or EPBC Act in the study area. Species considered to have the potential to occur within watercourses in and around the proposal site include:

- ▶ Silver perch (*Bidyanus bidyanus*) (listed as critically endangered under the FM Act and EPBC Act)—likely to occur within the proposal site in Macquarie River and Namoi River
- ▶ Murray cod (*Maccullochella peelii*) (listed as vulnerable under the EPBC Act)—likely to occur within the proposal site in Macquarie River, Namoi River and Narrabri Creek based on recent sightings
- ▶ Purple spotted gudgeon (*Mogurnda adspersa*) (listed as endangered under the FM Act and EPBC Act)—likely to occur within the proposal site in numerous watercourses
- ▶ Flathead galaxias (*Galaxias rostratus*) (listed as critically endangered under the FM Act and EPBC Act)—likely to occur within the proposal site in Narrabri Creek, Namoi River and Boggy Cowal.

The Trout cod (*Maccullochella macquariensis*) (listed as endangered under the FM Act and EPBC Act) may also occur within the proposal site in the Macquarie River; however, there has been no recent sightings and this species is often confused with the Murray cod.

Database searches also identified two endangered populations listed under the FM Act. These include:

- ▶ Olive perchlet (*Ambassis agassizii*) (western population)—likely to occur within the proposal site in numerous watercourses
- ▶ Eeltail catfish (*Tandanus tandanus*) (Murray Darling Basin population)—likely to occur within the proposal site in Namoi River, Narrabri Creek, Macquarie River and Barrone Creek.

Watercourses crossed by the proposal site, where the potential for threatened aquatic species has been identified by database searches, are listed in Table B1.3.

Threatened ecological communities

The proposal site does not contain any threatened aquatic ecological communities; however, it occurs within the mapped distribution of one endangered ecological community listed as endangered under the FM Act—the *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River*.

B1.2.5 Groundwater dependent ecosystems

Groundwater dependent ecosystems rely on a supply of groundwater to support the species composition, structure and function of the ecosystem. Groundwater dependent ecosystems are classified as aquatic (dependent on the surface expression of groundwater) or terrestrial (dependent on the subsurface presence of groundwater).

The water sharing plans that apply to the study area (see section B2.1.1) map areas of high-priority groundwater dependent ecosystems. These are located at the Macquarie River, Castlereagh River, Gulargambone Creek, Baradine Creek, Etoo Creek, Rocky Creek, Goona Creek, Bohena Creek and its tributary, Namoi River, and Narrabri Creek. The proposal site crosses these areas.

In addition, there are 10 mapped high-priority groundwater dependent ecosystem springs within the study area, with the closest located about 10 km from the proposal site.

A review of the *Groundwater Dependent Ecosystem Atlas* (Bureau of Meteorology, 2020) identified the following potential groundwater dependent ecosystems within the proposal site:

- ▶ Macquarie River, Castlereagh River and Namoi River—low potential aquatic groundwater dependent ecosystem
- ▶ Baronne Creek, Caleriwi Creek, Bohena Creek, Coghill Creek, Mollieroi Creek, Etoo Creek, Baradine Creek, Teridgerie Creek, Marthaguy Creek, Kickabil Creek and Wallaby Creek—moderate potential aquatic groundwater dependent ecosystem
- ▶ Narromine to Burroway area—low and high potential terrestrial groundwater dependent ecosystems including grassland and woodland areas
- ▶ Tonderburine to Kenebri area—low, medium and high potential terrestrial groundwater dependent ecosystems including woodland and forest
- ▶ Pilliga East State Forest—low potential terrestrial groundwater dependent ecosystems including woodland and forest
- ▶ Narrabri area—low and high potential terrestrial groundwater dependent ecosystems including grassland, woodland, forest and sedgeland.

B1.2.6 Wetlands of international importance

Macquarie Marshes, which is listed as a wetland of international importance under the Ramsar Convention, is located about 100 km downstream of the proposal site along the Macquarie River.

B1.2.7 Protected and sensitive lands

Protected areas

The regional study area contains a number of protected lands managed under the *National Parks and Wildlife Act 1974* (NSW) and the *Brigalow and Nandewar Community Conservation Area Act 2005* (NSW) (as shown in the maps in Part E). The nearest protected areas are:

- ▶ Pilliga State Conservation Area (Community Conservation Area (CCA) Zone 3 under the *Brigalow and Nandewar Community Conservation Area Act 2005* (NSW))—located about 1.7 km from the proposal site at the nearest point
- ▶ Drillwarrina National Park (CCA Zone 1)—located about 4.8 km from the proposal site at the nearest point.

There are no marine parks or aquatic reserves listed under the *National Parks and Wildlife Act 1974* (NSW) and the *Marine Estate Management Act 2014* (NSW) with the potential to be affected by the proposal.

The proposal site crosses a number of forestry management zones in State forests that are for the protection of specific flora and fauna habitats. These include a number of Zone 3: Harvesting Exclusions and Special Prescriptions areas. The purpose of zone 3 is for the management for conservation of identified values and/or forest ecosystems and their natural processes, while also facilitating other management and production activities.

Areas of Crown land (including travelling stock reserves) occur throughout the proposal site and surrounds. These often occur along road reserves, paper roads or in association with creeks and rivers, and provide continuous linear strips of vegetation. In some locations these connect to larger patches of vegetation elsewhere, providing increased connectivity in the landscape. Vegetated riparian corridors (not within Crown land) extend these linear strips across the landscape. These areas provide habitat for a range of fauna groups, including birds, possums, bats, reptiles and frogs.

Key fish habitat

Table B1.3 lists the areas of key fish habitat within/around the proposal site. These are areas classified as class 3 (minimal key fish habitat) or above in accordance with *Policy and guidelines for fish habitat conservation and management* (DPI, 2013c). Watercourses have been ordered from north to south and categorised into catchments.

TABLE B1.3 KEY FISH HABITAT

Watercourse	Strahler stream order	Potential for threatened species (DPI, 2016)	Habitat sensitivity type (DPI, 2013c)	Classification of watercourse for fish passage (DPI, 2013c)
Namoi River catchment				
Narrabri Creek	Ninth order	Yes	Type 1—Highly	Class 1—Major
Namoi River	Ninth order	Yes	Type 1—Highly	Class 2—Moderate
Bohena Creek	Sixth order	Yes	Type 1—Highly	Class 2—Moderate
Bundock Creek	Second order	No	Type 3—Minimally	Class 3—Minimal
Goon Creek	Third order	Yes	Type 1—Highly	Class 2—Moderate
Tributary of Black Creek	Second order	No	Type 3—Minimally	Class 3—Minimal
Black Creek	Third order	No	Type 3—Minimally	Class 3—Minimal
Molleroi Creek	Fourth order	Yes	Type 1—Highly	Class 2—Moderate
Coghill Creek	Fourth order	Yes	Type 1—Highly	Class 2—Moderate
Talluba Creek	Third order	No	Type 3—Minimally	Class 3—Minimal
Tinegie Creek	First order	No	Type 3—Minimally	Class 3—Minimal
Rocky Creek/Pine Creek	Fourth order	Yes	Type 1—Highly	Class 2—Moderate
Stockyard Creek	Third order	No	Type 1—Highly	Class 2—Moderate
Etoo Creek	Fifth order	Yes	Type 1—Highly	Class 2—Moderate
Cumbil Forest Creek	First order	No	Type 3—Minimally	Class 3—Minimal
Coolangla Creek	Third order	No	Type 3—Minimally	Class 3—Minimal
Baradine Creek	Sixth order	Yes	Type 1—Highly	Class 2—Moderate
Tenandra Creek	Fourth order	No	Type 3—Minimally	Class 3—Minimal
Castlereagh River catchment				
Gulargambone Creek	Fifth order	Yes	Type 1—Highly	Class 2—Moderate
Castlereagh River	Seventh order	Yes	Type 1—Highly	Class 1—Major
Macquarie-Bogan catchment				
Kickabil Creek	Fourth order	No	Type 1—Highly	Class 2—Moderate
Emogandy Creek	Fourth order	No	Type 1—Highly	Class 2—Moderate
Ewenmar Creek	Fourth order	No	Type 2—Moderately	Class 2—Moderate
Macquarie River	Ninth order	Yes	Type 1—Highly	Class 1—Major
Backwater Cowal	Wetland depression	Yes	Type 1—Highly	Class 2—Moderate

Waterfront land

The proposal site includes areas of waterfront land as defined by the *Water Management Act 2000* (NSW). Further information is provided in section B2.2.2.

Critical habitat

No land or waters identified as critical habitat/areas of outstanding biodiversity value under the BC Act, FM Act or EPBC Act are located in the proposal site.

Biobank sites, private conservation lands and other offset lands

Searches of public registers under the former *Threatened Species Conservation Act 1995* (NSW) and the BC Act were completed on 5 March 2020, identifying:

- ▶ One Biodiversity Banking Agreement located in the Narrabri LGA and the Peel-Namoi Interim Biogeographic Regionalisation for Australia (IBRA) subregion
- ▶ One Biodiversity Banking Agreement located in the Warrumbungle LGA and the Liverpool Plains (Part B) IBRA subregion.

Public register data does not identify the precise location of biobank sites, private conservation lands and other offset lands but does identify the LGA and the IBRA subregion. The portion of the proposal site in the Narrabri LGA and Warrumbungle LGAs corresponds with the Pilliga and Pilliga Outwash IBRA subregions, while the biobank agreements are identified as being in the Peel-Namoi and Liverpool Plains (Part B) IBRA subregions.

No Biodiversity Stewardship Agreements or Private Conservation Agreements are listed in the Biodiversity Conservation Trust registers for the regional study area.

Two Private Conservation Agreements have been established under Division 12, Part 4 of the *National Parks and Wildlife Act 1974* (NSW) on land located at High Park Road, Narromine. These sites are located over 900 m from the proposal site.

B1.3 Impact assessment—construction

Potential impacts on biodiversity during construction include:

- ▶ Direct impacts as a result of vegetation clearing and disturbance in the proposal site
- ▶ Indirect impacts on flora and fauna located outside the proposal site as a result of activities within the site.

A summary of the results of the impact assessment is provided in the following sections.

B1.3.1 Native vegetation

Vegetation would need to be cleared to construct and locate the new rail corridor and permanent operational infrastructure. Almost half of the proposal site is already disturbed and consists of cleared land containing introduced pasture species or environmental weeds. These areas contain little native vegetation cover and have limited habitat value for native plants. Vegetation clearing required in these areas would remove non-threatened native plants and introduced plant species including priority and high-threat weeds.

It is estimated that up to about 1,732 ha of native vegetation would need to be removed. This includes about:

- ▶ 1,125 ha native woodland and forest vegetation in good condition
- ▶ 600 ha of derived native grassland (including about 6 ha of derived Kurrajong grassy open woodland/isolated trees)
- ▶ 7 ha of wetland vegetation.

About 624 ha of native woodland and forest vegetation located within the Pilliga forests would be directly impacted by the proposal.

Mature trees have particular value within plant populations because they take longer to replace, are often profuse sources of pollen and seed, and contain critical resources, such as hollows and mistletoe.

Land clearance is listed as a key threatening process under the BC Act and EPBC Act. Land clearance consists of the destruction of the above-ground biomass of native vegetation and its substantial replacement by non-local species or by human artefacts. The removal of native vegetation would constitute a notable increase in the operation of this key threatening process in the locality, particularly within the Pilliga forests (discussed further in section B1.3.6). The removal of native vegetation would be permanent and irreversible.

The PCTs that would be directly impacted by the proposal are listed in Table B1.4. The largest areas of permanent impacts on native vegetation (more than 100 ha removed) would occur within the following native vegetation communities:

- ▶ PCT 619 Derived Wire Grass grassland
- ▶ PCT 398 Narrow-leaved Ironbark-White Cypress Pine-Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests
- ▶ PCT 88 Pilliga Box-White Cypress Pine-Buloke shrubby woodland
- ▶ PCT 49 Partly derived Windmill Grass-copperburr alluvial plains shrubby grassland.

None of these PCTs are commensurate with a threatened ecological community listed under the BC Act or EPBC Act.

The clearing of native vegetation would involve removing a large number of individuals and a moderately diverse range of non-threatened native plants. This reduction in the extent of native vegetation is less significant at the regional scale and is unlikely to threaten the persistence of any populations of native plants and vegetation communities. It is unlikely that an ecologically significant proportion of any regional plant populations would be located entirely within the proposal site. At the regional scale, flora populations would persist in habitat that is conserved in the various conservation reserves in the study area and, to a lesser extent, in regional State forests (see section A2.1).

Plant species with a limited distribution in the locality would be most affected by vegetation clearing for the proposal. Construction impacts on flora species are discussed in section B1.3.2.

TABLE B1.4 PLANT COMMUNITY TYPE—EXTENT OF IMPACTS WITHIN PROPOSAL SITE

Plant community type	Extent of impact (ha)
PCT 27 Weeping Myall open woodland of the Darling Riverine Plains bioregion and Brigalow Belt South Bioregion ^{1,2}	3.05
PCT 35 Brigalow-Belah open forest/woodland on alluvial plains often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion ^{1,2}	0.61
PCT 36 River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	5.08
PCT 49 Partly derived Windmill Grass-copperburr alluvial plains shrubby grassland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	176.1
PCT 55 Belah woodland on alluvial plain and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions—good	0.21
PCT 56 Poplar Box-Belah woodland on clay-loam soils on alluvial plains of north-central NSW	19.5
PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	26.23
PCT 88 Pilliga Box-White Cypress Pine-Buloke shrubby woodland in the Brigalow Belt South Bioregion	277.79
PCT 141 Broombush-wattle very tall shrubland of the Pilliga to Goonoo regions, Brigalow Belt South Bioregion	29.47
PCT 145 Western Rosewood-Wilga-Wild Orange-Belah low woodland of the Brigalow Belt South Bioregion and eastern Darling Riverine Plains bioregion	53.99
PCT 148 Dirty Gum-Buloke-White Cypress Pine-ironbark shrubby woodland on deep sandy soils in the Liverpool Plains region of the Brigalow Belt South Bioregion	45.04
PCT 168 Derived Copperburr shrubland of the NSW northern inland alluvial floodplains	8.56
PCT 185 Dwyer's Red Gum-White Cypress Pine-Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion	1.37
PCT 202 Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion ¹	3.59
PCT 206 Dirty Gum-White Cypress Pine-Buloke shrubby woodland in the Brigalow Belt South Bioregion—good	12.66
PCT 244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt) ²	31.84

Plant community type	Extent of impact (ha)
PCT 247 Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	6.91
PCT 248 Mixed box eucalypt woodland on low sandy-loam rises on alluvial plains in central western NSW ¹	14.71
PCT 250 Derived tussock grassland of the central western plains and lower slopes of NSW	82.84
PCT 255 Mugga Ironbark-Buloke-Pilliga Box-White Cypress Pine shrubby woodland on sandstone in the Dubbo region, south-western Brigalow Belt South Bioregion	11.77
PCT 256 Green Mallee tall mallee woodland on rises in the Pilliga-Goonoo regions, southern Brigalow Belt South Bioregion	0.27
PCT 394 Narrow-leaved Ironbark-White Cypress pine woodland on slopes and flats in the Coonabarabran-Pilliga Scrub regions	69.66
PCT 397 Poplar Box-White Cypress Pine shrub grass tall woodland of the Pilliga-Warialda region, Brigalow Belt South Bioregion	15.78
PCT 398 Narrow-leaved Ironbark-White Cypress Pine-Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests in the central north Brigalow Belt South Bioregion	369.78
PCT 399 Red gum-Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga-Goonoo sandstone forests, Brigalow Belt South Bioregion	53.71
PCT 404 Red Ironbark-White Bloodwood +/- Burrows Wattle heathy woodland on sandy soil in the Pilliga forests	23.05
PCT 406 White Bloodwood-Motherumbah-Red Ironbark shrubby sandstone hill woodland/open forest mainly in east Pilliga forests	2.30
PCT 409 Dirty (Baradine) Gum-White Bloodwood-White Cypress Pine-Motherumbah shrubby woodland on sandy soils in the Pilliga Scrub and surrounding region, Brigalow Belt South Bioregion	0.82
PCT 411 White Mallee-Dwyer's Red Gum Mallee heath on sands in the Goonoo-Pilliga region, Brigalow Belt South Bioregion	8.76
PCT 414 White Mallee - Dwyer's Red Gum Mallee heath on sands in the Goonoo-Pilliga region, Brigalow Belt South Bioregion	7.32
PCT435 White Box-White Cypress Pine shrub grass hills woodland in the Brigalow Belt South bioregion and Nandewar bioregion	6.11
PCT 436 Derived Kurrajong grassy open woodland/isolated trees in the Brigalow Belt South Bioregion and Nandewar Bioregion	5.98
PCT 444 Silver-leaved Ironbark grassy tall woodland on clay-loam soils on plains in the Brigalow Belt South Bioregion	1.11
PCT 473 Red Gum-Rough-barked Apple-Narrow-leaved Ironbark-cypress pine grassy open forest on flats and drainage lines in the Goonoo and surrounding forests, southern Brigalow Belt South Bioregion	15.26
PCT 589 White Box-White Cypress Pine-Silver-leaved Ironbark grassy woodland on mainly clay loam soils on hills mainly in the Nandewar Bioregion	1.23
PCT 599 Blakely's Red Gum-Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion ¹	2.21
PCT 619 Derived Wire Grass grassland of the NSW Brigalow Belt South Bioregion and Nandewar Bioregion	326.26
PCT 746 Brown Bloodwood-cypress-ironbark heathy woodland in the Pilliga region of the Brigalow Belt South Bioregion	2.12
PCT 1384 White Cypress Pine-Bulloak-ironbark woodland of the Pilliga area of the Brigalow Belt South Bioregion	8.77
Total	1,732.82

Notes:

1. listed under the BC Act
2. listed under the EPBC Act

Threatened ecological communities—BC Act

The proposal would result in direct impacts on the following BC Act listed threatened ecological communities and corresponding PCTs:

- ▶ Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (PCT 27)—3.05 ha would be permanently impacted
- ▶ Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (PCT 35)—0.61 ha would be permanently impacted
- ▶ Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (PCT 202)—3.59 ha would be permanently impacted
- ▶ Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (PCT 248)—14.71 ha would be permanently impacted
- ▶ White Box Yellow Box Blakely's Red Gum Woodland (PCTs 435 and 599)—8.32 ha would be permanently impacted.

Each of these threatened ecological communities are listed as endangered. The total direct impact on BC Act listed threatened ecological communities is 30.28 ha. The proposal is unlikely to result in serious and irreversible impacts on these communities.

To mitigate the potential impacts on biodiversity, biodiversity offsets would be provided in accordance with the BC Regulation, as described in section B1.5.

Threatened ecological communities—EPBC Act

The proposal would result in direct impacts on the following EPBC Act listed threatened ecological communities and corresponding PCTs:

- ▶ Weeping Myall Woodlands (PCT 27)—3.05 ha would be permanently impacted
- ▶ Brigalow (*Acacia harpophylla* dominant and co-dominant) (PCT 35)—0.61 ha would be permanently impacted
- ▶ Poplar Box grassy woodlands on alluvial plains (PCT 244)—31.94 ha would be permanently impacted
- ▶ Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (PCT 248)—14.71 ha would be permanently impacted
- ▶ White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (PCT 599)—2.21 ha would be permanently impacted.

These threatened ecological communities are listed as endangered, with White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed as critically endangered. The total direct impact on EPBC Act listed threatened ecological communities is 52.42 ha. The proposal is unlikely to result in a significant impact on these communities given the relatively small area of these communities to be removed compared to retained vegetation in the area and existing fragmentation.

Groundwater dependent ecosystems

There would be limited impacts on groundwater dependent ecosystems given the comparatively small area of groundwater dependent ecosystem vegetation impacted. Additionally, the small footprint of piers required to construct bridges, and the retention of riparian vegetation under the bridges, would further reduce the potential for impacts.

B1.3.2 Terrestrial flora

Species listed under the BC Act

The proposal would impact potential habitat for nine threatened candidate flora species listed under the BC Act. The species are listed below together with an estimate of the area of potential habitat that would be removed to construct the proposal:

- ▶ *Commersonia procumbens*—565.14 ha of potential habitat would be removed
- ▶ Pine donkey orchid (*Diuris tricolor*)—630 ha of potential habitat would be removed
- ▶ Slender darling pea (*Swainsona murrayana*)—43.58 ha of potential habitat would be removed
- ▶ Spiny peppercress (*Lepidium aschersonii*)—10.27 ha of potential habitat would be removed
- ▶ Native milkwort (*Polygala linariifolia*)—565.87 ha of potential habitat would be removed
- ▶ *Tylophora linearis*—582.57 ha of potential habitat would be removed
- ▶ Winged peppercress (*Lepidium monophlooides*)—194.29 ha of potential habitat would be removed
- ▶ Cobar greenhood (*Pterostylis cobarensis*)—193.04 ha of potential habitat would be removed
- ▶ Coolabah bertya (*Bertya opposens*)—13.86 ha of potential habitat would be removed.

In addition to potential habitat, four plants of coolabah bertya (*Bertya opposens*) would be removed. In accordance with the BC Regulation, species credits are required for the candidate flora species identified above. Further information is provided in section B1.5.

The proposal is unlikely to result in serious and irreversible impacts on any threatened flora species.

Species listed under the EPBC Act

The proposal would impact potential habitat for six threatened flora species listed under the EPBC Act. Significant impacts are predicted for three of these species:

- ▶ *Commersonia procumbens*—565.14 ha of potential habitat would be removed
- ▶ *Tylophora linearis*—572.34 ha of potential habitat would be removed
- ▶ Winged peppercress (*Lepidium monophlooides*)—194.29 ha of potential habitat would be removed.

Species credits have been calculated in accordance with the Biodiversity Assessment Method and would require retirement of like-for-like species credits in accordance with the BC Regulation and the bilateral agreement. Further information is provided in section B1.5.

B1.3.3 Terrestrial fauna

Fauna habitat and connectivity

The removal of the vegetation communities described in section B1.3.1 would impact fauna habitats, due to the removal of foraging and breeding habitat of fauna species.

The proposal would be located in a highly fragmented, rural landscape for much of the alignment. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings, and construction of linear infrastructure (such as transmission lines and roads). These land uses have created barriers to movement for some fauna species, particularly those that are limited by dispersal abilities and habitat preferences. More mobile species, such as birds and bats, can readily traverse this landscape. The proposal would exacerbate fragmentation in these areas.

The Pilliga forests provide a large area of connected habitat. These forests are fragmented by a range of roads and tracks. The proposal would be located alongside Cumbil Road and the realigned Pilliga Forest Way within the Pilliga forests for about 51 km, further widening the gap in the forest. At the northern end of the alignment, in Pilliga East State Forest, the proposal would create a new gap in the forest, with the potential for further habitat fragmentation in this area. A section of the alignment near Cumbil Road has been moved about 80 m from the road, to avoid impacts on Aboriginal heritage, and there would be additional forest fragments created at these locations. Where Pilliga Forest Way is proposed to be realigned, the forest gaps at these locations would be wider. Construction would result in a barrier to fauna movement in some areas and could result in fragmentation of populations.

It is estimated that between 13,000 and 30,000 hollow-bearing trees would be removed. This includes paddock trees in agricultural land, large remnant red gums in riparian areas, and those within vegetation to be removed in the Pilliga and other forested areas. Hollow-bearing trees are critical habitat components for many fauna species that rely on hollows for shelter and breeding habitat. Due to the long timeframe it takes for hollows to form in eucalypts (usually greater than 150 years), the loss of these hollows represents a long-term reduction in habitat resources for fauna. The loss of such a large number of hollow-bearing trees would impact local populations of threatened fauna reliant on these habitat features, such as the Glossy black-cockatoo, Barking owl, Squirrel glider, Corben's long-eared bat, and other microbat species.

The proposal is unlikely to affect the movement patterns of species such as the superb parrot, regent honeyeater, swift parrot and large bent-winged bat. While habitat would be removed along the alignment, alternate foraging (and/or breeding) habitat would remain in adjacent areas.

Construction could also result in the injury or mortality of individuals of less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the proposal site during clearing activities and unable to move out of the area. This could include nesting birds, small terrestrial mammals, lizards and frogs, nocturnal fauna sheltering in hollows and less mobile species, such as koalas. More mobile native fauna, such as adult birds, and larger terrestrial mammals and reptiles that may be sheltering in vegetation in the proposal site, are more likely to evade injury during construction activities.

A range of fauna species are at risk of vehicle strike during construction. Fauna at risk of injury and mortality include terrestrial fauna, as well as birds, bats and gliders.

Species listed under the BC Act

As a result of vegetation removal, the proposal would impact potential habitat for 11 threatened fauna species. These are listed in Table B1.5. In accordance with the BC Regulation, species credits are required (see section B1.5).

TABLE B1.5 IMPACTS ON THREATENED FAUNA

Common name	Scientific name	Total species polygon area (ha)
Barking owl	<i>Ninox connivens</i>	24.29 ¹
Bush stone-curlew	<i>Burhinus grallarius</i>	337.28
Eastern pygmy-possum	<i>Cercartetus nanus</i>	707
Glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	30.55 ¹
Koala	<i>Phascolarctos cinereus</i>	719.9 ²
Little eagle	<i>Hieraaetus morphnoides</i>	15.9 ¹
Masked owl	<i>Tyto novaehollandiae</i>	7.1 ¹
Pale-headed snake	<i>Hoplocephalus bitorquatus</i>	206.7
Rufous bettong	<i>Aepyprymnus rufescens</i>	244.36
Square-tailed kite	<i>Lophoictinia isura</i>	35.09 ¹
Squirrel glider	<i>Petaurus norfolcensis</i>	690.69

Notes:

1. Breeding habitat only
2. Important habitat only

Species listed under the EPBC Act

The proposal would impact known or potential habitat for at least nine threatened fauna species and three migratory fauna species listed under the EPBC Act. The assessment concluded that a significant impact is likely for the following species:

- ▶ Koala
- ▶ Pilliga mouse
- ▶ Regent honeyeater
- ▶ Corben's long-eared bat
- ▶ Painted honeyeater
- ▶ Swift parrot.

Significant impacts are likely due to the large area of habitat to be removed and the impacts on fauna connectivity. The substantial number of hollow-bearing trees proposed to be removed would also impact species such as the Corben's long-eared bat.

In accordance with the *Environmental Offsets Policy* (DSEWPac, 2012), biodiversity offsets are required to compensate for significant residual effects on matters of national environmental significance. Further information is provided in section B1.5.

Migratory species

The proposal is not likely to significantly impact important habitat for the Fork-tailed swift (*Apus pacificus*), White-throated needletail (*Hirundapus caudacutus*) or Rufous fantail (*Rhipidura rufifrons*). The fork-tailed swift and white-throated needletail species are highly mobile and there is no breeding habitat for the rufous fantail within the region.

B1.3.4 Aquatic ecology

Construction has the potential to impact on watercourses and water quality in the study area (see chapters B2 and B5). Associated potential impacts on aquatic ecology may include the following direct impacts:

- ▶ Removal of riparian vegetation and habitat features on the banks of watercourses to build bridges and/or culverts
- ▶ Temporary obstruction of fish passage associated with bridge and culvert works, and any vehicle access across watercourses
- ▶ Removal of in-stream vegetation and woody debris
- ▶ Impacts on fish within any semi-permanent pools within the proposal site.

Potential indirect impacts on aquatic ecology may occur as a result of:

- ▶ Changes to hydraulic conditions and stability of bed and banks
- ▶ Disturbance of soils and sediments has the potential to increase sediment load in watercourses, which could, in turn, indirectly impact on water quality
- ▶ Accidental release of contaminants, such as lubricating oils, hydraulic fluids and fuel from construction equipment, has the potential to impact on water quality
- ▶ Any modification of riparian and aquatic habitats, and/or changes to water quality, have the potential to indirectly impact on abundance, distribution, and health of aquatic and riparian biota
- ▶ Impacts on behaviour (e.g. avoidance response and foraging) and physiology (e.g. respiration, gill damage, loss of equilibrium) of fish may be associated with any increased suspended sediment concentrations and/or changes in stream bed substratum.

As noted in section B1.2.4, the majority of watercourses that cross the proposal site are intermittent. Potential water quality impacts would be addressed by implementing standard mitigation measures designed to minimise erosion and sedimentation, and potential water quality impacts (see chapters B2 and B5).

Some of the watercourses crossed by the proposal site comprise important aquatic ecosystems and key fish habitat (see section B1.2.7); however, potential impacts would occur in localised areas where the rail corridor crosses the watercourses, and only a very small proportion of the aquatic habitat associated with the watercourses would be impacted. No long-term impacts on aquatic ecology are predicted with the implementation of appropriate construction mitigation measures (see sections B1.5.2, B2.5 and B5.5). Additionally, watercourse crossings would be designed and constructed in accordance with relevant policies and guidelines, including *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003).

The proposal site is located within the mapped distribution of an aquatic threatened ecological community and two endangered aquatic populations. Assessments of significance of the potential impact on these matters were undertaken as part of the aquatic ecology assessment provided in Technical Report 2.

The assessments concluded that the proposal would not result in any lasting impacts. Any temporary impacts during construction are expected to be minor and/or manageable through the implementation of standard mitigation and management practices. Fauna salvage within the enclosed works area would also be undertaken prior to commencement of bridge piling works (where this is proposed) to minimise the risk of injury or mortality of individuals. Potential impacts on key fish habitat are considered in section B1.3.8.

The proposal is not expected to significantly change local surface water flow regimes (see chapter B2). Clearance of riparian vegetation for the upgrading of watercourse structures may occur where it is not practicable to undertake works within the existing disturbance area. Works to watercourse crossings are not expected to adversely alter local surface or groundwater flow regimes and the proposal is not expected to impact on groundwater aquatic dependent ecosystems.

The results of the aquatic ecology assessment determined that the proposal would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within assemblages of biota beyond the small affected areas. The majority of impacts would be temporary and, with the implementation of appropriate mitigation measures (see sections B1.5.2, B2.5 and B5.5), the residual impacts on aquatic ecology would be minimal.

B1.3.5 Indirect impacts

A summary of the potential indirect impacts associated with construction is provided in Table B1.6. The potential for indirect impacts would be managed by implementing the mitigation measures provided in relevant chapters and the CEMP (see section D5.2). With the implementation of these measures, no significant indirect impacts on biodiversity are predicted.

TABLE B1.6 INDIRECT IMPACTS ON BIODIVERSITY VALUES

Impact	Description
Weed invasion and edge effects	<p>'Edge effects' refers to increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna.</p> <p>The proposal site and adjoining land have been extensively cleared for agriculture, although large areas of native vegetation are present, particularly in the Pilliga forests area (see section B1.2.1). Small patches of vegetation occur elsewhere along the alignment.</p> <p>Constructing and operating the proposal would create a new edge and extend the edge effects in some areas.</p>
Pests and pathogens	<p>Construction activities, particularly the movement of construction vehicles, have the potential to introduce pests and pathogens to a site or transfer them to other sites. These could include plant pathogens (such as <i>Phytophthora</i> and myrtle rust) and frog pathogens (chytrid fungus).</p> <p>The potential for impacts associated with these pathogens is low, given the arid and dry nature of the region.</p> <p>There are large numbers of priority weeds, high threat weeds and weeds of national environmental significance present across the proposal site. The proposal has the potential to result in further spread of these weed species into native vegetation where they are not yet established or where they occur at low densities.</p> <p>Construction has the potential to result in an increase in aquatic pest species, which may be able to tolerate poorer water quality. Release of aquatic fauna, including pest species such as Common carp (<i>Cyprinus carpio</i>) and Eastern gambusia (<i>Gambusia holbrooki</i>), could occur during decommissioning of farm dams.</p>
Light, noise and vibration	<p>Light, noise and vibration can indirectly affect breeding, foraging and roosting activities where fauna are located close to construction activities, particularly in environments that are not already subject to these affects. Fauna are currently subject to varying levels of disturbance from light, noise and vibration. Fauna that occupy habitats within the proposal site and adjacent to existing roads and rail lines would be accustomed to existing lights and high noise and vibration levels.</p> <p>Individuals that nest or den in trees could abandon their nests and dens as a result of noise and vibration during construction. While there would be localised increases in light, noise and vibration during construction, these are unlikely to result in a significant impact.</p>
Sedimentation and erosion	<p>Uncontrolled erosion can spread weeds, reduce habitat values and stifle plant growth. Sediment-laden runoff entering watercourses can affect water quality and adversely affect aquatic life. Measures would be implemented during construction to minimise the potential for water quality impacts. Further information is provided in chapter B5.</p>
Dust	<p>Construction has the potential to generate dust that could indirectly impact habitat values. High dust levels could reduce habitat quality for flora and fauna species by reducing plant and animal health in adjacent areas of vegetation. Given drought conditions and restricted water availability, the suppression of dust may be limited during construction works.</p> <p>Drought conditions in the region in recent years have resulted in regular dust storms in the area. Vegetation in close proximity to Pilliga Forest Way and other rural dirt roads are regularly subject to generation of dust as a result of vehicle movements. The proposal may increase the dust impacts in the area. Further information is provided in chapter B10.</p>
Fire	<p>The proposal would increase the risk of fire during construction, e.g. from the storage of combustible fuels or ignition from works areas. Although fire is a natural ecosystem process, fires can lead to fauna mortality and the destruction of habitat resources. In drought conditions, the fire risk is increased due to the dry nature of the vegetation.</p> <p>The risk of fires spreading to adjacent areas would be minimised through an emergency response plan. Further information is provided in chapter B12.</p>
Aquatic disturbance and pollution	<p>Construction has the potential to mobilise contaminated sediments. The introduction of pollutants into the surrounding environment has the potential to impact on water quality and affect aquatic biodiversity values within and downstream of the proposal site, including habitat for fish, wading birds and other species that use downstream habitats.</p> <p>Measures would be implemented during construction to minimise the potential for mobilisation of contaminated sediments and associated surface and groundwater quality impacts. Further information on the potential for groundwater, contamination and surface water impacts is provided in chapters B2, B4 and B5, respectively.</p>

B1.3.6 Impacts on key threatening processes

The BC Act, FM Act and EPBC Act list a series of key threatening processes. These are defined as an action, activity, project or potential threat that:

- ▶ Adversely affects two or more threatened species, populations, or ecological communities
- ▶ Could cause species, populations or ecological communities that are not currently threatened to become threatened.

The proposal itself does not constitute a key threatening process. The proposal would exacerbate the following key threatening processes during construction and operation:

- ▶ Clearing of vegetation (BC Act and EPBC Act)
- ▶ Removal of hollows (BC Act)
- ▶ Removal of dead wood and dead trees (BC Act)
- ▶ Degradation of native riparian vegetation along NSW watercourses (FM Act)
- ▶ Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (BC Act and FM Act)
- ▶ Removal of large woody debris from NSW rivers and streams (FM Act)
- ▶ Human-caused climate change (BC Act and EPBC Act).

In addition, the proposal has the potential to result in the following key threatening processes, mainly during construction:

- ▶ Ecological consequences of high-frequency fires (BC Act)
- ▶ Aggressive exclusion of birds by noisy miners (*Manorina melanoccephala*) (BC Act and EPBC Act)
- ▶ Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species (BC Act)
- ▶ Infection of frogs by amphibian chytrid causing the disease *chytridiomycosis* (BC Act and EPBC Act)
- ▶ Infection of native plants by *Phytophthora cinnamomi* (BC Act and EPBC Act)
- ▶ Introduction and establishment of exotic rust fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (BC Act)
- ▶ Invasion of native plant communities by exotic perennial grasses (BC Act)
- ▶ Competition from feral honeybees (BC Act)
- ▶ Competition and grazing by the feral rabbit (*Oryctolagus cuniculus*) (BC Act and EPBC Act)
- ▶ Competition and habitat degradation by feral goats (*Capra hircus*) (BC Act)
- ▶ Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) (BC Act)
- ▶ Predation by feral cats (BC Act and EPBC Act)
- ▶ Predation by the European red fox (*Vulpes vulpes*) (BC Act and EPBC Act)
- ▶ Importation of Red imported fire ants into NSW (BC Act)
- ▶ Invasion of the Yellow crazy ant (*Anoplolepis gracilipes*) into NSW (BC Act)
- ▶ Novel biota and their impact on biodiversity (EPBC Act).

The approach to managing the potential impacts of the proposal is described in section B1.5.

B1.3.7 Additional impacts that require consideration

In accordance with the Biodiversity Assessment Method, assessment of biodiversity values, in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat are required. For many of these impacts, the biodiversity values may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical. Clause 6.1 of the BC Regulation requires the following prescribed actions to be assessed under the NSW Biodiversity Offsets Scheme. These include, where they relate to the proposal:

- ▶ Connectivity—there is the potential for impacts on fauna connectivity, particularly in the Pilliga forests (see section B1.3.3)
- ▶ Movement of threatened species—the proposal is unlikely to affect the bioregional persistence of species with reference to their movement patterns
- ▶ Vehicle strike—impacts of vehicle strike during construction are unlikely to substantially impact threatened species in the local areas and region as a whole
- ▶ Areas of geological significance—no areas of karst, caves, crevices or cliffs are present in the proposal site
- ▶ Rocks—limited areas of scattered rock throughout the study area
- ▶ Human-made structures—the removal of old structures, such as buildings and telegraph poles, (where required) could disturb roosting microbats and potentially result in mortality of individuals
- ▶ Non-native vegetation—a large proportion of the proposal site comprises cleared or cropped land with small areas of planted trees
- ▶ Hydrological processes—given the generally ephemeral nature of watercourses in the proposal site, changes to hydrology are likely to be minimal in the context of impacts on riparian habitat relevant to threatened species.

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles identified in clause 6.7 of the BC Regulation. The proposal would not result in any serious or irreversible impacts on any species or ecological community.

B1.3.8 Impacts on protected and sensitive lands

Protected areas and critical habitats

The proposal would not impact any conservation reserves or national parks.

The proposal would impact a number of forestry management zones set aside for the protection of specific flora and fauna habitats. These include:

- ▶ Forestry management zone (FMZ) 1—flora reserve broomplain. Management of this zone is aimed at preserving the flora and fauna in a natural and undisturbed condition.
- ▶ FMZ 3A—special value fauna broom/bloodwood. This zone is managed to protect habitat for the Pilliga mouse.
- ▶ FMZ 3A—special value fauna wattle. This zone is managed to provide areas of structural diversity (mid storey).
- ▶ FMZ 3B—grassy box woodland. This zone is managed to encourage the same species that are often associated with Inland Grey Box and Box Gum Woodland threatened ecological communities.
- ▶ FMZ 3B—general habitat mosaic. This zone is managed to protect large-crowned trees which provide areas of structural diversity (overstorey).

Some other areas of Crown land (including travelling stock reserves and paper roads) would be impacted by the proposal. Potential impacts on State forests and Crown land are considered in chapter B12.

Key fish habitat

The proposal crosses numerous watercourses and floodplains via bridges and culverts. Each crossing would interface with waterfront land and the riparian corridor as defined under the *Water Management Act 2000* (NSW). The design of the bridges and culverts has been undertaken to meet the required flooding design standards (e.g. flood levels) for Inland Rail (see chapter B3) while minimising impacts on bed and bank stability, water quality and habitat diversity, and connectivity, as far as practicable.

An assessment of potential impacts on key fish habitats has been undertaken in Technical Report 2. The assessment identified that all relevant watercourse crossings have been designed to provide for the maintenance of fish passage in accordance with NSW Fisheries guidelines and policies.

Waterfront land

Construction would involve works on some areas of waterfront land. Further information about the potential impacts of the proposal on watercourses (including waterfront land) is provided in chapter B2.

Critical habitat

As no critical habitats have been identified in the study area, no critical habitats are expected to be impacted by the proposal.

Biobank sites, private conservation lands and other offset lands

The proposal would not affect any biobank sites, private conservation lands or other offset lands.

B1.4 Impact assessment—operation

Operation has the potential to result in the following impacts:

- ▶ Injury and mortality of fauna attempting to cross the rail line and roads
- ▶ Impacts on connectivity (and associated impacts on population viability and genetics), particularly for terrestrial fauna in the Pilliga area
- ▶ Additional noise, vibration and light impacts as a result of train operations
- ▶ Mobilisation of dust
- ▶ Potential for spills from refuelling
- ▶ Potential for bushfire from sparks
- ▶ Spread of weeds and pests.

Increased train movements in the study area may result in adverse impacts on locally occurring fauna species as a result of vehicle (train) strike. This mainly has the potential to affect mobile terrestrial species, but could also affect birds, microbats and gliders. The risk of strike due to the proposal is much lower than for a road project where there may be thousands of vehicle movements per day.

The presence of the proposed rail infrastructure would provide a barrier to fauna movement and connectivity and could result in fragmentation of populations and impacts on gene flow. Rail lines create a physical and behavioural barrier as well as disturbance (such as noise, pollution and human presence), mortality, and habitat loss and fragmentation. It is noted that permanent fauna exclusion fencing of the rail corridor is not proposed. The barrier that fauna exclusion fencing would create is considered likely to result in an adverse effect on the connectivity of habitat along the rail corridor and the movement of fauna species across the landscape.

Proposed rail bridges, drainage culverts and dedicated fauna culverts allowing for fauna passage would assist in minimising the potential for connectivity impacts, as well as the potential for train strike impacts. Measures to minimise the potential for fauna connectivity impacts would be defined by the proposed fauna connectivity strategy (see section B1.5).

Operation has the potential to result in water quality impacts as a result of runoff from impervious surfaces and increased scour and erosion at culverts and drainage outlets. This could result in an increase in aquatic pest species, which may be able to tolerate poorer water quality; however, the potential for water quality impacts during operation is considered to be minimal with the implementation of the proposed design features and mitigation measures described in section B5.5.

No other operational activities, such as maintenance inspections or monitoring, are expected to impact on native flora and fauna or other biodiversity values.

B1.5 Mitigation and management

B1.5.1 Approach

Approach to mitigation and management

The overall approach to managing impacts on biodiversity is, in order of importance, to:

- ▶ Avoid impacts through the planning and design process
- ▶ Minimise impacts through the planning and design process
- ▶ Mitigate impacts using a range of mitigation measures
- ▶ Offset any residual impact that could not be avoided or mitigated as required by relevant legislation.

ARTC is committed to minimising the potential impacts of the proposal and is investigating opportunities to reduce actual impact areas, where practicable. The area that would be directly impacted by construction activities would depend on factors such as the presence of significant vegetation; constructability; construction management and safety considerations; landform; slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable. The exact amount of clearance (within the proposal site) would be refined during detailed design.

Approach to managing the key potential impacts identified

The key potential issues identified by the biodiversity assessment are:

- ▶ Removal of native vegetation, including hollow-bearing trees
- ▶ Substantial direct impacts on BC Act listed fauna species and fauna habitat
- ▶ Significant impacts on threatened fauna and flora species listed under the EPBC Act
- ▶ Impacts on fish habitat
- ▶ Impacts on fauna connectivity and train strike during operation.

Vegetation clearing

Measures are provided in section B1.5.2 to mitigate impacts that cannot be avoided. The potential for impacts during construction would be managed in accordance with a proposal-specific biodiversity management plan, which would be implemented as part of the CEMP. The plan would detail processes, relevant requirements and responsibilities to minimise biodiversity impacts during construction. Further information on the CEMP is provided in chapter D5. The requirements for the biodiversity management plan are provided in the CEMP outline in Appendix I.

The proposal would not result in any serious or irreversible impacts on any species or ecological community.

Impacts on fauna

As part of the biodiversity management plan, protocols would be included for the removal of habitat features and rescue and relocation of fauna from areas of disturbance. Pre-clearing surveys targeting threatened species are recommended to determine additional site-specific management measures required during construction.

Fauna connectivity

The proposal includes structures that would promote fauna connectivity measures. These tend to be drainage structures that would also be used by fauna, such as bridges and culverts. The appropriate location and design of other structures to enhance connectivity (such as dedicated culverts, glider poles and barrier poles) would be identified during detailed design. These measures would be defined by the proposed fauna connectivity strategy, which would also outline appropriate monitoring and reporting requirements.

Measures to enhance connectivity would also assist in minimising the potential for train strike impacts.

Monitoring of fauna connectivity structures and relevant threatened species would assist in confirming the value of the proposed structures in terms of minimising the potential impacts of habitat fragmentation. Monitoring would also potentially allow for improvements to be identified for this proposal and other rail proposals in Australia (as appropriate).

Impacts on fish habitat

Potential water quality impacts would be addressed by implementing standard mitigation measures designed to minimise impacts on watercourses, erosion and sedimentation, and contamination impacts (see sections B2.5, B4.5 and B5.5).

Watercourse crossings would be designed and constructed in accordance with relevant policies and guidelines, including *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003).

Biodiversity offset requirements under the BC Act

The offsets required to compensate for the residual biodiversity impacts under the BC Act were determined using the Biodiversity Assessment Method Calculator. In accordance with the offset rules established by the BC Regulation, offset obligations can be achieved by retiring the appropriate biodiversity credits from an established Biodiversity Stewardship Site, monetary payment directly into the Biodiversity Conservation Fund, or funding an approved biodiversity action.

A total of 34,820 ecosystem credits are required for the proposal. Two PCTs do not require ecosystem credit offset as the vegetation integrity score was less than 17 (i.e. the vegetation is in low condition). This may be due to the drought conditions that existed at the time, and such communities would be targeted for additional surveys when seasonal conditions are favourable (see description of additional surveys proposed on the following page).

The proposal is known to support six species credit species and an additional 14 that are assumed to be present due to limited site access and poor survey conditions due to prolonged drought. These species require a total of 160,421 species credits. Species credits have been calculated for the following species:

- | | |
|--|--|
| ▶ Cobar greenhood orchid (<i>Pterostylis cobarensis</i>) | ▶ Bush stone-curlew (<i>Burhinus grallarius</i>) |
| ▶ <i>Commersonia procumbens</i> | ▶ Eastern pygmy-possum (<i>Cercartetus nanus</i>) |
| ▶ Coolabah bertya (<i>Bertya opposens</i>) | ▶ Glossy black-cockatoo (<i>Calyptorhynchus lathami</i>) |
| ▶ Native milkwort (<i>Polygala linariifolia</i>) | ▶ Koala (<i>Phascolarctos cinereus</i>) |
| ▶ Pine donkey orchid (<i>Diuris tricolor</i>) | ▶ Little eagle (<i>Hieraaetus morphnoides</i>) |
| ▶ Slender darling pea (<i>Swainsona murrayana</i>) | ▶ Masked owl (<i>Tyto novaehollandiae</i>) |
| ▶ Spiny peppercress (<i>Lepidium aschersonii</i>) | ▶ Pale-headed snake (<i>Hoplocephalus bitorquatus</i>) |
| ▶ <i>Tylophora linearis</i> | ▶ Rufous bettong (<i>Aepyprymnus rufescens</i>) |
| ▶ Winged peppercress (<i>Lepidium monoplacoides</i>) | ▶ Square-tailed kite (<i>Lophoictinia isura</i>) |
| ▶ Barking owl (<i>Ninox connivens</i>) | ▶ Squirrel glider (<i>Petaurus norfolcensis</i>). |

ARTC is managing implementation of the offset strategy for the Inland Rail program. ARTC has invited landowners within 100 km of the route in NSW to contact them regarding establishing a Biodiversity Stewardship Site so that ARTC can purchase the appropriate credits. Where credits are not available for purchase, or cannot be obtained in other ways (such as generation from an ARTC site), another option would be for ARTC to make a payment into the Biodiversity Conservation Fund. Where suitable offsets for the proposal are unable to be sourced, ARTC may seek to apply the variation rules for retirement of some ecosystem and species credits, particularly those associated with native grasslands, which may be difficult to source. Further information is provided in Technical Report 1.

Additional surveys

Additional targeted seasonal surveys are proposed to be undertaken in spring 2020, to assist in further refining the extrapolation of plant community types and assumed species presence due to the survey limitations noted in section B1.1.2 and Technical Report 1. Additional surveys are likely to include vegetation integrity plots in previously extrapolated areas and targeted species credit surveys for:

- ▶ *Commersonia procumbens*
- ▶ *Tylophora linearis*
- ▶ Winged peppercress (*Lepidium monoplacoides*)
- ▶ Spiny peppercress (*Lepidium aschersonii*)
- ▶ Pine donkey orchid (*Diuris tricolor*)
- ▶ Cobar greenhood (*Pterostylis cobarensis*)
- ▶ Coolabah bertya (*Bertya opposens*).

The results of these findings would be documented in an addendum biodiversity report.

Offsetting impacts on protected marine vegetation and key fish habitat

Where instream habitat features or riparian vegetation at watercourses identified as key fish habitat need to be removed, an offset strategy would be agreed in consultation with the Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources Division).

Biodiversity offset obligations under the EPBC Act—offset for significant impacts

The NSW and Australian governments have amended the bilateral agreement for environmental assessment (the bilateral agreement) after changes to NSW legislation. Amending Agreement no. 1 was signed on 24 March 2020. The Australian Government formally endorsed the NSW Biodiversity Offsets Scheme through the *EPBC Act Condition-setting Policy* (DAWE, 2020a).

Under the bilateral agreement, only one decision, including conditions of approval, is made by the NSW Government, accounting for NSW matters of national environmental significance. The *EPBC Act Condition-setting Policy* notes that where a project demonstrates compliance with an endorsed state or territory policy, the proponent will not be required to simultaneously comply with the corresponding Australian Government policy.

To meet required offsets for Commonwealth-listed entities for controlled actions under the NSW Biodiversity Offsets Scheme, ARTC retains the ability to:

- ▶ Retire biodiversity credits based on the like-for-like provisions in the BC Regulation
- ▶ Fund biodiversity conservation actions that are listed in the ancillary rules: Biodiversity conservation actions, and directly benefit the threatened entity impacted
- ▶ Pay into the Biodiversity Conservation Fund, noting it is ARTC's responsibility to notify the Biodiversity Conservation Trust that their payment is for a controlled action, as the Trust is required to meet the Commonwealth offset requirement component in a like-for-like manner.

Like-for-like offsets would be required for the following species credit species:

- ▶ *Commersonia procumbens*
- ▶ Winged peppercreep (Lepidium monoplacoides)
- ▶ *Tylophora linearis*
- ▶ Koala (*Phascolarctos cinereus*).

Appropriate ecosystem credits would be required for the following ecosystem credit species:

- ▶ Corben's long-eared bat (*Nyctophilus corbeni*)
- ▶ Pilliga mouse (*Pseudomys pilligaensis*)
- ▶ Painted honeyeater (*Grantiella picta*)
- ▶ Regent honeyeater (*Anthochaera phrygia*)
- ▶ Swift parrot (*Lathamus discolor*).

Approach to managing other impacts

Other measures to further minimise impacts on biodiversity are provided in section B1.5.2.

Expected effectiveness

The mitigation measures specified in Table B1.7 are anticipated to reduce the likelihood and/or consequence of the identified risks. Developing a biodiversity management plan to identify the process for clearing and rehabilitation, protect sensitive areas, manage weeds, and manage unexpected finds, is expected to be the most effective measure to minimise the potential impacts as far as reasonably practicable.

Interaction between measures

Mitigation measures to minimise potential impacts associated with watercourses, soils and contamination, water quality, noise and air quality would also assist in mitigating the potential impacts on biodiversity. These mitigation measures are provided in chapters B2, B4, B5, B8 and B10. The rehabilitation strategy (see Table B1.7) would also assist in mitigating identified land use, landscape and visual impacts.

B1.5.2 List of mitigation measures

Measures that will be implemented to address potential impacts on biodiversity are listed in Table B1.7.

TABLE B1.7 BIODIVERSITY MITIGATION MEASURES

Stage	Ref	Impact/issue	Mitigation measures
Detailed design/ pre- construction	BD1	<i>Avoiding impacts on biodiversity</i>	Detailed design and construction planning would avoid or minimise the need to remove and/or disturb native vegetation and fauna habitat, as far as reasonably practicable.
	BD2		Vegetation clearing would be limited to the minimum necessary to construct the proposal and allow for its effective operation. Where appropriate, facilities within the multi-function compounds and temporary workforce accommodation would be located to further minimise or avoid impacts on native vegetation where practicable.
	BD3	<i>Impacts on threatened species</i>	Additional threatened flora surveys would be undertaken (where suitable climatic conditions occur) prior to clearing for the species likely to be impacted by the proposal, including: <ul style="list-style-type: none"> ▶ <i>Lepidium monolocoides</i> ▶ <i>Tylophora linearis</i> ▶ <i>Commersonia procumbens</i> ▶ <i>Bertya opposens</i>. The need for translocation options would be discussed with the Department of Planning, Industry and Environment (Biodiversity and Conservation Division), should these be required.
	BD4	<i>Offsetting impacts on native vegetation and threatened species</i>	Biodiversity offsets would be finalised in accordance with the requirements of the <i>Biodiversity Assessment Method</i> (OEH, 2017). This includes retirement of like-for-like offsets for impacts on matters of national environmental significance.
	BD5	<i>Impacts on fish passage</i>	Watercourse crossing structures would meet Inland Rail design standards and be designed in accordance with <i>Why do fish need to cross the road? Fish passage requirements for waterway crossings</i> (Fairfull and Witheridge, 2003).
	BD6	<i>Fauna connectivity</i>	A fauna connectivity strategy would be prepared to guide detailed design. It would include investigation and design of: <ul style="list-style-type: none"> ▶ Locations for fauna crossing structures in the Pilliga East State Forest, including bridges and culverts for threatened fauna (such as the Koala and Pilliga mouse in areas of preferred habitat), glider poles at regular intervals, and wooden barrier poles at bridges ▶ The provision of localised fencing to direct fauna to crossing structures ▶ Fauna furniture to be included in the design of bridges and culverts where appropriate to encourage crossings by koalas and other native fauna. The connectivity strategy would include monitoring and reporting requirements in relation to the operational performance of the final measures.
Construction	BD7	<i>Managing the potential for biodiversity impacts during construction</i>	A biodiversity management plan would be prepared prior to construction and implemented as part of the CEMP. The plan would include measures to manage biodiversity and minimise the potential for impacts during construction. The plan would be prepared in accordance with relevant legislation, guidelines and standards. The plan would include, but not be limited to: <ul style="list-style-type: none"> ▶ Locations and requirements for pre-clearing surveys ▶ Establishing protocols for the staged clearing of vegetation and safe tree felling and log removal to reduce the risk of fauna mortality ▶ Measures to avoid and minimise clearing of hollow-bearing trees, where practicable ▶ Measures relating to the provision and management of nest boxes, including reuse of hollows and monitoring protocols ▶ An unexpected finds protocol ▶ Measures to manage biosecurity risks in accordance with the <i>Biosecurity Act 2015</i> ▶ Measures to reduce the risk of aquatic fauna mortality/injury.

Stage	Ref	Impact/issue	Mitigation measures
	BD8		<p>Pre-clearing surveys would be undertaken prior to construction by a suitably qualified ecologist in accordance with the biodiversity management plan. Specific surveys would include:</p> <ul style="list-style-type: none"> ▶ Surveys for roosting microbats and birds in structures, including telegraph poles and buildings, that are proposed to be removed ▶ Searches for nest trees ▶ Identification of hollow-bearing trees and logs requiring fauna management during removal ▶ Surveys for koalas, which may include trained detection dogs or other appropriate survey technique ▶ Aquatic fauna salvage in watercourses or residual pools within 50 m of the construction footprint, and in areas that would be enclosed by silt curtains (e.g. piling locations).
	BD9		<p>Compounds and stockpile sites would be located an appropriate distance from riparian habitat to avoid indirect impacts on aquatic habitat. This includes, where practicable, a minimum of 100 m for Type 1, Class 1 watercourses; 50 metres for Type 2, Class 2 and 3 watercourses; and 10 to 50 m for Type 3, Class 2 to 4 watercourses.</p> <p>Direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided, as far as practicable.</p>
	BD10		<p>Exclusion areas would be established and maintained around native vegetation to be retained, particularly areas of biodiversity value adjoining the proposal site that are located in close proximity to work areas.</p>
	BD11	<i>Rehabilitation of vegetation subject to temporary disturbance</i>	<p>A rehabilitation strategy would be prepared to guide rehabilitation planning, implementation, monitoring and maintenance of disturbed areas outside the operational footprint (such as compounds and temporary workforce accommodation).</p> <p>The strategy would include clear objectives for rehabilitation of native vegetation in temporary disturbances areas. It would include clear objectives for rehabilitation of native vegetation in temporary disturbances areas.</p>
Operation	BD12	<i>Weed management</i>	<p>Weed inspections would be undertaken and weed management would occur in accordance with ARTC's standard operating procedures to meet its obligations under the <i>Biosecurity Act 2015</i>.</p>
	BD13	<i>Fauna connectivity</i>	<p>The operational performance of fauna connectivity measures would be monitored in accordance with the fauna connectivity strategy. This would include recording of wildlife collisions with trains, and monitoring of use of crossing structures by target species (including the Pilliga mouse and eastern pygmy-possum) and feral predators.</p> <p>The need for additional measures or modifications to existing measures would be identified to respond to any issues identified.</p>
	BD14	<i>Aquatic ecology</i>	<p>Culverts that provide for the flow of watercourses would be inspected and maintained in accordance with ARTC's standard operating procedures to address any issues that may contribute to the blockage of fish passage.</p>

B1.5.3 Managing residual impacts

Residual impacts are impacts of the proposal that may remain after implementation of:

- ▶ Design and construction planning measures to avoid and minimise impacts (see sections A7.2 and A8.1)
- ▶ Specific measures to mitigate and manage identified potential impacts (see section B1.5.2).

The key potential biodiversity issues and impacts originally identified by the environmental risk assessment (see section A9.1) are listed in Table B1.8. The (pre-mitigation) risks associated with these impacts, which were identified by the environmental risk assessment, are provided. Further information on the approach to the environmental risk assessment, including descriptions of criteria and risk ratings, is provided in section A9.1.

The potential issues and impacts identified by the environmental risk assessment were considered as part of the biodiversity development assessment report and aquatic ecology assessment, summarised in sections B1.3 and B1.4. The mitigation and management measures (listed in Table B1.7) that would be applied to manage these impacts are also identified. The significance of potential residual impacts (after application of these mitigation measures) is rated using the same approach as the original environmental risk assessment. The approach to managing significant residual impacts (considered to be those rated medium or above) is also described.

The proposal would result in some unavoidable residual impacts, including:

- ▶ Removal of 1,732 ha of native vegetation and associated habitat resources
- ▶ Removal of BC Act and/or EPBC Act listed threatened ecological communities
- ▶ Significant impact to a number of threatened flora and fauna listed under the EPBC Act
- ▶ Removal/loss of between 13,000 and 30,000 hollow-bearing trees
- ▶ Reduced fauna connectivity
- ▶ Fauna mortality as a result of vehicle and/or train strike
- ▶ Impacts from noise, light, traffic and altered environmental conditions.

These impacts are expected to reduce the biodiversity values within the study area.

TABLE B1.8 RESIDUAL IMPACT ASSESSMENT—BIODIVERSITY

Assessment of pre-mitigated risk (see section A9.1 and Appendix E)					Mitigation measures (see Table B1.7)	Residual impact assessment			
Phase	Potential impacts	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	How residual impacts would be managed'
Construction	Clearing of native vegetation (including vegetation in the Pilliga State forests) resulting in loss of fauna habitat, habitat fragmentation and loss of connectivity	Almost certain	Moderate	High	BD1-BD11	Likely	Moderate	High	<p>A fauna connectivity strategy would be prepared to guide detailed design and would include crossing structures, particularly in the Pilliga State forests and at major watercourses.</p> <p>A biodiversity management plan would be implemented and would include measures to manage biodiversity and minimise the potential for impacts during construction. Implementation of these measures would minimise the potential for residual impacts.</p>
	Direct impacts on listed threatened flora species and endangered terrestrial ecological populations and communities	Almost certain	Moderate	High	BD1-BD11	Likely	Moderate	High	The biodiversity management plan would include measures to manage impacts on threatened flora species and endangered ecological communities. Implementation of these measures would minimise the potential for residual impacts.
	Impact on potential habitat for listed threatened fauna species	Almost certain	Moderate	High	BD1-BD11	Likely	Moderate	High	<p>The fauna connectivity strategy includes crossing structures for threatened fauna species.</p> <p>The biodiversity management plan would include measures to manage impacts on threatened fauna species.</p> <p>Implementation of these measures would minimise the potential for residual impacts.</p>
	Potential impacts on aquatic ecology and threatened species, including as a result of removal of riparian vegetation and fish passage blockages during construction of watercourse crossings.	Possible	Moderate	Medium	BD5, BD7-BD9, BD14	Unlikely	Minor	Low	n/a

Assessment of pre-mitigated risk (see section A9.1 and Appendix E)					Mitigation measures (see Table B1.7)	Residual impact assessment			
Phase	Potential impacts	Likelihood	Consequence	Risk rating		Likelihood	Consequence	Risk rating	How residual impacts would be managed ¹
Construction (continued)	Water quality impacts and changes to flow regimes affect aquatic ecosystems.	Possible	Moderate	Medium	BD7, BD14, measures in chapter B5	Unlikely	Minor	Low	n/a
	Potential impacts on protected and sensitive lands.	Possible	Moderate	Medium	BD1-BD4, BD6-BD11	Unlikely	Minor	Low	n/a
Operation	Impacts on connectivity (and associated impacts on population viability and genetics), particularly for terrestrial fauna in the Pilliga forests, as a result of the presence of the new rail corridor.	Likely	Moderate	High	BD13	Possible	Moderate	Medium	The operational performance of fauna connectivity measures would be monitored in accordance with the fauna connectivity strategy.

Note:

1. For residual impacts with a risk rating of medium or above.