CHAPTER

10

Biodiversity

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10 Biodiversity

This chapter is a summary of the biodiversity impact assessments (both terrestrial and aquatic) for the Narrabri to North Star (N2NS) Phase 2 Moree to Camurra North section of Inland Rail (the proposal). It describes the existing environment, assesses the impacts of construction and operation of the proposal, and provides recommended mitigation and management measures. The full assessment reports are in Technical paper 1: Biodiversity development assessment report and Technical paper 2: Post-wet aquatic ecology assessment.

The Secretary's Environmental Assessment Requirements (SEARs) relevant to biodiversity and where they are addressed are listed in Table 10-1. A full copy of the SEARs is in Appendix A.

TABLE 10-1 SEARS REQUIREMENTS RELEVANT TO BIODIVERSITY

Key issues		Requirement	Where addressed
4. Biodiversity	1	Biodiversity impacts in accordance with s7.9 of the Biodiversity Conservation Act 2016 (BC Act) (NSW), the Biodiversity Assessment Method (BAM), and be documented in a Biodiversity Development Assessment Report (BDAR).	Technical Paper 1: Biodiversity Development Assessment Report (BDAR), and summarised in Chapter 10
	2	The BDAR must document the application of the avoid, minimise and offset framework in accordance with the BAM.	BDAR, and summarised in section 10.4.1
	3	The BDAR must include information in the form detailed in s6.12 of the BC Act, cl6.8 of the Biodiversity Conservation Regulation 2017 and the BAM.	BDAR, and summarised in Chapter 10
	4	The BDAR must be submitted with all digital spatial data associated with the survey and assessment as per Appendix 10 of the BAM.	Spatial files provided separately on EIS lodgement
	5	The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the BC Act.	BAM accreditation numbers supplied in section 10.2.1
	6	The BDAR must include details of the measures proposed to address offset obligations.	Section 10.5.3
	7	Impacts on biodiversity values not covered by the BAM. This includes a threatened aquatic species assessment (Part 7A *Fisheries Management Act 1994*) to address whether there are likely to be any significant impact on listed threatened species, populations or ecological communities listed under the *Fisheries Management Act 1994* (FM Act) (NSW).	Section 10.4.8
	8	Identify whether the project, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the BC Act, FM Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth).	Section 10.4.10

10.1 Summary of impacts

The construction and operational phases of the proposal have the potential to impact biodiversity values and contribute to key threating processes at the site that cannot be avoided. This would occur through direct impacts, such as habitat clearing and the ongoing existence of infrastructure.

Habitat clearing for permanent and temporary construction facilities (e.g., new rail line, replacement bridges, upgraded crossings, ancillary facilities) will impact 99.71 ha of native vegetation in various condition states, with 37.79 ha in the Northern Outwash subregion and 61.92 ha in the Castlereagh-Barwon Subregion. The extent of non-native vegetation to be impacted is 43.31 ha with 27.59 ha occurring in the Northern Outwash Subregion and 15.73 ha in the Castlereagh-Barwon Subregion.

Threatened Ecological Community's (TECs) likely to be affected in the development footprint include:

- Weeping Myall Woodland
- Carbeen Open Forest
- Natural Grasslands
- Poplar Box Woodland.

Habitat for threatened species (species credit species) will be impacted during the construction phase (10.3.6) which may result in injury and mortality of fauna and potential over-clearing of habitat outside proposed development footprint. Further impacts to the development site include removal of 35 hollow bearing trees (HBTs), degradation of native riparian vegetation along NSW water courses; and removal of large woody debris from NSW rivers and streams.

Key mitigation measures will be taken for this proposal and include timing works to avoid critical life cycle events, implementing clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, with the presence of a trained ecological or wildlife handler, the rehabilitation in areas of retained vegetation to enhance connectivity and relocate habitat features (fallen timber, hollow logs) from within the subject land to an adjacent area.

Mitigation measures for indirect impacts will be taken during and after the construction phase of the proposal and include implementing vegetation clearing protocols, dust monitoring programs to control air quality, temporary fencing to protect significant environmental features and threatened species habitat and hygiene protocols to prevent the spread of weeds or pathogens.

10.2 Assessment approach

10.2.1 Methodology

Biodiversity impacts have been assessed through comprehensive landscape assessment (including a Land Category Assessment), targeted field survey, impact assessment and offset obligation calculations. The methodology is set out in the following section and the results are in section 10.3. The assessment has been completed by accredited Biodiversity Assessment Method (BAM) assessors in accordance with the BAM 2020 (DPIE, 2020a).

10.2.1.1 Study area

The proposal site was the area subject to detailed terrestrial biodiversity assessment. For the aquatic ecology assessment, the proposal site, as well as all watercourses within the catchment potentially impacted by the proposal, was subject to detailed assessment. The following terms define the assessed areas undertaken for the biodiversity assessment:

- **Assessment area**—all land within 500 metres (m) of the outside edge of the boundary of the development footprint. This is the BAM 2020 buffer zone requirement for linear developments (in contrast to the 1500 m buffer zone for non-linear developments).
- **Development footprint**—the area of land that is directly impacted by the proposal (also known as the proposal site defined in section 2.2.1 of this EIS). This includes the existing rail footprint, new rail realignment, replacement bridges and associated construction areas (i.e., compounds, stockpiles). The development footprint is approximately 143 hectares (ha).
- **Subject land**—the subject land is a 100 m wide corridor, which contains the development footprint, together with areas of land that are subject to potential direct and indirect impacts from the proposal. This equates to approximately 692.3 ha and is the study area for the BDAR to support the EIS. The combined areas of the subject land and development footprint are where the BAM has been applied.

The database searches undertaken for both of these assessments were generally based on a search area with a radius of between 5 and 10 kilometres (km) from the proposal site. Database searches for aquatic ecology were based on local government areas (LGAs).

The assessment of protected and sensitive land was undertaken for the assessment area, defined above as the development footprint plus a general buffer of 500 m.

10.2.1.2 Land category assessment

In accordance with section 6.8(3) of the *Biodiversity Conservation Act 2016* (NSW) (BC Act), the biodiversity assessment excludes the assessment of any clearing of native vegetation and loss of habitat on Category 1—exempt land within the meaning of Part 5A of the *Local Land Services Act 2013* (NSW) (LLS Act). This does not include any impacts prescribed by the Biodiversity Conservation Regulations 2017 (NSW), (under section 6.3 of the BC Act) as boundaries delineating Category 1—exempt land are not yet publicly available.

In accordance with section 60F of the LLS Act, during the transitional period, accredited BAM assessors may determine those boundaries and any associated categorisations for the consent authority to consider by approximating the method used to develop the Native Vegetation Regulatory Map (NVR map) under the provisions of the BC Act and the LLS Act.

To meet the Category 1—exempt land requirement, land must be:

- legally cleared at, or since, 1 January 1990 (woody vegetation only)
- significantly disturbed or modified since 1990 (non-woody vegetation).

Based on the data sources and the survey undertaken for the proposal, with the exception of travelling stock routes (TSRs), there is evidence to suggest that large areas of the subject land have been under regular rotational cropping or pasture improvement prior to 1990. This is supported by recent and historical imagery, as well as 2017 Land Use Mapping data. These areas include mapped areas such as:

- exotic—areas of cropping and horticultural plantings
- irrigation dams and channels
- urban—fringing areas of the Moree township containing exotic plantings and non-local indigenous native species
- infrastructure—roads, dwellings and agricultural infrastructure.

These areas, in addition to rivers including aquatic areas of the Mehi and Gwydir rivers (except Murray Cod (*Maccullochella peelii*) habitat), have been excluded from the BAM assessment, except where prescribed impacts are relevant and discussed in Section 7.3 of Technical paper 1: Biodiversity development assessment report. Where in doubt, or where data sources are conflicting, a precautionary approach has been implemented for areas deemed inconclusive in terms of determining historical land use. The land category assessment is provided in full in Appendix A of the BDAR.

10.2.1.3 Landscape assessment

Desktop assessment was undertaken as required by the BAM. This included determination of the relevant Interim Biogeographic Regionalisation for Australia (IBRA) subregion, Mitchell landscapes, native vegetation and cleared areas within a 500 m buffer of the site, rivers, streams and wetlands, connectivity features and geological areas of significance. This component was undertaken largely by geographic information system (GIS) analysis with appropriate ground truthing.

10.2.1.4 Aquatic ecology

The assessment of aquatic ecology involved the following key tasks:

- background research, including database searches of threatened species distribution maps and key fish habitat mapping to inform the scope of field surveys and assist in the description of the ecological context of the proposal site
- preliminary stream order mapping in accordance with the Strahler ordering system, and habitat mapping based on review of aerial imagery and topographic mapping
- field surveys undertaken between 3 and 6 December 2019 and 10 to 12 March 2020, to identify aquatic habitat features, indications of stream condition, and to assess the potential for threatened aquatic species to be present. Field surveys included sampling via netting and bait traps in two farm dams for aquatic species (refer to section 3.6 of Technical paper 2: Post-wet aquatic ecology assessment for further detail)
- assessment of fish habitat in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (NSW Department of Primary Industries (DPI), 2013)
- assessing the potential impacts of the proposal on aquatic ecology and identifying mitigation and management measures to address the impacts identified.

Aquatic habitat assessments adapted and modified from AUSRIVAS[1] along the Mehi River, Gwydir River and Duffy's Creek were undertaken. Additionally, 'tests of significance' and 'assessments of significance' for relevant listed threatened species and ecological communities under the *Fisheries Management Act 1994* (NSW) (FM Act) and *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) have been undertaken.

A detailed description of the assessment methodology for aquatic ecology is provided in section 3 of Technical Paper 2: Post-wet aquatic ecology assessment.

10.2.1.5 Terrestrial field surveys

Vegetation mapping, Vegetation Integrity Plots (VIPs), and targeted threatened flora and fauna surveys were undertaken by numerous ecologists in December 2019, February 2020 and February 2022.

Additionally, the proposal, as part of the broader N2NS project, was surveyed by ecologists from Umwelt in February and April 2016.

Targeted surveys were undertaken between 3 to 6 December 2019, 2 to 5 February 2020, 17 to 19 August 2020 and 21 to 24 February 2022. General vegetation mapping, plot-based surveys and targeted threatened flora and fauna surveys, in accordance with relevant guidelines, were undertaken for relevant species in their suitable habitat. Survey methods were guided by:

- *NSW guide to Surveying Threatened Plant and their habitats* (DPIE, 2020b)
- *'Species credit' threatened bats and their habitats* (OEH, 2018a)
- *Threatened biodiversity survey and assessment* (OEH, 2004)
- *Survey guidelines for Australia's threatened birds* (Department of the Environment, Water, Heritage and the Arts (DEWHA), 2010)
- *Survey guidelines for Australia's threatened reptiles* (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2011a)
- *Survey guidelines for Australia's threatened fish* (DSEWPaC, 2011b).

Targeted field surveys were undertaken for the following species:

- Diurnal avifauna (Australian Bustard (*Ardeotis australis*), Glossy Black Cockatoo (*Calyptorhynchus lathami*), Little Eagle (*Hieraaetus morphnoides*), Square-tailed Kite (*Lophoictinia isura*), White-bellied Sea-eagle (*Haliaeetus leucogaster*) and Painted Honeyeater (*Grantiella picta*))
- Nocturnal avifauna (Bush Stone-curlew (*Burhinus grallarius*), Barking Owl (*Ninox connivens*))
- Nocturnal mammals (Koala (*Phascolarctos cinereus*))
- Flying-foxes and microbats (Bristle-faced Free-tailed Bat (*Mormopterus eleryi*), Corben's Long-eared Bat (*Nyctophilus corbeni*), Grey-headed Flying-fox (*Pteropus poliocephalus*))
- Reptiles (Pale-headed Snake (*Hoplocephalus bitorquatus*), Five-clawed Worm-skink (*Anomalopus mackayi*))
- Threatened flora (Bluegrass (*Dichanthium setosum*), Cyperus conicus (*Cyperus conicus*), Creeping Tick-trefoil (*Desmodium campylocaulon*), Finger Panic Grass (*Digitaria porrecta*), Belson's Pain (*Homopholis belsonii*), Spiny Peppercress (*Lepidium aschersonii*)).

10.2.1.6 BAM credit calculations

As defined under the BAM assessment method, the proposal is a linear-shaped development that crosses two Interim Biogeographic Regionalisation for Australia (IBRA) subregions. The linear-based method has been applied.

[1] AUSRIVAS (**Aus**tralian **Riv**er **A**ssessment **S**ystem) is a prediction system used to assess the biological health of Australian rivers.

10.2.2 Legislative and policy context

The key pieces of legislation and guidelines relevant to the assessment of biodiversity impacts for this proposal are:

- Biodiversity Conservation Act 2016 (NSW)
  - *Biodiversity Assessment Method*
  - Biodiversity Assessment Method Calculator (BAM-C)
  - *Biodiversity Assessment Method Operational Manual Stage 1 and Stage 2* (OEH, 2018b)
  - *Threatened species survey and assessment guidelines*
  - Biodiversity Conservation Regulation 2017
- *Local Land Services Act 2013* (NSW)
- *Fisheries Management Act 1994* (NSW)
  - *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull & Witheridge, 2003)
  - *Aquatic Ecology in Environmental Impact Assessment* (Lincoln Smith, 2003)
- Environment Protection and Biodiversity Conservation Act 1999 (Cth)
  - *Significant Impact Guidelines 1.1 Matters of National Environmental Significance* (Department of Environment (DoE), 2013)
  - *EPBC Policy Statement 3.17—Weeping Myall Woodlands* (DEWHA, 2009)
  - *Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland and the Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin* (DSEWPaC, 2012).
  - EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory), Commonwealth Department of Environment, 2014 (see comment below).

Pursuant to section 7.9 of the BC Act, the biodiversity assessment for State Significant Infrastructure (SSI) must include information in the form detailed in section (s) 6.12 of the BC Act, clause (cl) 6.8 of the Biodiversity Conservation Regulation 2017, and be prepared in accordance with the methodology set out in the Biodiversity Assessment Method Order 2017, under s6.10 of the BC Act.

As stated in the BC Act s6.8(3), the biodiversity assessment is to exclude the assessment of any clearing of native vegetation and loss of habitat on Category 1—exempt land (within the meaning of Part 5A of the LLS Act; therefore, the impact assessment is based on re-categorised land.

Tests of significance for relevant listed threatened species and ecological communities under the FM Act and the EPBC Act have been undertaken as part of this assessment. Referral was undertaken on the basis of potentially significant impacts under the EPBC Act and the general assessment requirements provided by the Australian Government Department of Agriculture, Water and the Environment (DAWE) have been assessed as part of the BDAR.

The Koala referral guidelines were rescinded in February 2022. As the proposal has been determined a controlled action there is no need to revise assessments, and the old provisions apply.

10.3 Existing environment

The majority of the subject land has been cleared of native vegetation, and largely consists of existing rail corridor and land cultivated for agriculture, which is the dominant land use in the area. The majority consists of irrigated cropping, horticulture, and grazing of sheep and cattle; however, the proposal would cross and impact on areas of river systems and native vegetation, including the following:

- Mehi and Gwydir rivers and tributaries—riparian areas dominated by River Red Gum *Eucalyptus camaldulensis.*
- TSRs—areas of natural grassland, Cooba *Acacia salicina* and Weeping Myall *Acacia pendula* woodlands; however, generally dominated by naturalised Mimosa *Vachellia farnesiana* and exotic species such as African boxthorn *Lycium ferocissimum* and tiger pear *Opuntia aurantiaca.*

- Road reserves—generally areas adjacent to the Newell Highway and other minor roads, including a combination of native species and environmental weeds, such as Johnson Grass (*Sorghum halepense*) and key emerging weed species in the region such as Coolatai Grass (*Hyparrhenia hirta*) and Sabi Grass (*Urochloa mosambicensis*).
- Urban areas—inclusive of the outer areas of the Moree township. Species are dominated by planted natives and exotics such as Jacaranda (*Jacaranda mimosifolia*) and Silky Oak (*Grevillea robusta*).

10.3.1 Land category assessment

Large areas of the subject land have been under regular rotational cropping or pasture improvement historically, supported by recent and historical imagery, as well as 2017 Land Use Mapping data. Where in doubt, or where data sources are conflicting, a precautionary approach has been implemented for areas deemed inconclusive in terms of determining historical land use.

Draft maps of those areas considered to be Category 1 land and Category 2 land have been produced and these areas have been excluded from the BAM assessment, except where prescribed impacts are relevant. Where in doubt, or where data sources were conflicting, a precautionary approach has been implemented for areas deemed inconclusive in terms of determining historical land use. Refer to Figure 10-1 for land excluded from the BAM assessment. The detailed LCA assessment is provided in full as Appendix A to Technical paper 1: Biodiversity development assessment report.

10.3.2 Landscape assessment

The majority of the subject land falls within the Brigalow Belt South Bioregion and Northern Outwash Sub-region; however, a portion of the proposal site, at the Camurra end, falls within the Darling Riverine Plains Bioregion and Castlereagh–Barwon Bioregion and Sub-region. The subject land is located within the Gwydir Alluvial Plains and Gwydir Channels and Floodplains Mitchell Landscape.

As determined by GIS mapping from available aerial imagery and Namoi/BRG NSW Vegetation Mapping, about 598.72 ha of native vegetation (woody and non-woody) occurs in the 500 m linear buffer area. This constitutes approximately 22 per cent of the buffer area. The vegetation in the buffer area includes riparian areas, grassy woodland communities, and natural grassland communities in varying condition classes. Cleared areas in, and adjacent to, the subject land primarily consists of flat or slightly undulating agricultural land that has been historically and heavily modified, with sparse patches of fragmented vegetation remaining within riparian areas and TSRs.

Four rivers and streams within the subject land are listed as areas of high biodiversity value under the Biodiversity Conservation Regulation 2017 (BC Regulation)—Mehi River (seventh-order stream), Gwydir River (seventh-order stream), Duffy's Creek (third-order stream) and Skinners Creek (third-order stream). In addition to this, a further five ephemeral tributaries, excluding irrigation channels, are within the subject land. Approximately five irrigation dams, farm dams and irrigation channels occur within the subject land. The nearest important wetland listed under the EPBC Act is the Gingham and lower Gwydir wetlands, which occur 30–40 km downstream of the locality. An unnamed ephemeral wetland was recorded to the north-west of the proposed alignment, with a maximum riparian vegetation height of 30 m.

Significant regional connectivity features occur within or adjacent to the subject land. Being a largely cleared and fragmented landscape, riparian areas, including the Mehi and Gwydir rivers, are generally in reasonable condition and fundamental to the movement of fauna in the region, inclusive of the some of the smaller more ephemeral tributaries, i.e., Duffy's Creek. Additionally, a TSR (Camurra to Mia Mia), which links up the two rivers systems, is an important corridor, and although some sections are sparse in terms of trees, is critical for Koala and other common and threatened fauna species to move throughout the landscape. Outside these areas, there are small pockets of remnant vegetation and grasslands within council land, private properties and road reserves that provide some habitat connectivity for more disturbance-tolerant and mobile species to travel across the landscape.

No karsts, caves, crevices or cliffs, or other areas of geological significance occur in or adjacent to the subject land. No areas of outstanding biodiversity value occur within the subject land.

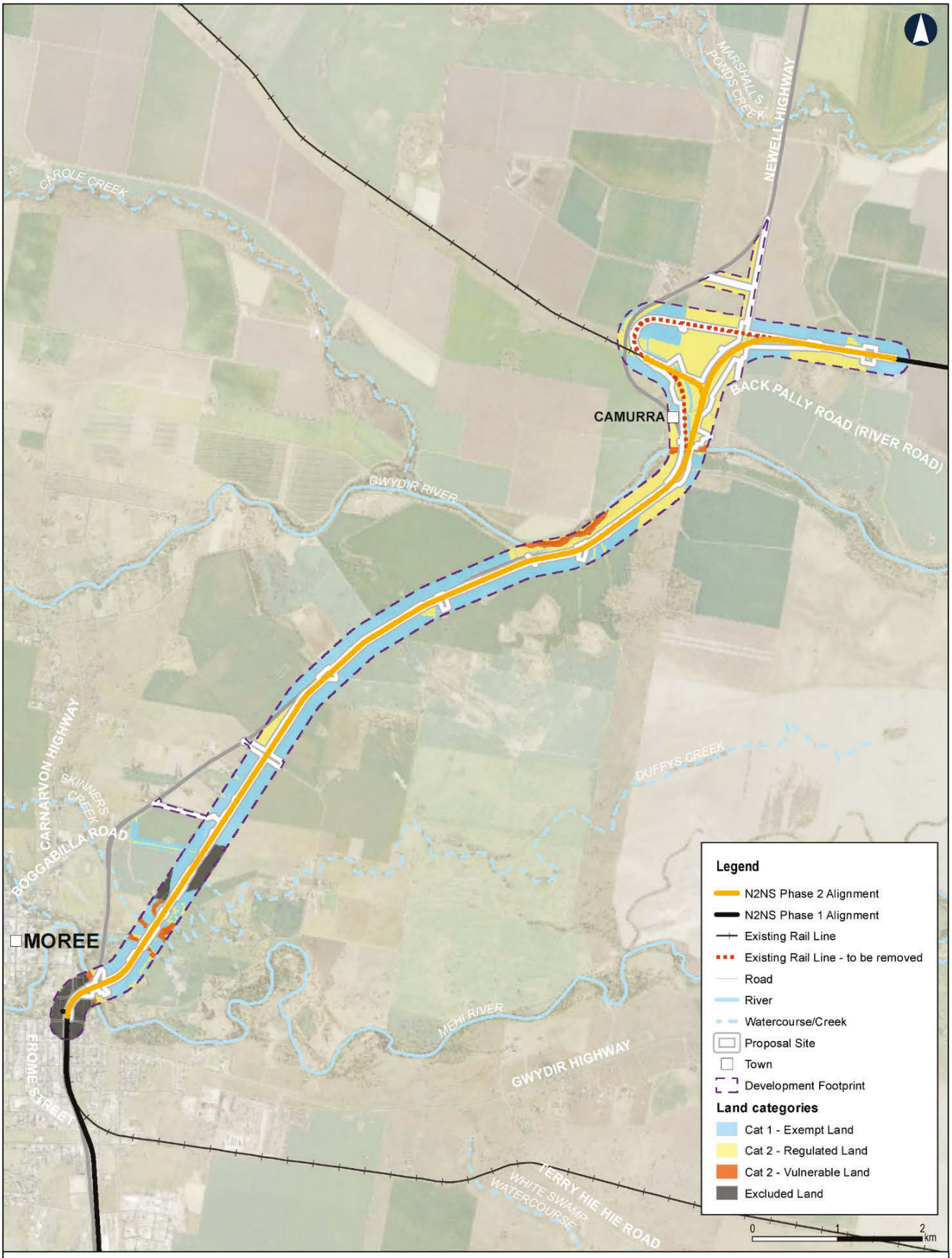

Figure 10-1 Development footprint overview and land categorisation

Data Sources: ARTC, IRDJV, LPI

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:58,019
Paper size: A4
Date: 9/22/2021
Map 1 of 1

10.3.3 Plant Community Types

Six Plant Community Types (PCTs) were identified within the subject land, as shown in Table 10-2. Descriptions of the PCTs identified are provided with the BDAR, and the PCTs and their associated threatened ecological communities, where relevant, are provided in Figure 10-2.

TABLE 10-2 PCTS WITHIN THE SUBJECT LAND

PCT	Condition	Threatened Ecological Community (TEC)	Extent in proposal site (ha)
PCT 27 Weeping Myall Open Woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Very low to moderate	Listed as Endangered under the NSW BC Act—Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray–Darling Depression, Riverina and NSW South Western Slopes Bioregion (Endangered). Listed as Endangered under the EPBC Act—*Weeping Myall Woodlands* (Endangered).	17.31
PCT 36 River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	Low to moderate	Listed as Endangered under the NSW BC Act—River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion. Not listed under the EPBC Act.	39.48
PCT 52 Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	Low to moderate	Not listed under the NSW BC Act. Listed as Critically Endangered under the EPBC Act—Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland and the Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin (Critically Endangered).	220.28
PCT 56 Poplar Box–Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Low to moderate	Not listed under the NSW BC Act; however, intergrades with the Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions—New England Tablelands (Endangered) (PCT 71). Listed as Endangered under the EPBC Act—Poplar Box Grassy Woodland on Alluvial Plains (Endangered).	6.94
PCT 71 Carbeen–White Cypress Pine–River Red Gum–bloodwood tall woodland on sandy loam alluvial and eolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Moderate	Listed as Endangered under the NSW BC Act—Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions—New England Tablelands. Not listed under the EPBC Act.	8.20
PCT 78 River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	Low to moderate	N/A	12.40

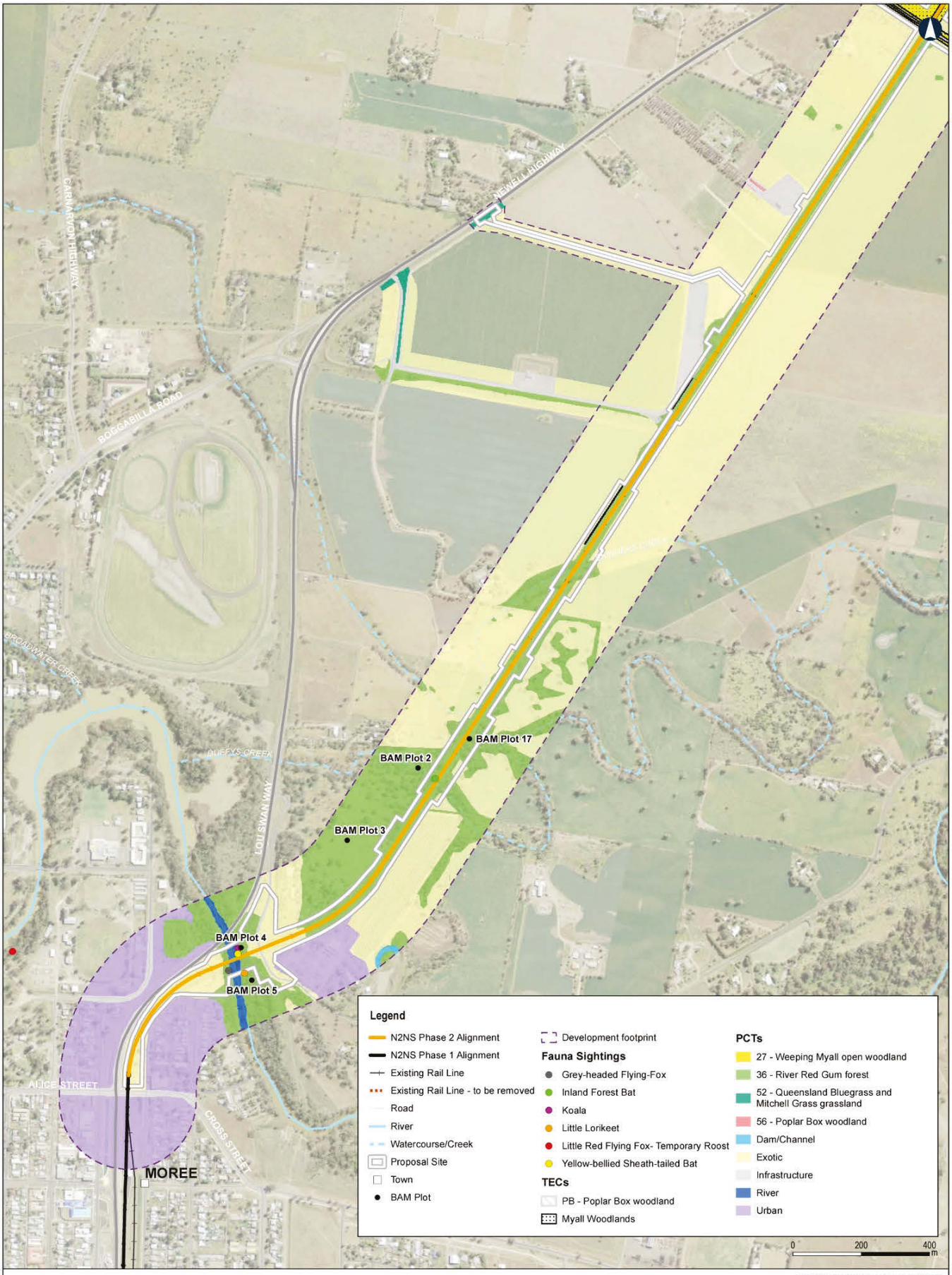

Figure 10-2 PCTs and TECs within the development footprint

Data Sources: ARTC, IRDJV, LPI

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:10,000
Paper size: A3
Date: 9/22/2021
Map 1 of 5

N2NS_SP2_EIS_F10_02_PCTandTECs_r2v2.mxd

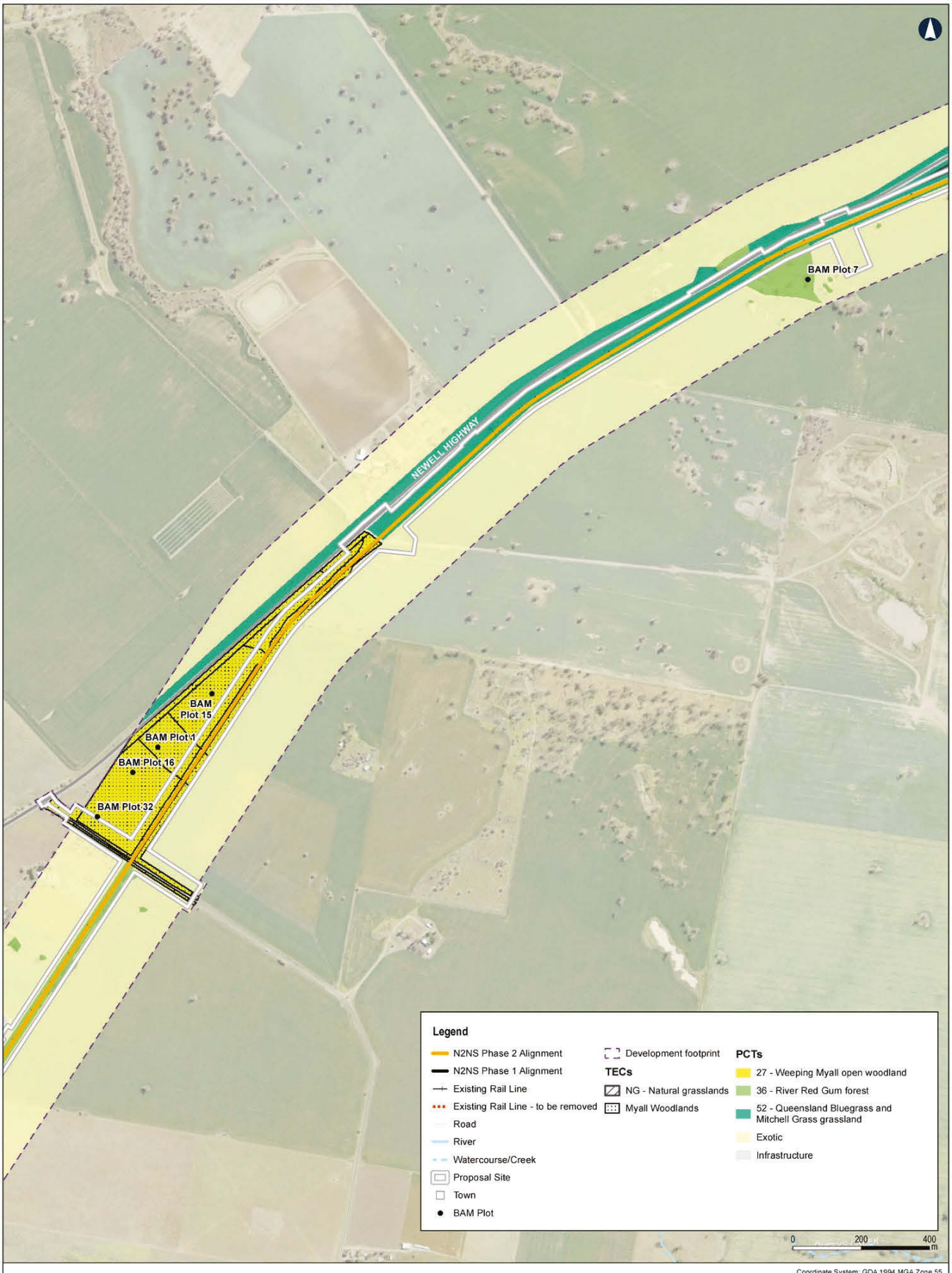

Figure 10-2 PCTs and TECs within the development footprint

Data Sources: ARTC, IRDJV, LPI

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:10,000
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Date: 9/22/2021
Map 2 of 5

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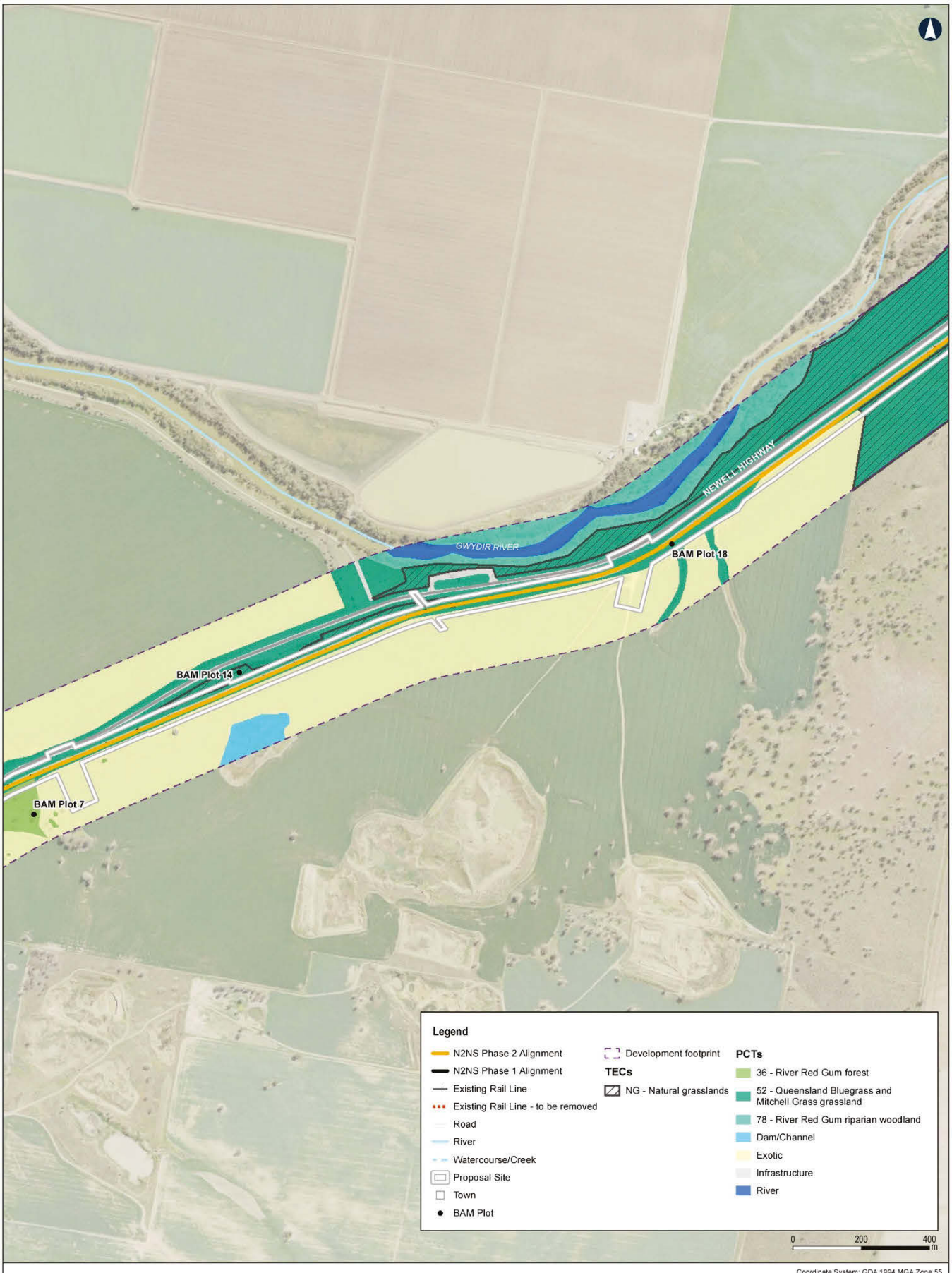

Figure 10-2 PCTs and TECs within the development footprint

Data Sources: ARTC, IRDJV, LPI

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Date: 9/22/2021
Map 3 of 5

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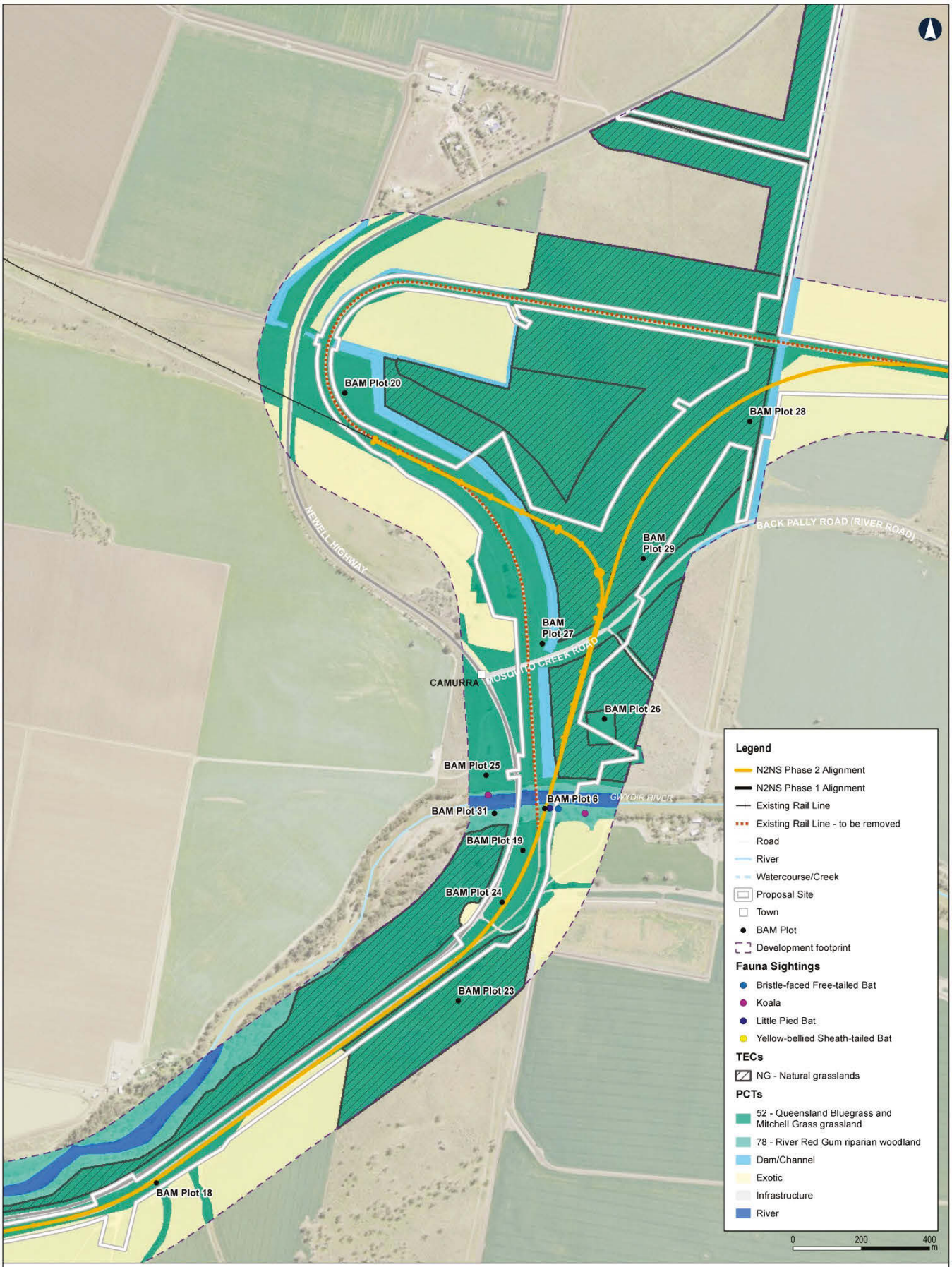

Figure 10-2 PCTs and TECs within the development footprint

Data Sources: ARTC, IRDJV, LPI

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:10,000
Paper size: A3
Date: 9/22/2021
Map 4 of 5

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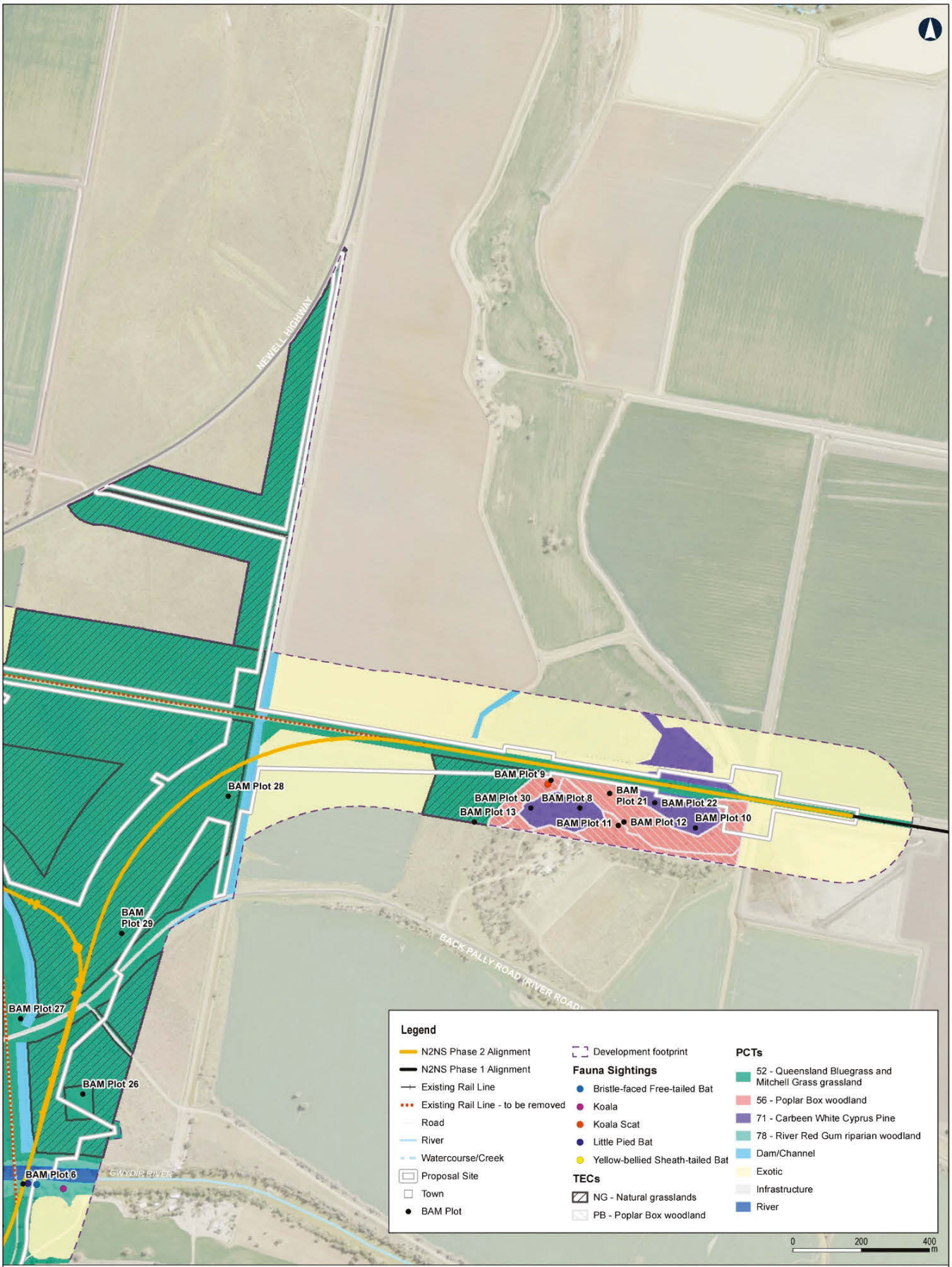

Figure 10-2 PCTs and TECs within the development footprint

Data Sources: ARTC, IRDJV, LPI

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:10,000
Paper size: A3
Date: 9/22/2021
Map 5 of 5

N3NS_SP2_EIS_F10_02_PCTandTECs_r2v2.mxd

10.3.4 Vegetation zones

Previous vegetation mapping, collection of rapid assessment points, and detailed floristic plots have been used to define vegetation zones. seventy-two Vegetation Integrity Plots (VIPs) were undertaken during the field surveys. All zones were entered into the BAM-C to generate vegetation integrity scores as well as the relevant ecosystem and species credit species requiring assessment/generating offset requirements.

Field surveys undertaken in December 2019 were completed during drought conditions. The drought conditions may have reduced the abundance and cover of forbs and grasses. The drought conditions presented difficult conditions for confirmation of many groundcover species, where they were present, with little or no floristic features or material evident for confident identification. Although abundance of native species may have been affected in some instances, native cover was generally lower than average. Canopy species were largely unaffected by the drought conditions, and common, more readily identifiable shrub and groundcover species were evident. The condition of PCTs despite the drought conditions, in conjunction with previous studies and surveys conducted by Umwelt in 2016, were considered to have a h10.igh confidence and considered adequate.

In order to more accurately assess the receiving environment, the BAM VIP plots within the subject land were resurveyed in 2022. Forty VIP plots were undertaken during the field surveys in February 2022.

Mapped PCTs were separated into management zones, which comprise areas of the same PCT, which have similar structure, condition or functional characteristics such as woodlands and grasslands, or exotic-dominated or native-dominated forms of a PCT. VIPs were undertaken within these management zones to provide an average of vegetation condition across the zone. Values within the plots were compared with 'benchmark' values for PCTs, which is the 'ideal' condition that a fully functional PCT could be. Vegetation Integrity Scores (VIS) were calculated based on a proportion of the ideal condition to give an indication of vegetation quality. The results of the assessment are provided in Table 10-3.

TABLE 10-3 CURRENT VEGETATION INTEGRITY SCORES FOR EACH VEGETATION ZONE WITHIN THE SUBJECT LAND

Zone ID	PCT / Zone	Composition score	Structure score	Function score	Vegetation Integrity Score
N1	27 Moderate	72.9	99.9	44	68.4
N2	27 Low	20.8	71	19.3	30.5
N2A	27 Very Low	70.5	87.1	0.1	8.5
N3	36 Moderate	47.7	50.9	54.9	51.1
N4	36 Low	68.5	67.8	20	45.3
N5	36 Moderate (FV)	65.6	51.7	30.6	47
N6	36 Low (FV)	89.5	42.2	5.6	27.6
N7	52 High	75.9	84.3	–	80
N7A	52 Moderate	58.9	73.7	–	65.9
N8	52 Low	72	13.3	–	30.9
N9	56 Moderate	61.1	64	24.1	45.5
N10	71 Moderate	61	42.9	25.8	55.2
C1	52 High (Mimosa)	94.9	100	–	97.4
C1A	52 Moderate (Mimosa)	76.6	92.2	–	84
C2	52 High	97.8	100	–	98.9
C3	52 Moderate	95.1	100	–	97.5
C4	52 Low	49.3	93.4	–	67.8
C5	78 Moderate	38.4	62.3	83.4	58.4
C6	78 Low	13.5	62.5	26.9	28.3

10.3.5 Ecosystem credit species

The ecosystem credit species associated with the zones in Table 10-3 are assumed to occur on the subject land and contribute to ecosystem credits. Numerous ecosystem credit species were observed or detected within the subject land during field surveys. These include:

- Grey-headed flying-fox (*Pteropus poliocephalus)*
- Koala (*Phascolarctos cinereus*)
- Little Pied Bat (*Chalinolobus picatus*)

- Yellow-bellied Sheath-tail bat (*Saccolaimus flaviventris)*
- Inland Forest Bat (*Vespadelus baverstocki*)
- Little Lorikeet (*Glossopsitta pusilla*).

The Inland Forest Bat and Little Lorikeet records are unique as they occur at their most eastern and western distributions, respectively. These species were not predicted by the BAM-C, but as they were recorded onsite during surveys, they have been manually added into the assessment. All other species are assumed to occur within the subject land on occasion. No ecosystem species were excluded from the assessment.

10.3.6 Species credit species

The BAM-C uses geographic, vegetation and habitat data to generate a list of threatened species with the potential to occur in an area. These species are referred to by the BAM as 'candidate species credit species'. The BAM-C predicted 28 species credit species with a moderate or higher likelihood of occurrence within the subject land.

Under Section 6.4.1.17 of the BAM, a candidate species credit species can be considered unlikely to occur on a subject land (or within specific vegetation zones) if, following field assessment, it is determined that the habitat is substantially degraded such that the species is unlikely to use the subject land (or specific vegetation zones). Slender darling pea was excluded on this basis. No species credit species have been either included or excluded from the assessment based on lack of habitat features or geographic limitations.

The following candidate species were recorded during targeted survey effort:

- Koala (*Phascolarctos cinereus*)
- Bristle-faced Free-tailed Bat (*Setirostris eleryi)*
- Creeping Tick-trefoil (*Desmodium campylocaulon*)
- Finger Panic Grass (*Digitaria porrecta).*

Candidate species returned for this proposal by the BAM and requiring survey are set out in Table 10-4. The right-hand column summarises the results of the targeted field surveys.

TABLE 10-4 CANDIDATE SPECIES CREDIT SPECIES RETURNED FOR THIS PROPOSAL

Species Credit Species	NSW Listing Status	National listing status	Presence at site
Fauna			
Ardeotis australis Australian bustard	Endangered	Not listed	Not recorded during surveys.
Burhinus grallarius Bush stone-curlew	Endangered	Not listed	Not recorded during surveys.
Calyptorhynchus banksii samueli Red-tailed Black-Cockatoo (Inland Sub-species) (Breeding)	Vulnerable	Not Listed	Survey not undertaken. To be surveyed in 2022.
Calyptorhynchus lathami Glossy black cockatoo (breeding)	Vulnerable	Not listed	Not recorded during surveys.
Haliaeetus leucogaster White-bellied sea-eagle (breeding)	Vulnerable	Not listed	Not recorded during surveys.
Hieraaetus morphnoides Little eagle (Breeding)	Vulnerable	Not listed	Not recorded during surveys.
Hamirostra melanosternon Black-breasted Buzzard (Breeding)	Vulnerable	Not listed	Survey not undertaken. To be surveyed in 2022.
Hoplocephalus bitorquatus Pale-headed snake	Vulnerable	Not listed	Not recorded during surveys.
Lophoictinia isura Square-tailed kite (Breeding)	Vulnerable	Not listed	Not recorded during surveys.
Lophochroa leadbeateri Major Mitchell's Cockatoo (Breeding)	Vulnerable	Not listed	Survey not undertaken. To be surveyed in 2022.

Species Credit Species	NSW Listing Status	National listing status	Presence at site
Ninox connivens Barking owl (Breeding)	Vulnerable	Not listed	Not recorded during surveys.
Phascolarctos cinereus Koala	Vulnerable	Vulnerable	Yes. Recorded during surveys; 12.5 ha of habitat.
Polytelis swainsonii Superb Parrot (Breeding)	Vulnerable	Vulnerable	Survey not undertaken. To be surveyed in 2022.
Pteropus poliocephalus Grey-headed flying-fox	Vulnerable	Vulnerable	No. Species recorded foraging during surveys but no breeding camps within the subject land.
Setirostris eleryi Bristle-faced free-tailed bat	Endangered	Not listed	Yes. Associated vegetation within 500 m of waterbodies.
Tyto novaehollandiae Masked Owl (Breeding)	Vulnerable	Not listed	Survey not undertaken. To be surveyed in 2022.
Flora			
Dichanthium setosum Bluegrass	Vulnerable	Vulnerable	No. Not recorded during surveys.
Cyperus conicus Cyperus conicus	Endangered	Not listed	No. Not recorded during surveys.
Desmodium campylocaulon Creeping tick-trefoil	Endangered	Not listed	Yes. Recorded during surveys. 30 m buffer of locations; 0.84 ha in 52 Mimosa.
Digitaria porrecta Finger panic grass	Endangered	Not listed	Yes. Recorded during surveys. 30 m buffer of locations; 0.28 ha in 52 Mimosa.
Homopholis belsonii Belson's panic	Endangered	Vulnerable	No. Not recorded during surveys.
Lepidium aschersonii Spiny peppercress	Vulnerable	Vulnerable	No. Not recorded during surveys.
Polygala linariifolia Native milkwort	Endangered	Not listed	No. Not recorded during surveys.
Swainsona murrayana Slender darling pea	Vulnerable	Vulnerable	No. Habitat degraded such that the species is unlikely to occur.
Lepidium monoplocoides Winged Peppercress	Endangered	Endangered	Survey not undertaken. To be surveyed in 2022.
Platyzoma microphyllum Braid Fern	Endangered	Not listed	Survey not undertaken. To be surveyed in 2022.

10.3.7 Matters of National Environmental Significance

The BAM assessment included assessment of entities listed under the EPBC Act. A protected matters report was undertaken on the 20 October 2019 (10 km buffer of the subject land) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the subject land. Table 10-5 lists those relevant to biodiversity.

TABLE 10-5 CANDIDATE SPECIES CREDIT SPECIES RETURNED FOR THIS PROPOSAL

Category	NSW Listing Status
Wetlands of International Importance (Ramsar)	Four Wetlands of International Importance were identified from the protected matters report. The nearest of these (30 to 40 km downstream) is the Gwydir Wetland: Gingham and lower Gwydir (big leather) watercourses. The Gwydir Wetland would interact with the Gwydir River and Mehi River, which intersect or are proximal to the subject land. All other wetlands returned from the search are over 900 km away.
TECs	Five TECs were identified from the protected matters report. Three of these TECs were confirmed as present within the subject land: ▸ Weeping Myall Woodlands (Endangered) ▸ Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland (Critically Endangered) ▸ Poplar Box Grassy Woodland on Alluvial Plains (Endangered).
Threatened species	Threatened species—excluding marine species, 16 threatened species encompassing seven birds, one fish, three mammals, four plants, and one reptile were identified from the protected matters report. Of these, six are considered to have the potential to utilise the habitats at the subject land: ▸ Belson's Panic (*Homopholis belsonii)*—Vulnerable ▸ Painted Honeyeater (*Grantiella picta)*—Vulnerable ▸ Koala (*Phascolarctos cinereus)*—Vulnerable (recorded) ▸ Grey-headed Flying-fox (*Pteropus poliocephalus)*—Vulnerable (recorded) ▸ Murray cod (*Maccullochella peelii)*—Vulnerable ▸ Five-clawed Worm-skink (*Anomalopus mackayi)*—Vulnerable. Following field survey and associated updates to the BAM-C in 2022, three (3) additional threatened species listed under the EPBC Act were identified as having the potential to utilise the habitats at the subject land: ▸ Superb Parrot (*Polytelis swainsonii*)—Vulnerable ▸ Winged Peppercress (*Lepidium monoplocoides*)—Endangered ▸ Corben's Long-eared Bat (*Nyctophilus corbeni*)—Vulnerable Freshwater Ecology completed surveys for EPBC aquatic species likely to occur within the subject land in accordance with Survey Guidelines for Australia's Threatened Fish. The survey effort recorded the following species: ▸ Murray Cod (*Maccullochella peelii*)—Vulnerable.
Migratory species	Migratory species—excluding marine species, eight migratory species were identified from the protected matters report. Of these, one is considered to have the potential to utilise the habitats and was observed within the subject land: ▸ Satin Flycatcher (*Myiagra cyanoleuca*).

General assessment requirements were provided by DAWE regarding the assessment of MNES, and these are included in the BDAR.

10.3.8 Weeds

Much of the subject land is comprised of non-native vegetation. Large cropping areas were found to be already cleared or fallowed during the surveys, with persistent drought conditions limiting cropping opportunities. Traditionally, cotton and wheat production dominate the land use within the subject land and broader region. Much of the more natural areas consist of the naturalised Mimosa, as well as exotic flora, such as such as African Boxthorn (*Lycium ferocissimum*), Tiger Pear (*Opuntia aurantiaca*) and environmental weeds such as such as Cathead (*Tribulus terrestris*), Johnson Grass (*Sorghum halepense*) and Buffalo Grass (*Cenchrus ciliaris*) also occur commonly. Of particular note, species such as Sabi Grass (*Urochloa mosambicensis*) and Green Panic (*Megathyrsus maximus*) were observed and are potentially a key emerging weed and biosecurity threat in the North West NSW region.

10.3.9 Aquatic ecology

Four rivers and streams within the subject land are listed as areas of high biodiversity value under the Biodiversity Conservation Regulation 2017 (BC Regulation)—Mehi River, Gwydir River, Duffy's Creek and Skinners Creek. The two major rivers, the Mehi and Gwydir rivers, are both seventh-order rivers, and although impacted by exotic flora, these contain important habitat features and are identified as Class 1 fish habitat and type 1 highly sensitive environments. These sensitive aquatic ecosystems and key fish habitat would be subjected to temporary construction impacts.

In addition to this, a further five ephemeral tributaries, excluding irrigation channels, are within the subject land. The majority of watercourses along the existing rail line are first, second and third order ephemeral streams that contain intermittent flow following rain events, with little or poorly defined channels and minimal aquatic flora species. The watercourses and rivers have been modified by crossing structures for rail, road and agricultural land practices, and are all subject to a moderate to high abundance of exotic flora and environmental weeds.

10.4 Impact assessment

10.4.1 How potential impacts have been avoided

ARTC has commissioned a range of studies to guide the site selection for the proposal. The existing single bi-directional track was originally constructed for light traffic running a variety of freight, grain and passenger trains. Alternatives would be to construct a new rail line in its entirety, but this would be detrimental in regard to socio-economic and environmental aspects.

The current proposal incorporates an upgrade of the existing rail line to accommodate the Inland Rail requirements for a 30-tonne axle load structural loading and improved flood immunity. Where practicable, the design of the proposal has been sited within the existing rail corridor with a commitment to upgrading the existing rail line. As a result, the overall development footprint of the proposal would be reduced through use of the existing corridor that is regularly subject to disturbances relating to the rail network and the surrounding agricultural activities.

Additionally, it is proposed as far as practicable to house laydown areas, construction compounds and other ancillary facilities in areas containing wholly exotic flora (Category 1—Exempt Land) or where impacts to biodiversity would be considered negligible. However, due do the overall objectives of the proposal, additional sections of rail are required to be established to improve safety, efficiencies and associated flood management works.

10.4.2 Risk assessment

An environmental risk assessment for the proposal is included in Appendix C and includes potential risks to biodiversity. Risks to biodiversity with an assessed risk of medium or higher were:

- potential increase of threatening processes (weed and pest distribution) due to increased vehicle and plant movements
- disruption to fauna connectivity during bridge and culvert construction
- impacts on endangered populations and threatened species during construction and operation
- removal of breeding places/habitat features (hollow bearing trees)
- impacts to aquatic species species-specific aquatic habitats around watercourses
- impacts to riparian vegetation
- increase of threatening processes (weed and pest distribution) due to increased train movements
- increase in bushfire risk due to operational maintenance.

10.4.3 Direct impacts

Direct impacts, such as displacement of resident fauna, injury or death of fauna and disruption to connectivity, are existing impacts due to the existing rail line; however, the operational phase of the proposal has the potential to increase these impacts.

The construction and operation of the proposal has the potential to impact biodiversity values at the site that cannot be avoided resulting in direct impacts, as set out in Table 10-6.

TABLE 10-6 POTENTIAL DIRECT IMPACTS OF THE PROPOSAL TO BIODIVERSITY

Nature of impact	Extent	Duration and timing	Consequence
Habitat clearing for permanent and temporary construction facilities (e.g., new rail line, replacement bridges, upgraded crossings, ancillary facilities)	99.71 ha containing native vegetation in various condition states, with 37.79 ha in the Northern Outwash subregion and 61.92 ha in the Castlereagh-Barwon Subregion. 43.31 ha of non-native vegetation with 27.59 ha occurring in the Northern Outwash Subregion and 15.73 ha in the Castlereagh-Barwon Subregion.	Construction phase: long term	▸ Direct loss of native flora and fauna habitat ▸ Potential over-clearing of habitat outside proposed development footprint ▸ Injury and mortality of fauna during clearing of fauna habitat and habitat trees ▸ Disturbance to stags, fallen timber, and bush rock.
Displacement of resident fauna	Unknown	Construction phase: long term	▸ Direct displacement of native fauna ▸ Potential decline in local fauna populations.
Injury or death of fauna	Unknown	Construction and operational phase: long term	▸ Direct loss of native fauna ▸ Decline in local fauna populations.
Disruption to connectivity	Unknown	Construction and operational phase: long term	▸ Direct loss of native fauna habitat ▸ Reduction in ability for fauna to move across the landscape.
Removal of habitat features, e.g., hollow bearing trees (HBTs)	35 HBTs removed out of 94 recorded (~37%) Removal of 1 scattered paddock tree	Construction: long term	▸ Direct loss of native fauna habitat ▸ Injury and mortality of fauna during clearing of habitat features.
Work in waterways	Approximately 1 ha of aquatic habitat	Construction	▸ Direct loss of riparian habitat ▸ Temporary disturbance of aquatic habitat.

10.4.4 Indirect impacts

Indirect impacts to biodiversity are those impacts that are not a direct result of the construction or operation of the proposal and are either removed from the location of the proposal or are produced as a secondary result of the initial direct impacts. Indirect impacts that contribute to key threatening processes from the proposal include soil and water contamination, invasion of key emerging weeds, introduction of pests, creation of barriers to fauna movement, or the generation of excessive dust, light or noise. The indirect impacts due to the proposal are set out in Table 10-7.

TABLE 10-7 POTENTIAL INDIRECT IMPACTS OF THE PROPOSAL TO BIODIVERSITY

Nature of impact	Extent	Duration and timing	Consequence
Inadvertent impacts on adjacent habitat or vegetation	Unknown	Construction	▸ Direct loss of native flora and fauna habitat ▸ Potential for injury and mortality of fauna during clearing of fauna habitat and habitat trees ▸ Disturbance to stags, fallen timber, and small bush rock ▸ Increased edge effects. The combined impacts are likely to be minor in nature, if they occur at all, and would result in a negligible consequence for bioregional persistence
Reduced viability of adjacent habitat due to edge effects	Unknown	Operation	▸ Degradation of TECs ▸ Loss of native flora and fauna habitat. The combined impacts are likely to be minor in nature, if they occur at all, and would result in a negligible consequence for bioregional persistence.

Nature of impact	Extent	Duration and timing	Consequence
Reduced viability of adjacent habitat due to noise, dust or light spill	Unknown	Operation	▸ May alter fauna activities and/or movements ▸ Minor loss of foraging or breeding habitat. The combined impacts are likely to be minor in nature, if they occur at all, and would result in a negligible consequence for bioregional persistence.
Transport of weeds and pathogens from the site to adjacent vegetation	Unknown	Construction & operation	▸ Further degradation of TECs and threatened species habitat through weed encroachment.
Increased risk of starvation, exposure and loss of shade or shelter	Unknown	Construction & operation	▸ Loss of foraging habitat.
Cumulative loss of breeding habitat and competition for remaining resources	35 HBTs	Construction	▸ Loss of potential breeding habitat, including fallen and hollow logs at height ▸ Loss of vegetation close to water ▸ Increased pressure and competition from cumulative loss for HBTs resources from native and exotic hollow-dependent fauna.
Rubbish dumping	Unknown	Construction & operation	▸ Further degradation of TECs and threatened species habitat.
Increase in predatory species populations	Unknown	Construction & operation	▸ Further degradation of TECs and threatened species habitat.
Increase in pest animal populations inclusive of Cane toad movement	Unknown	Construction & operation	▸ Further degradation of TECs and threatened species habitat ▸ Inadvertent movement of Cane toads from Queensland into the region via more frequent train services.
Earthworks and mobilisation of sediments	Unknown	Construction	▸ Erosion and sedimentation and/or pollution of soils, dams and downstream habitats ▸ Potential loss of ground cover resulting in unstable ground surfaces and sedimentation of adjacent waterways.
Increased risk of fire	Unknown	Operation	▸ Slight increase in the unlikely event of component failure or damage causing a bushfire, resulting in biodiversity impacts.

10.4.5 Prescribed impacts

Prescribed biodiversity impacts, and the development of mitigation measures of the proposal have been considered:

- impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- impacts of development on the connectivity on movement of threatened species that maintains their life cycle
- impacts of development on the habitat of threatened species or ecological communities associated with human made structures
- impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- impacts of vehicle strikes on threatened species or on animals that are part of a TEC
- impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.

10.4.6 Serious and irreversible impacts

There are no serious and irreversible impact (SAII) candidate TECs recorded at the proposal site.

10.4.7 Impacts that are uncertain

Impacts to biodiversity values, such as the removal of foraging habitat or HBTs, are readily quantifiable; however, the level of impact resulting from vehicle and train strikes as well as introduction of movement of Cane toads (*Bufo marinus*) into the areas are uncertain. As per Section 9.4.2.4 of the BAM, an adaptive management plan would be prepared to manage these impacts. The components of this plan are detailed in section 8.2 of the BDAR.

10.4.8 Key Threatening Processes

A summary of the relevant Key Threatening Processes (KTP) listed under the BC Act, EPBC Act and FM Act is shown in Table 10-8.

TABLE 10-8 RELEVANT KEY THREATENING PROCESSES AND REQUIREMENTS UNDER THE LEGISLATION

Key threatening process	Listing	Relevance
Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	BC Act	Mitigation would be implemented to reduce these impacts.
Anthropogenic climate change	BC Act, FM Act and EPBC Act	The construction of the proposal would contribute towards anthropogenic climate change through the emission of greenhouse gases and clearing of native vegetation. This would be mitigated by offsets and improved gain in biodiversity values within the offset areas. Once operational, the Inland Rail Program is predicted to reduce current carbon emissions by 750,000 tonnes per year, as a result of transferring road freight to rail.
Bushrock removal	BC Act	Bushrock may be required to be removed during construction but would be placed within areas of adjacent habitat were practicable to do so.
Clearing of native vegetation	BC Act and EPBC Act	Clearing of native vegetation would occur for the proposal. This would be mitigated by offsets and improved gain in biodiversity values within the offset areas.
Infection of amphibians with cyrtid fungus resulting in chytridiomycosis	EPBC Act	Mitigation would be implemented to reduce these impacts.
Invasion and establishment of the Cane toad	BC Act and EPBC Act	Mitigation would be implemented to reduce these impacts.
Invasion of native plant communities by exotic perennial grasses	BC Act	Mitigation would be implemented to reduce these impacts.
Loss of HBTs	BC Act	Up to 35 HBTs may be removed by the proposal. This would be mitigated by offsets and improved gain in biodiversity values within the offset areas.
Degradation of native riparian vegetation along NSW water courses	FM Act	Mitigation would be implemented to reduce these impacts.
Removal of dead wood and dead trees	BC Act and FM Act	Mitigation would be implemented to reduce these impacts.

10.4.9 Fisheries Management Act impacts

Potential impacts to aquatic habitat and riparian vegetation include:

- removal of riparian vegetation, instream vegetation and woody debris
- potential increase in localised turbidity during construction
- potential impacts associated with spills.

Construction would include the removal of existing concrete piles as part of the bridge demolition, installation of new crossing structures (including placing piles in the waterway) and clearing of adjoining riparian vegetation. This may cause significant impacts to key fish habitat in a small, localised area.

Impacts may include loss of riparian vegetation, localised turbidity and associated spills. Mitigation measures provided in section 10.5 would be implemented to ensure risks are managed to minimise adverse impacts so far as practicable.

Tests of significance for the Lower Darling River endangered ecological community (EEC), Eel-tailed Catfish (*Tandanus tandanus*), Olive Perchlet (*Ambassis agassizii*) and Silver Perch (*Bidyanus bidyanus*) in accordance with the FM Act concluded that a significant impact is unlikely. Further information on these assessments is provided in the BDAR.

10.4.10 EPBC Act impacts

The BDAR includes an assessment of EPBC Act listed entities. An evaluation was undertaken for species predicted to occur within the broader study locality (10 km radius). An EPBC Act Assessment of Significance was completed for each entity with a moderate to high likelihood of presence within the subject land, addressing the nine criteria under the Act. Additionally, the EPBC Act *Referral Guidelines for the Vulnerable Koala* (DoE, 2014) were addressed.

Three EPBC-listed species were recorded during the field surveys, the Murray cod, Koala and Grey-headed flying-fox. A summary of the key impacts to these species, as determined by the significance assessment detailed in full in Appendix H of Technical paper 1: Biodiversity development assessment report, follows:

- Murray cod: due to the nature of the development and the current understanding of development actions and plans, it is unlikely that the development would significantly impact the Gwydir River population of Murray cod.
- Koala: disturbance or removal of 23% of potential Koala habitat in the subject land has the possibility to impact an important population of this species. Given that this habitat has been assessed as constituting habitat critical to the Koala, a significant impact is possible.
- Grey-headed flying-fox: the habitat to be removed as part of this proposal is not of critical importance to the Grey-headed Flying-fox. Although vegetation may be used for seasonal foraging, roosting sites or breeding camp would not be directly impacted. The likelihood of a roosting site or breeding camp being established within the subject land is unlikely and increases in likelihood further away from the existing rail and highway. The proposed action is not considered likely to have a significant impact.

The following species and ecological communities were considered to have potential to occur due to the presence of suitable habitat within the subject land and may be impacted:

- Belson's Panic (*Homopholis belsonii*)
- Painted Honeyeater (*Grantiella picta*)
- Five-clawed Worm-skink (*Anomalopus mackayi*)
- Superb Parrot (*Polytelis swainsonii*)
- Corben's Long-Eared Bat (*Nyctophilus corbeni*)
- Winged Peppercress (*Lepidium monoplocoides*)
- Satin Flycatcher (*Myiagra cyanoleuca*) (Migratory Species)
- Grey Falcon (*Falco hypoleucos*)
- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered)
- Poplar Box Grassy Woodland on Alluvial Plains (Endangered)
- Weeping Myall Woodlands (Endangered).

An EPBC Act assessment of significance was also completed for each of above-mentioned species and is detailed in Appendix H of Technical paper 1: Biodiversity development assessment report.

Based on this assessment, an EPBC referral was undertaken for the Koala, Murray cod and Five-claw worm skink, due to unknown impacts or a perceived significant impact. A significant impact for the remaining species was not considered likely. A referral decision has determined that the proposal constitutes a controlled action and impacts to EPBC-listed entities are to be assessed under the bilateral agreement with NSW.

10.5 Mitigation and management

10.5.1 Key strategies

Mitigation measures proposed to manage impacts, including proposed techniques, are outlined below. Responsibility for implementing each measure, timing, frequency, risk of failure, and an analysis of the consequences of any residual impacts are provided in detail in the BDAR and summarised in the following key strategies:

- habitat clearing for permanent and temporary construction facilities (e.g. new rail line, replacement bridges, upgraded crossings, ancillary facilities):
  - time works to avoid critical life cycle events where practicable, including but not limited to:
    - all practical measures would be taken to avoid removal of HBTs and important habitat features during breeding and hibernation season (June to January) to mitigate impacts
    - detailed/staged pre-clearing surveys would be undertaken by a suitably qualified person to check hollows and usage, to prevent any adverse impacts to fauna
  - implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, with the presence of a trained ecological or wildlife handler
  - clearing extents/site boundary/limit of works would be consistent with the proposal extents and clearly defined with flagging or marking tape, with signage or other suitable means to delineate no go areas
- chainsaw hollows and/or nest boxes would be provided to mitigate hollow bearing tree removal displacement of resident fauna:
  - undertake staged clearing, with the presence of a trained ecological or wildlife handler
  - all hollows, fissures, logs and rocks to be checked by ecologist/spotter catcher post felling or impacts, and any fauna present caught and safely housed in a well- ventilated area. Habitat features to be moved to allow all hollows to be inspected
  - rehabilitate vegetation to increase habitat availability
  - include aquatic fauna salvage of work areas
  - records to be kept of number of hollows, number and species of individuals captured, and outcome of capture to incorporate into monthly environmental reporting
- injury or death of fauna:
  - time works to avoid critical life cycle events, where practicable
  - undertake staged clearing, with the presence of a trained ecological or wildlife handler
  - injured fauna to be euthanised on site by a suitably experienced ecologist in accordance with OEH Code of Practice for Injured, Sick and Orphaned Protected Fauna if severely injured, or taken to vet or wildlife carer for assessment
- disruption to connectivity:
  - implement rehabilitation in areas of retained vegetation to enhance connectivity
  - vegetation clearing to be limited to the minimum necessary to construct the proposal and allow for effective operation
  - disturbance to be minimised to avoid impacts to native vegetation and habitats as far as practicable
  - implement fauna connectivity structures
  - implement a detailed design to minimise the potential for impacts to fish passage
  - in areas of high vegetative connectivity, include installation of fauna fencing (to RMS specifications) to exclude fauna from entering rail corridor, with inclusion of fauna escape devices to allow any fauna within corridor to escape. This may include earthen ramps and/or escape poles from within the corridor
  - topsoil stockpiles would be a maximum of 2.5 m in height to avoid heat sterilisation of seed bank
- removal of habitat features, e.g. HBTs:
  - where possible, relocate habitat features (fallen timber, hollow logs) from within the subject land to an adjacent area
  - habitat features to be clearly marked and flagged with a highly visible colour “H” on all sides of feature
  - exclusion of caves and structures that are inhabited by microbat species where possible
- indirect impacts:
  - implement clearing protocols that identify vegetation to be retained, prevent inadvertent damage, and reduce soil disturbance; disturbance, e.g. removal of native vegetation by hand-held chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed
  - implement adaptive dust monitoring programs to control air quality
  - implement measures to avoid noise encroachment on adjacent habitats such as avoiding night works as much as practicable

- implement measures to avoid light spill such as avoiding night works and directly light away from vegetation as practicable
- erect temporary fencing to protect significant environmental features and threatened species habitat such as riparian zones
- implement hygiene protocols to prevent the spread of weeds (key emerging and priority weeds) or pathogens between infected areas and uninfected areas
- employ staff training and site briefing to communicate environmental features to be protected and measures to be implemented
- management and control of pest animal populations inclusive of Cane toad movement
- pesticide and herbicide use, documentation and limitations on use i.e., not used in sensitive environmental areas, drainage lines that flow to waterways and aquatic habitats, broadscale use does not result in an increased erosion and sediment risk
- no stockpiling or storage within dripline of any mature trees
- construction areas including compounds, stockpiles, fuel storage areas, laydown areas and staff parking would be located and established outside the tree protection zone as defined in AS4970-2009 Protection of trees on development sites (Standards Australia, 2009)

- prescribed impacts:
  - placement of sediment barriers and spill management protocols to control the quality of water runoff from the site into the receiving environment
  - enforce speed limits, restrict dawn and dusk driving and install signage during construction to reduce impacts of vehicle strikes on threatened and other fauna
  - implement monitoring of train strike rates, and fence hotspots
  - protect via clearly surveying and marking (flagging) environmental no-go areas during construction to prevent clearing within unauthorised areas and where threatened species habitat occurs
  - erect fencing to deter Koala from entering the subject land during construction, and rail corridor in areas of suitable habitat
  - security fencing to be used in township areas to incorporate measures to prevent entanglement of flying foxes/gliders where there is adjacent vegetation
  - use of non-barbed wire fencing for permanent fencing where practicable
  - installation of artificial connectivity measures to allow traversal of species such as Koala between areas of habitat surrounding the subject land post construction
  - staff training and site briefing to communicate environmental features to be protected and measures to be implemented. Regular toolbox meetings and commencement meetings to be held with relevant ecologist prior to clearing
- impacts to aquatic fauna and their habitat:
  - construction methods and temporary accesses that do not block fish passage
  - consider installation of alternative watercourse structures to allow fish passage
  - include aquatic fauna salvage of work areas
  - works within the riparian zone would minimise vegetation disturbance as far as practical. Where riparian vegetation is removed, revegetation of disturbed riparian areas would be undertaken using local native species and would include native in-stream macrophytes suited to the ephemeral nature of the watercourses where applicable
  - any large debris (snags) would be salvaged and relocated upstream or downstream
- ancillary facilities associated with replacement or upgrading of infrastructure to be sited in areas already subject to disturbance, or within areas dominated by exotic flora, limiting impacts to riparian vegetation.

10.5.2 Adaptive management strategy

Adaptive management during construction and operation will be receptive to any new and relevant data that may arise through ongoing assessment and monitoring and is key to the successful implementation of the relevant management plans. This will allow ongoing flexibility to manage objectives and allow for relevant feedback and modifications. Construction management plans will contain management plans for flora and fauna, which will have an adaptive management component. This includes measures to monitor predicted impacts of vehicle/train strikes, thresholds for species mortality, based on relevant literature, which will trigger adaptive management actions, and any measures proposed to mitigate potential impacts.

A flora and fauna management plan (FFMP) would be implemented demonstrating adaptive management strategies to ensure key milestones are achieved, including:

- fauna monitoring and management protocol, including identification and reporting of fauna mortalities to the relevant Biodiversity Conservation Division office
- protecting vegetation and fauna habitat outside the approved disturbance areas and managing the remaining remnant vegetation and fauna habitat within the proposal toward a benchmark state
- ensuring no increase in baseline data of key emerging weeds or invasive pests (i.e. Cane toads)
- nest box monitoring and reporting
- monitoring criteria
- clear performance targets
- corrective actions
- timing and responsibilities.

A recommended outline of the FFMP is provided below with further details demonstrated within the mitigation measures listed in Table 10-11:

- introduction:
  - purpose and objectives
  - description of the proposal
- planning requirements
- existing environments:
  - flora and fauna values
  - soils
  - weeds and pests (i.e., key emerging weeds and priority weed, cane toads)
- environmental impacts
- construction and operational activities
- management zones:
  - protocols, actions, and procedures
  - performance criteria, triggers, and responses
  - compliance management
  - review and improvement.

10.5.3 Requirements for offsetting

10.5.3.1 NSW BAM offset requirement

The ecosystem credit requirement has been summarised in Table 10-9 and species credit requirement summarised in Table 10-10.

TABLE 10-9 ECOSYSTEM CREDITS REQUIRED

PCT	Scattered paddock trees	Threatened Ecological Community	Area	Credits generated
Northern Outwash IBRA subregion				
PCT 27 Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	–	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray–Darling Depression, Riverina and NSW South Western Slopes bioregion (Endangered).	7.15	116
PCT 35 River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	–	–	0.36	3
PCT 36 River red gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	–	–	11.99	166
PCT 52 Queensland bluegrass +/- Mitchell grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	–	Natural grasslands on Basalt and fine-textured Alluvial Plains of Northern NSW and Southern Queensland and the natural grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin (Critically Endangered).	16.88	263
PCT 56 Poplar box–Belah woodland on clay-loam soils on alluvial plains of north-central NSW	–	Poplar box grassy woodland on Alluvial Plains (Endangered).	0.64	10
PCT 71 Carbeen–White cypress pine–River red gum–Bloodwood tall woodland on sandy loam alluvial and eolian soils in the northern Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	–	Carbeen open forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions— New England Tablelands.	0.77	16
Castlereagh Barwon IBRA subregion				
PCT 52 Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion			60.88	2,844
PCT 78 River red gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	–	–	1.04	26
Subtotal (Northern Outwash IBRA subregion)				574
Subtotal (Castlereagh Barwon IBRA subregion)				2,870
Total				**3,444**

TABLE 10-10 SPECIES CREDITS REQUIRED

Species	Area (ha)	Credits generated
Black-Breasted Buzzard	4.44	146
Braid Fern	1.04	44
Bristle-faced Free-tailed Bat	13.73	307
Creeping Tick-trefoil	Northern Outwash: 19.61 Castlereagh-Barwon: 49.22	445 2,358
Finger Panic Grass	Northern Outwash: 18.68 Castlereagh-Barwon: 49.22	422 2,358
Koala	Northern Outwash: 8.85 Castlereagh-Barwon: 0.72	195 21
Little Eagle	Northern Outwash: 21.17 Castlereagh-Barwon: 14.66	360 497
Major Mitchell's Cockatoo	10.73	477
Masked Owl	4.55	193
Red-tailed Black Cockatoo (Inland Sub-species)	5.81	257
Superb Parrot	4.55	193
Winged Peppercress	47.66	2,285
Subtotal (Northern Outwash IBRA subregion)		**1,729**
Subtotal (Castlereagh-Barwon IBRA subregion)		**8,829**
Total		**10,558**

The retirement of these credits would be carried out in accordance with the NSW Biodiversity Offsets Scheme (BOS) and would be achieved by:

- acquiring or retiring credits under the BOS
- making payments into the Biodiversity Conservation Fund using the offsets payment calculator
- funding a biodiversity action that benefits the threatened entities impacted by the development.

The full Biodiversity Credit Report generated by the BAM calculator is provided in the BDAR.

10.5.3.2 Offsets required under the EPBC Act

Assessment of Significance for the Koala, Five-clawed worm skink, Weeping Myall woodlands and Natural grasslands on basalt critically endangered ecological communities (CEECs), detailed in Appendix H of Technical paper 1: Biodiversity development assessment report, determined the potential for these species to be significantly impacted by the proposal.

The proposal has been determined by the Minister for the Environment to constitute a controlled action. 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* (DAWE, 2020) notes that where a project demonstrates compliance with an endorsed state or territory policy, the proponent would not be required to simultaneously comply with the corresponding Australian Government policy. As such, the requirement to settle an EPBC offset obligation would be undertaken in accordance with NSW offset rules where applicable to do so and consistent with the endorsed bilateral agreement. As the proposal would be approved under the EPBC Act after March 2020 offset obligations for EPBC listed species would be met in accordance with the NSW offset rules.

The following entities require offsetting for residual impacts, and would be offset through the generation of ecosystem credits associated with the following vegetation zones:

- Weeping Myall Open Woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion – N1 – PCT 27 Low, N2 – PCT 27 Moderate
- Poplar Box Woodland – N9 – PCT 56 Moderate
- Native Grasslands on basalt – N7 and C2 - PCT 52 High, C3 – PCT 52 Moderate, N8 and C4 – PCT 52 Low, C1 – PCT 52 High – Mimosa.

Impacts to two species, the Five-clawed Worm-skink and Koala have been generated through the use of the BAM–C. The Five-clawed Worm-skink has been included as an ecosystem credit associated with all vegetation zones impacted by the development, while species polygons have been generated for the Koala within the following vegetation zones:

- N2 – Low PCT 27 – Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion – 0.01 ha
- N5 – PCT 36 Moderate_FV and N6 – PCT 36 Low_FV - River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion – Floodplain Vegetation – 0.96 ha
- N3 – PCT 36 Moderate and N4 – PCT 36 Low – River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion – 7.8 ha
- C5 – PCT 78 Moderate and C6 – PCT 78 Low – River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion – Gwydir – 0.72 ha.

The Superb Parrot has been assumed to be present, impacts have been calculated in the BAM-C, and species polygons have been generated for the species within the following vegetation zones:

- C1 – PCT 52 High_Mimosa – Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (dominated by Mimosa) – 1.2 ha
- C3 – PCT 52 Moderate – Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion – 1.8 ha
- C4 – PCT 52 Low – Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion – 1.2 ha
- C5 – PCT 78 Moderate – River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion – 0.96 ha
- C6 – PCT 78 Low – River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion – 0.08 ha.

The Winged Peppercress has been assumed to be present, impacts have been calculated in the BAM-C, and species polygons have been generated for the species within the following vegetation zones:

- C1 – PCT 52 High_Mimosa – Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (dominated by Mimosa) – 30.5 ha
- C2 – PCT 52 High – Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion – 4.8 ha
- C3 – PCT 52 Moderate – Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion – 9.8 ha
- C4 – PCT 52 Low – Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion – 2.5 ha.

ARTC would manage the implementation of required offsets for the Inland Rail program. ARTC would investigate both existing and new Biodiversity Stewardship Sites, and potentially invite local landowners to establish Stewardship Sites on their private land, allowing ARTC to purchase the appropriate credits and offset biodiversity loss in the same region. Where credits are not available for purchase or cannot be obtained in other ways (e.g. through generation from an ARTC-owned 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. Biodiversity credits would be retired in accordance with the requirements of the BC Act as applicable to SSI projects.

10.5.4 Summary of mitigation measures

Mitigation measures to manage potential impacts to biodiversity would also be implemented as part of those identified for hydrology and flooding, water quality, soils and contamination, and air quality. A summary of mitigation measures relating to biodiversity assessment is provided in Table 10-11, and Chapter 27: Approach to environmental management.

TABLE 10-11 BIODIVERSITY—SUMMARY OF MITIGATION MEASURES

Ref	Impact	Mitigation measure	Timing
B-1	Flora and fauna management plan	A flora and fauna management plan (FFMP) 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: ▸ locations and requirements for pre-clearing surveys ▸ pre-clearing procedure and clearing protocol ▸ dedicated management actions for the Five-clawed Worm Skink which will be informed by the Species Management Plan which is under development by ARTC with DPE ▸ dedicated management actions for the Braid Fern in the form of a protective buffer between the development footprint and the remaining suitable habitat for the Braid Fern ▸ establishing protocols for the staged clearing of vegetation and safe tree felling and log removal to reduce the risk of fauna mortality ▸ survey for species in potential habitat to identify any additional populations ▸ where practicable, protection of native vegetation to be retained through mapping in sensitive area plans, and physical fencing through the use of star-pickets with high visibility flagging/bunting and environmental exclusion zone signage ▸ best practice removal and disposal of vegetation including separation and stockpiling of declared weeds, incorporation of recovered habitat features into revegetation, and identification of mulch stockpile locations and structure to avoid tannin leaching ▸ staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by a suitably trained fauna handler though the implementation of the clearing protocol ▸ weed management throughout the lifespan of the proposal to ensure that no increase to weed load occurs as a result of the works ▸ measures to avoid and minimise clearing of hollow-bearing trees where practicable ▸ a waterway crossing design ▸ 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 *Biosecurity Act 2015* ▸ measures to reduce the risk of aquatic fauna mortality/injury ▸ stop works arrangements in the immediate area of the threatened species ▸ protocols and procedures for the use of suitably qualified, licensed and experienced fauna handlers/spotter catchers ▸ notification and communication protocol ▸ adaptive management strategy.	Design and pre-construction

Ref	Impact	Mitigation measure	Timing
B-2	Riparian vegetation	▸ Compounds would be located more than 40 m away from riparian vegetation to avoid indirect impacts on aquatic habitat. ▸ Works within waterfront land (creek beds and land within 40 metres of the highest bank) would be programmed to ensure that they take place during dry periods (i.e. when the watercourses within the proposal site do not have water in them). ▸ Where it is not possible to work in the dry, a sediment or silt screen would be installed around the entire work area, attached to the same bank upstream and downstream of the work site so that it does not impede fish passage. Sediment or silt screens would be inspected daily and maintained to prevent the escape of suspended sediments. ▸ Temporary fencing or bunting to be erected along marked riparian zones and drainage lines to protect significant environmental features.	Design and pre-construction
B-3	Aquatic ecology/ fish passage	▸ Detailed design and construction planning would minimise the potential for impacts to fish passage. To ensure that fish passage is maintained, watercourse crossing structures would be designed in accordance with the guideline *Why do fish need to cross the road*? (Fairfull and Witheridge, 2003). ▸ Fish passage requirements for waterway crossings (Fairfull and Witheridge, 2003) and the minimum design requirements specified in Table 5.1 of Technical paper 2: Post-wet aquatic ecology assessment.	Design and pre-construction
B-4	Aquatic habitat	▸ The proposal would be designed to minimise impacts to waterways, riparian vegetation and in-stream flora and habitats including: ▸ adopt a crossing structure hierarchy: bridges preferred to culverts; however local conditions and constructability impacts would be considered when determining the preferred environmental solution ▸ aim to avoid, then minimise the extent of waterway diversions or realignments, including the re-instatement of large woody debris upstream or downstream of the area of impact ▸ Include aquatic fauna salvage of work areas ▸ Ancillary facilities associated with replacement or upgrading of infrastructure to be sited in areas already subject to disturbance, or within areas dominated by exotic flora, limiting impacts to riparian vegetation.	Design and pre-construction
B5	Vegetation and habitat clearing	▸ Prior to commencement of clearing, a detailed pre-clearing check of all areas of potential fauna habitat to be impacted undertaken ▸ Habitat features to include trees containing hollows and/or nests, logs, bushrock and burrows ▸ All habitat features to be clearly marked with >1m spray painted in a highly visual colour (i.e. pink) “H” on all sides of feature ▸ All features to be mapped using GPS or equivalent portable GIS software ▸ Each feature to be flagged with pink flagging tape, with unique identifying number written on tape ▸ Areas of potential Five-clawed Worm-skink habitat to be mapped ▸ Report to be prepared including detailed maps of habitat features, and locations to be incorporated into sensitive area plans Pre-construction.	Pre-construction

Ref	Impact	Mitigation measure	Timing
B-6	Vegetation and habitat clearing	▸ Vegetation clearing would be limited to the minimum necessary to construct the proposal and allow for its effective operation ▸ Disturbance would be minimised, to avoid impacts to native vegetation and habitats so far as practicable ▸ All practical measures would be taken to avoid removal of HBT during breeding and hibernation season (June to January) to mitigate impacts.	Pre-construction and construction
B-7	Vegetation and habitat clearing	▸ Scheduling of clearing activities would avoid breeding seasons as far as reasonably practical. Clearing activities would avoid winter months to avoid risk of injury to hibernating or torpid reptiles as far as reasonably practical. Where this is not practical and where breeding sites are identified within the corridor during pre-clearance surveys, a suitably qualified person would provide mitigation measures for exclusion zones/relocation requirements relevant to the specific species identified. Ideally, program clearing for late summer/early autumn.	Pre-construction and construction
B-8	Vegetation and habitat clearing	▸ Pre-clearing surveys would be undertaken prior to construction. The surveys, inspections and any subsequent relocation of species, would be undertaken in accordance with the flora and fauna management plan in the CEMP ▸ Clearing extents/site boundary/limit of works would be consistent with the proposal extents defined in a condition of approval ▸ The clearing extents/site boundary/limit of works would be clearly defined with flagging or marking tape, signage or other suitable means to delineate no go areas. This delineation and marking process would be incorporated and will align with the proposal flagging/marking tape process and specifications, to ensure that it aligns with the greater proposal processes and does not conflict or contradict any of their demarcation ▸ No stockpiling or storage within dripline of any mature trees ▸ Where clearing is to occur adjacent to vegetation to be retained, appropriate techniques must be used to prevent unauthorised disturbance.	Pre-construction and construction
B-9	Relocation of habitat features (fallen timber/hollow logs)	▸ Tree-clearing procedure including relocation of habitat features to adjacent area for habitat enhancement where practicable.	Construction
B-10	Noise impacts	▸ CEMP will include measures to avoid noise encroachment on adjacent habitats such as avoiding night works as much as practicable.	Construction
B-11	Light spill impacts	▸ Avoid night works ▸ Direct lights away from vegetation as far as practicable.	Construction
B-12	Air Quality	▸ Regular monitoring of dust generated by construction and operation activities ▸ Construction would cease if excessive dust or wind conditions observed being blown from site until control measures were implemented ▸ All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the subject land.	
B-13	Erosion and sedimentation	▸ An erosion and sediment control plan would be prepared within the CEMP and/or soil/water management plan in conjunction with the final design and implemented ▸ Spill management procedures would be implemented.	

Ref	Impact	Mitigation measure	Timing
B-14	Connectivity and fauna passage	▸ Fauna passage opportunities would be included within the flora and fauna management plan where the need to maintain habitat connectivity is identified. Plan to include the following: ▸▸ Where practical to do so and structures large enough (e.g., under bridges, culverts) incorporate fauna crossing structures including timber logs with connection to adjacent vegetation to account for arboreal fauna movement, and woody ground debris to allow for terrestrial fauna movement, in accordance with NSW RMS guidelines ▸▸ In areas of high vegetative connectivity, include installation of fauna fencing (to RMS specifications) to exclude fauna from entering rail corridor, with inclusion of fauna escape devices to allow any fauna within corridor to escape. This may include earthen ramps and/or escape poles from within the corridor ▸ Fauna fencing would be designed in accordance with relevant guidelines where impact assessments identify it is required to limit fauna strike and fauna mortality risk and/or maintain habitat connectivity. The placement of fauna fencing would take into account the requirements and responsibilities for maintaining an appropriate clearance zone between adjacent vegetation and fauna fencing to limit opportunities for fauna to jump or climb from adjacent vegetation over the fence into the proposal area: ▸▸ Security fencing to be used in township areas to incorporate measures to prevent entanglement of flying foxes/gliders where there is adjacent vegetation ▸▸ Fencing adjacent to areas of the subject land that are connected to areas of bushland outside the subject land are to include Koala friendly structures to aid traversal of Koala across their range, particularly around the Gwydir and Mehi Rivers ▸ Where possible, fauna fencing would refer to Inland Rail standard drawings ▸ Fauna fencing and adjacent vegetation clearance zones would be inspected and maintained during operation to retain the fauna fencing integrity.	Detailed design, pre-construction and construction
B-15	Fauna fencing	Fauna fencing and movement opportunities would be further developed during detailed design. Development of these opportunities would involve: ▸ assessment of the compatibility of each approach with the general fencing principles at each location and existing land use ▸ assessment of adjacent habitat and connectivity (including existing adjacent land use) ▸ consideration of safety requirements for the rail corridor and adjoining properties. e.g. rail corridor fencing has not been proposed across the Macintyre River floodplain to prevent the possibility of debris accumulation in fencing during flood events ▸ consideration of maintenance constraints that a fauna connectivity or fencing opportunity may introduce ▸ consideration of the type of fauna crossings that would be best suited to the location: ▸▸ elevated fauna crossing structures may be required to provide clearance over double-stacked trains (e.g. glider poles) ▸▸ for higher bridges or viaducts, rope-bridge underpasses may be more practical ▸▸ fauna crossing structures may include glider poles, rope-bridge underpasses and fauna furniture within culverts ▸ fauna exclusion fencing to channel fauna towards crossing structures ▸ fish passage measures would be assessed in consultation with NSW DPI Fisheries for implementation monitoring and reporting requirements.	Design and pre-construction

Ref	Impact	Mitigation measure	Timing
B-16	Fauna fencing	▸ Vegetation maintenance on the habitat side of the fauna exclusion fencing associated with fauna passages would be undertaken to ensure that species cannot use vegetation to climb onto the exclusion fencing.	Operation
B-17	Flora	Construction areas including compounds, stockpiles, fuel storage areas, laydown areas and staff parking would be located and established outside the tree protection zone as defined in *AS4970-2009 Protection of trees on development sites* (Standards Australia, 2009).	Pre-construction and construction
B-18	Tree clearing and loss of habitat	▸ Clearing to be undertaken as close as is practical following pre-clearing survey so as to minimise chance of missing newly created habitat (such as nests or possum dreys) ▸ Where the pre-clearing survey was completed more than 48 hours before the commencement of clearing, a re-inspection of the work area shall be undertaken by the ecologist/licensed fauna handler to ensure fauna has not moved back into the area ▸ Where sub optimal or low condition habitat is to be cleared, confirm any potential habitat feature locations with clearing contractor ▸ Clearing within wooded vegetation, PCTs, TECs and in locations of threatened species identified to be supervised by ecologist/fauna spotter at all times ▸ Habitat features to be isolated and left overnight to allow for fauna relocation ▸ A second pre-clearing survey will be undertaken the morning of clearing to ensure no fauna have moved back in the interim ▸ Habitat features to be cleared following day in the presence of a trained ecological or licensed wildlife handler ▸ Known and potential habitat trees to be felled with minimal impact – this shall include use of arborists to section and lower hollow sections from trees, or use of excavators with grabs to avoid uncontrolled felling of trees ▸ All hollows, fissures, logs and rocks to be checked by ecologist/spotter catcher post felling or impacts, and any fauna present caught and safely housed in a well- ventilated area. Habitat features to be moved to allow all hollows to be inspected ▸ Where practicable, hollows to be inspected by ecologists using torch and/or borescope within deeper fissures. Crowbar to be used to crack open sections of dead limbs and check under bark ▸ Uninjured fauna to be released in adjacent suitable habitat on day of clearing ▸ Injured fauna to be euthanised on site by a suitably experienced ecologist in accordance with OEH Code of Practice for Injured, Sick and Orphaned Protected Fauna if severely injured, or taken to vet or wildlife carer for assessment ▸ Records to be kept of number of hollows, number and species of individuals captured, and outcome of capture to incorporate into monthly environmental reporting.	Pre-construction and construction
B-19	Loss of HBTs and trees containing habitat features	▸ HBTs would be retained where possible ▸ Trees to be removed would be marked and an inventory would be kept of trees and hollows to be removed ▸ Hollows from cleared hollow bearing trees would be salvaged and reused where possible. Chainsaw hollows and/or nest boxes would be provided to mitigate hollow bearing tree removal ▸ Trees to be retained would be protected prior to the commencement of construction in accordance with *AS4970-2009 Protection of trees on development sites* (Standards Australia, 2009).	Pre-construction and construction

Ref	Impact	Mitigation measure	Timing
B-20	Loss of cave and structure dependent microbat habitat clearing	▸ A protocol for the survey and exclusion of cave-dependent microbats which may be utilising bridge structures is to be developed as part of the FFMP ▸ Protocol to include identification during pre-clearing survey, followed by inspection day prior to disturbance of habitat (if identified) ▸ Where roosting bats identified, bats to be captured and relocated at or after dusk. Survey to confirm any bats not captured have left roost for the night ▸ Once bats have left roost, roost habitat to exclude re-entry. Measures such as using shade cloth, geofabric or expanding foam may be suitable to exclude bats ▸ Survey report to be prepared detailing species, number, and relocation and/or other actions undertaken to discourage occupancy.	Pre-construction and construction
B-21	Injury and mortality	▸ Speed limits would be implemented on access and haul routes to reduce the impact of vehicle strike mortality on native fauna ▸ Requirements for pre-clearing surveys, including terrestrial and aquatic habitats, breeding habitats (including burrows and hollow bearing trees/logs, existing culverts and structures) would be implemented ▸ Staged and sequential clearing protocols would be implemented ▸ Animal handling protocols, including relocation and emergency care would be implemented ▸ Site induction to be held ▸ Regular toolbox talks to be held ▸ At the commencement of the proposal, pre-starts or kick off meetings to be conducted with relevant personnel by ecologist/environmental advisor prior to clearing.	Pre-construction and construction
B-22	Fauna habitat clearing: Five-clawed Work-skink	▸ Dedicated management actions for the Five-clawed Worm Skink which will be informed by the Species Management Plan which is under development by ARTC with DPE.	Pre-construction and construction
B-23	Flora and fauna/ biodiversity	▸ The siting of temporary construction facilities compounds, stockpiles, mobile fuel storage, laydown areas, temporary access roads and staff parking would be in accordance with the proposal conditions of approval and sited to minimise the extent of disturbance. ▸ Where activities are to occur outside of the defined proposal limit, consult with regulators to determine any additional assessments, approvals or amendments required to existing approvals.	Pre-construction and construction
B-24	Flora and fauna	The need for translocation options would be discussed with the Department of Planning and Environment (Biodiversity, Conservation and Science Directorate), should these be required.	Design and pre-construction
B-25	Flora	Topsoil stockpiles would be a maximum of 2.5 m in height to avoid heat sterilisation of seed bank.	Pre-construction and construction

Ref	Impact	Mitigation measure	Timing
B-26	Weeds and pests	A biosecurity (or weed and pest) management plan would be developed as part of the CEMP, which complies with the proposal's conditions of approval, relevant regulatory requirements and guidelines. This plan would include: ▸ requirements for pre-clearing surveys, including weeds, pest animal presence or risk of presence—map existing extent and severity of weed infestation and to determine weed management requirements ▸ pest animal management, including Cane toad mitigation ▸ site hygiene and waste management to deter pest animals ▸ weed surveillance and treatment during construction and rehabilitation activities ▸ pesticide and herbicide use, documentation and limitations on use i.e., not used in sensitive environmental areas, drainage lines that flow to waterways and aquatic habitats, broadscale use does not result in an increased erosion and sediment risk ▸ vehicle, machinery and imported fill hygiene protocols and documentation ▸ erosion and sediment control risk associated with broadscale weed removal or treatment ▸ any outbreak of priority and/or weeds of national environmental significance within or immediately adjacent to construction areas as a result of construction activity would be managed in accordance with the relevant regulatory requirements.	Pre-construction and construction
B-27	Weeds and pests	▸ Suitability of cleared vegetation for mulching/erosion protection would be assessed on a site-by-site basis ▸ Any vegetated material containing or with the potential to contain weed seed material would not be used for on-site mulching or erosion protection ▸ Any mulch generated as part of the proposal would be re-used within appropriate timeframes and manners as specified in the erosion and sediment control plan and the reinstatement and rehabilitation Plan. The erosion and sediment control plan and the reinstatement and rehabilitation plan would clearly specify this as per any relevant applicable conditions of approval, regulatory requirements and industry guidelines.	Pre-construction and construction
B-28	Biosecurity	Priority weeds would be managed in accordance with the *Biosecurity Act 2015*. Weeds of national environmental significance would be managed in accordance with the *Weeds of National Significance Weed Management Guide* (Cooperative Research Centre for Australian Weed Management, 2003). Vegetation would be managed in accordance with the general biosecurity duty to prevent, eliminate or minimise any cross contamination and/or spreading of known weeds.	Pre-construction, construction and post-construction
B-29	Biosecurity	The effectiveness of weed hygiene measures would be monitored as a component of the environmental monitoring procedure for the proposal.	Post-construction
B-30	Biosecurity	Property-specific biosecurity requirements would be agreed with the relevant landowner/operator prior to pre-construction/construction activities occurring on that property. Agreed protocols would be documented in individual property management agreements, to be signed by ARTC and the landowner/operator.	Design and pre-construction

Ref	Impact	Mitigation measure	Timing

B-31	Rehabilitation	A reinstatement and rehabilitation plan 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).
		The reinstatement and rehabilitation plan would include clear objectives for rehabilitation of native vegetation in temporary disturbances areas and would be supported by the urban design and landscape plan. These plans would be based on the Inland Rail Landscape and Rehabilitation Strategy, the Inland Rail Landscape and Rehabilitation Framework and property-specific reinstatement commitments. As a minimum the reinstatement and rehabilitation plan would establish the following:
		▸ timeframes for rehabilitation and/or reinstatement/stabilisation works to be achieved
		▸ details of the actions and responsibilities to progressively rehabilitate, regenerate and/or revegetate areas, consistent with the agreed objectives
		▸ include rehabilitation requirements such as:
		  ▸ milling and removal of bitumen pavement
		  ▸ removal of any decommissioned culverts
		  ▸ tyning and ripping of base and sub-base material
		  ▸ application of soil ameliorants
		  ▸ topsoiling and/or compost blanket
		  ▸ stabilisation and rehabilitation (e.g. planting and or seeding)
		▸ consideration for maintenance or performance issues of rehabilitation e.g. vegetation that does not grow and obscure signals or impact the longevity of rail infrastructure
		▸ procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/ stabilisation areas
		▸ where temporary construction facilities are required, land will be returned to a stable condition that complies with the conditions of applicable landowner agreements and regulatory approvals.
			Construction and post-construction

B-32	Rehabilitation	▸ Pallets of locally endemic species, targeted to the structure and plant community type of the original landscape, would be used as part of rehabilitation ▸ Plantings would include complex mid-stratum to increase habitat for woodland birds and support small faunal movement ▸ Rehabilitation would be targeted around any fauna furniture or rail corridor crossing structures—dense mid-stratum of vegetation and connectivity with larger patches to be enhanced ▸ Rehabilitation would be used to enhance fauna habitat connectivity along movement corridors ▸ Felled timber and recovered habitat features would be incorporated in rehabilitation to enhance small mammal, reptile and invertebrate habitat ▸ Installation of nest boxes or assisted hollow augmentation would be considered.	Pre-construction, construction and post-construction
B-33	Offsets	Biodiversity offsets would be finalised in accordance with the BAM calculator as calculated in Appendix D of Technical paper 1: Biodiversity development assessment report.	Design and pre-construction
B-34	Aquatic ecology	Works within the riparian zone would minimise vegetation disturbance as far as practical. Where riparian vegetation is removed, revegetation of disturbed riparian areas would be undertaken using local native species and would include native in-stream macrophytes suited to the ephemeral nature of the watercourses where applicable.	Pre-construction and construction

Ref	Impact	Mitigation measure	Timing
B-35	Aquatic ecology	Works within or adjacent to watercourses would be conducted in accordance with the intent of: ▸ *Policy and Guidelines for Fish Habitat Conservation and Management Update 2013* (DPI, 2013) ▸ *Guidelines for controlled activities on waterfront land* (DPI, 2018) ▸ The salvage and relocation of fish within isolated aquatic environments would be managed in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management Update 2013* (DPI, 2013) ▸ *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003).	Pre-construction and construction
B-36	Aquatic ecology	Any large debris (snags) would be salvaged and relocated upstream or downstream and aligned so that they point downstream so that water is deflected towards the centre of the stream.	Pre-construction and construction
B-37	Fish passage	Regular inspection and maintenance of instream structures would be undertaken to ensure their functionality is maintained and minimise occurrence of accidental blockage of fish passage.	Design, pre-construction and construction