

APPENDIX

O

Matters of National Environmental Significance Report

Part 1 of 6

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

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ACRONYMS AND ABBREVIATIONS

Acronyms	Description
ADR	Accepted development requirement
AEP	Annual exceedance probability
ALA	Atlas of Living Australia
ARTC	Australian Rail Track Corporation Limited
AUSRIVAS	Australian River Assessment System
BPA	Biodiversity Planning Assessment
CCC	Community Consultative Committees
CE	Critically Endangered
CEMP	Construction Environmental Management Plan
CIA	Cumulative impact assessment
Cth	Commonwealth
CTI0	Change in time of Inundation (0.5 - 12 hours)
CTIA	Change in time of Inundation (>12 hours)
CTIB	Change in time of Inundation (> 24 hours)
DAF	Department of Agriculture and Fisheries
DAWE	Department of Agriculture, Water and the Environment (Cth)
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DDMRB	Darling Downs Moreton Rabbit Board
DEHP	Department of Environment and Heritage Protection (former)
DESI	Department of Environment and Science and Innovation
DoR	Department of Resources
DTMR	Department of Transport and Main Roads
E	Endangered
EIS	Environmental Impact Statement
EP Act	<i>Environmental Protection Act 1994 (Qld)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
ETV	Erosive threshold velocity
GDE	Groundwater dependent ecosystem
GIS	Geographic information system
GRC	Goondiwindi Regional Council
ha	hectare
HVR	High Value Regrowth
Inland Rail	Melbourne to Brisbane Inland Rail

Acronyms	Description
km	kilometre
LC	Least concern
m	metre
MCA	multi-criteria analysis
MDC	Material Distribution Centre
MER	Monitoring, evaluation and reporting
mm	Millimetre
MNES	matters of national environmental significance
NC Act	<i>Nature Conservation Act 1992 (QLD)</i>
nm	nanometres
NP	National Park
NSW	New South Wales
NT	Near Threatened
OC	Of concern
PMF	Probable maximum flood
Project	Border to Gowrie Project
QLD	Queensland
QR	Queensland Rail
RE	Regional Ecosystem
RMAR	Rail Maintenance Access Road
RUMP	Road Use Management Plan
SEQ	South East Queensland
SEVT	Semi-evergreen vine thicket within the Brigalow Belt (north and south) and Nandewar bioregions
SDPWO Act	<i>State Development and Public Works Organisation Act 1971 (Qld)</i>
SIA	Significant impact assessment
SPRAT	Species Profile and Threats Database
T	Tree (canopy) stratum
TEC	Threatened ecological community
Threatened	Critically endangered, Endangered and Vulnerable
TMP	Traffic Management Plan
ToR	Terms of Reference
TRC	Toowoomba Regional Council
V	Vulnerable
VM Act	<i>Vegetation Management Act 1999 (Qld)</i>

Acronyms	Description
WDCF	Wild dog check fence

GLOSSARY

Term	Explanation
Adverse impact	Adverse impacts are defined as those impacts that result in an unwanted and unanticipated result of taking a particular action. In an environmental context, an adverse impact means any change in the physical or biological conditions of the natural environment that results in a detrimental effect upon flora, fauna, air, water, minerals or other natural characteristic of the area.
Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: - Genetic diversity – the variety of genes (or units of heredity) in any population - Species diversity – the variety of species - Ecosystem diversity – the variety of communities or ecosystems.
Bioregion	A bioregion as defined in An Interim Biographic Regionalisation of Australia (Thackway and Cresswell 1995). The bioregion subject to this report is the Brigalow Belt bioregion.
<i>Biosecurity Act 2014</i> (Qld) (Biosecurity Act)	The Biosecurity Act lists declared plants and animals that have, or could have, serious economic, environmental or social impacts and are targeted for control. There are legal obligations associated with the control supply, sale, keeping and transport of declared species. Where these exotic pests and weeds are encountered, landholders have an obligation under the Biosecurity Act to control the declared weeds and pest animals, in accordance with relevant guidelines and local government area (LGA) pest management plans. There are seven categories for restricted matter defined in the Biosecurity Act: - Categories 1 and 2 are restricted matters that have specific urgent reporting requirements. - Categories 3, 4, 5, 6 and 7 relate to restricted matter that is in a person's possession, under their control and is also about not feeding restricted matter. Several restriction categories apply to some restricted matter. In such cases, you would need to follow the requirements of all restriction categories for these restricted matter listings.
Brownfield	A site with existing rail infrastructure.
Conservation significant	A collective term used with reference to species that are listed as 'Critically Endangered', 'Endangered', 'Vulnerable' or 'Near Threatened' and migratory species listed under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC Act) (EPBC Act conservation significance for more details).
Critical priority	Rating associated with the Back on Track species prioritisation framework. Constitutes the highest total score/priority.
Critically Endangered	Designated as 'Critically Endangered' under the EPBC Act. Refer to definition of EPBC Act conservation status for meaning of 'Critically Endangered' under the Act.
Cumulative impact assessment area	The cumulative impact assessment area encompasses the Project and extends 50 km beyond the temporary Project footprint.

Term	Explanation
Cumulative impact Project footprint	The cumulative impact Project footprint encompasses the Projects that are identified within Table 9-2 of this technical report.
Cumulative impacts	The impacts that result from the incremental impact of an activity when it is added to past, present, and reasonably foreseeable future activities. Cumulative impacts arise when several developments that may have insignificant effects but when taken together have a significant effect.
Direct impacts	Impacts that result from a direct interaction between integral Project activities and the Environmental Value (e.g. land clearing resulting in vegetation and habitat loss).
Ecological community	An assemblage of species occupying a particular area.
Ecological receptor	A receptor is an individual or grouping of features, areas and/or structures that may be affected by direct or indirect changes to the environment.
Endangered	Designated as 'Endangered' under the EPBC Act. Refer to definitions of EPBC Act conservation status for meaning of 'Endangered' under each Act. 'Endangered' refers to a species of community that: • Is not 'Critically Endangered' • Is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Greenfield	A site that has not been developed or does not contain any rail infrastructure.
Habitat	An area or areas permanently, periodically or occasionally occupied by a species, population or ecological community, including any and all biotic and abiotic features of the area or areas occupied.
High constraint area	The Environmental Value is at risk from the Project activity. The activity will only be allowed with a specific set of stringent mitigation measures.
Impact assessment area	This Project footprint plus a nominal 1 km buffer area. Where multiple options were identified, a 1 km buffer was maintained from the edge of each option, resulting in areas that are wider in some locations.
Indirect impacts	Impacts that are not a direct result of project activities but occur away from the original impact area via a complex pathway (e.g. soil disturbance during construction promoting weed and/or pest invasion that reduces habitat quality). Indirect impacts include the following: • Downstream or downwind impacts, including impact on wetlands or ocean reefs from sediment, fertilisers or chemical which are washed or discharged into river systems • Upstream impacts including impacts associated with the extraction of raw materials and other inputs which are used to undertake the action • Facilitated impacts which result from further actions (including actions by third parties) which are made possible or facilitated by the action.
K-selected species	Those species with low fecundity and longer lifespans.
Matters of national environmental significance (MNES)	The nine MNES protected under the EPBC Act are: • World heritage properties • National heritage places • Wetlands of International Importance (listed under the Ramsar Convention) • Listed threatened species and ecological communities • Migratory species protected under international agreements • Commonwealth marine areas • The Great Barrier Reef Marine Park • Nuclear actions (including uranium mines) • A water resource, in relation to coal seam gas development and large coal mining development.

Term	Explanation
Microchiropteran bats	This report uses the term Microchiropteran bats to refer to small mostly insectivorous bats that use echolocation to navigate and find food, in the suborder <i>Microchiroptera</i> .
Migratory	Species listed as Migratory under the EPBC Act. Refer to definitions of EPBC Act conservation status, for meaning of migratory under the Act.
Naturalness and ecological condition	The apparent naturalness or health/condition of an ecological community, as assessed against the following criteria: • Disturbance — described in terms of its cause (natural or human), its degree or severity, its extent and distribution within the community • Weed content — description of species abundance, horizontal and vertical distribution of each species • Ecological viability — measure of a community's ability to survive in the longer term • Ecological health — measure of regeneration, size, structure and number of dead or dying plants within a community • Ecological relationships — the sequential relationship of one community to another, including diurnal systems.
NC Act conservation status	Under the NC Act, protected species are assigned a conservation status of 'Extinct in the wild', 'Endangered', 'Vulnerable', 'Near Threatened', or 'Least Concern'. Definitions of these terms under the NC Act are as follows: 'Extinct in the wild' • There have been thorough searches conducted for the wildlife, and • It has not been seen in the wild over a period that is appropriate for the lifecycle or form of the wildlife 'Endangered' • There have not been thorough searches conducted for the wildlife and the wildlife has not been seen in the wild over a period that is appropriate for the lifecycle or form of the wildlife, or • The habitat or distribution of the wildlife has been reduced to an extent that the wildlife may be in danger of extinction, or • The population size of the wildlife has declined, or is likely to decline, to an extent that the wildlife may be in danger of extinction, or • The survival of the wildlife in the wild is unlikely if a threatening process continues 'Vulnerable' • Its population is decreasing because of threatening processes, or • Its population has been seriously depleted, and its protection is not secured, or • Its population, while abundant, is at risk because of threatening processes, or • Its population is low or localised or depends on limited habitat that is at risk because of threatening processes 'Near Threatened' • The population size or distribution of the wildlife is small and may become smaller, or • The population size of the wildlife has declined, or is likely to decline, at a rate higher than the usual rate for population changes for the wildlife, or • The survival of the wildlife in the wild is affected to an extent that the wildlife is in danger of becoming 'Vulnerable' 'Least Concern' • The wildlife is common or abundant and is likely to survive in the wild • Native wildlife may be prescribed as 'Least Concern' wildlife even if: • The wildlife is the subject of a threatening process, or • The population size or distribution of the wildlife has declined, or • there is insufficient information about the wildlife to conclude whether the wildlife is common or abundant or likely to survive in the wild.
Negative impact	An impact that is considered to result in an unfavourable or adverse change to the receptor.

Term	Explanation
Non-remnant vegetation	Vegetation that is not mapped as remnant vegetation by DES and/or which fails to meet DESs criteria for remnant vegetation (see definition of remnant vegetation, below). This includes regrowth, heavily thinned or logged vegetation and significantly disturbed vegetation that fails to meet the structural and/or floristic characteristics of remnant vegetation. It also includes urban and cropping land. Non-remnant vegetation may retain significant biodiversity values (Neldner <i>et al.</i> 2023).
Of Concern	Designated as 'Of Concern' under the EPBC Act. 'Of Concern' refers to a community in which 10% to 30% of pre-clearing extent of remnant vegetation exists in the bioregion, or more than 30% of pre-clearing extent remains and the remnant vegetation is less than 10,000 ha.
Precautionary principle	The precautionary principle stipulates that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Project cumulative impact area	The Inland Rail Program cumulative impact area encompasses the Inland Rail disturbance footprint and extends 50 km beyond the Project footprint boundary.
Project footprint	The Project footprint is the area subject to direct disturbance (both temporary and permanent) associated with the Project.
Protected matters	Under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act), protected matters are nationally significant (protected) animals, plants, habitats or places. The EPBC Act covers 9 protected matters: • world heritage areas; • national heritage places; • wetlands of international importance (listed under the Ramsar Convention); • listed threatened species and ecological communities; • listed migratory species (protected under international agreements); • Commonwealth marine areas; • Great Barrier Reef Marine Park; • nuclear actions (including uranium mines); and • water resources (that relate to coal seam gas development and large coal mining development).
R-selected species	Those species with high fecundity and shorter lifespans.
Red-boarded	Rail term: A line with a stop board attached to the rail preventing traffic entering the section.
Region	A bioregion as defined in An Interim Biographic Regionalisation of Australia (Thackway and Cresswell 1995). The region subject to this report is the Brigalow Belt South bioregion.
Regional Ecosystem (RE)	A vegetation community, within a bioregion, that is consistently associated with a particular combination of geology, landform and soil (Young <i>et al.</i> 1999). REs may be classified under schedules 1 to 3 of the Vegetation Management Regulation as 'Endangered', 'Of Concern' or 'Least Concern'. Refer to VM Act conservation status for meaning of 'Endangered', 'Of Concern' and 'Least Concern' under the Act. These terms in reference to REs in this report refers to the RE status under the Act.
Regrowth vegetation	As defined under the VM Act, regrowth vegetation means vegetation that is not remnant vegetation.
Remnant vegetation	Remnant woody vegetation is defined as vegetation where the dominant canopy has >70% of the height and >50% of the cover relative to the

Term	Explanation
	undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy (Neldner <i>et al.</i> 2023).
Significant impact	In accordance with the EPBC Act, a significant impact is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.
Spatial extent	Impacts are considered with respect to the biologically meaningful spatial extents of local, regional, State, and national/international.
Study area	This includes a nominal 1 km buffer area either side of the centreline, wider in some areas where multiple design options required an increase investigation area. Where temporary disturbance exceeds the nominal 1 km buffer from the centreline, a 100m buffer was placed around these footprints to account for potential indirect impacts.
Threatened	A collective term used with reference to species that are listed as 'Critically Endangered', 'Endangered' or 'Vulnerable' under the provisions of the EPBC Act (EPBC Act conservation significance for more details).
VM Act conservation status	Under the VM Act, REs may be classified as either 'Endangered', 'Of Concern' or 'Least Concern'. Definitions of these terms under the Act are provided below Endangered - Less than 10% of pre-clearing extent of remnant vegetation (see following definition) exists in the bioregion, or 10% to 30% of pre-clearing extent remains and the remnant vegetation is less than 10,000 ha Of Concern 10% to 30% of pre-clearing extent of remnant vegetation exists in the bioregion, or more than 30% of pre-clearing extent remains and the remnant vegetation is less than 10,000 ha Least Concern - More than 30% of pre-clearing extent of remnant vegetation exists in the bioregion, and it is greater than 10,000 ha. In addition, for biodiversity planning purposes, the DES also classifies a RE as "No concern at present" if the degradation criteria listed above for 'Endangered' or 'Of Concern' REs are not met.
Vulnerable	Designated as 'Vulnerable' under the EPBC Act. Refer to definitions of EPBC Act conservation status for meaning of 'Vulnerable' under the Act.
Weeds of National Environmental Significance (WoNS)	The State Government is responsible for the legislation and administration of WoNS in Queensland and landholders are responsible for managing WoNS. The Australian Weeds Strategy provides a framework for establishing consistency between all stakeholders and identifies priorities for national weed management with the aim of minimizing the environmental, social and economic impacts of weeds. A National Management Group has been established for each of the WoNS to manage the implementation of the respective National Strategic Plans.
Wetland	- Areas shown on the Map of Referable Wetlands which is a document approved by the chief executive on 4 November 2011 and published by the department, as amended from time to time by the chief executive under section 144D of the Environmental Protection Regulation 2008 (Qld); and - Are wetlands as defined under the Queensland Wetlands Program as areas of permanent or periodic/intermittent inundation, with water that is static or flowing fresh, brackish or salt, including areas of marine

Term	Explanation
	water, the depth of which at low tide does not exceed 6 m, and possess one or more of the following attributes: ◦ At least periodically, the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their lifecycle; or ◦ The substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers; or ◦ The substratum is not soil and is saturated with water or covered by water at some time.

EXECUTIVE SUMMARY

This Matters of National Environmental Significance (MNES) Report supports the revised draft Environmental Impact Statement (EIS) for the construction and operation of the NSW/QLD Border to Gowrie Project (the Project), a section of the larger Inland Rail Program. This 'stand-alone' assessment addresses Sections 11.1 to 11.35 of the Terms of Reference for an environmental impact statement: Inland Rail – Border to Gowrie project.

Australian Rail Track Corporation Limited (ARTC) proposes to construct and operate the Project, which consists of a total of 217.48 kilometres (km) of single-track railway with five crossing loops and will be constructed to accommodate 1,800 metres (m) long double stack freight trains. The Project will utilise a combination of 68.00 km of existing open access rail corridor (brownfield) and 149.48 km of new rail corridor (greenfield) to prioritise areas of existing pre-clearing and disturbance.

The Study area for the MNES assessment includes the Project footprint and an additional 1 km buffer. The assessment of potential impacts has focused on the Project footprint, which totals 3,382.17 hectares (ha) and includes all areas where works are proposed (both temporary and permanent), but also considers potential indirect impacts outside of the Project footprint.

The Study area is located within the Brigalow Belt South bioregion and has a long history of human disturbance from agricultural practices and resource development. At a regional level, most remaining areas of vegetation are now fragmented, occurring on the rockier hilly areas of ranges, as part of state protected lands (State forests), as roadside vegetation, or as relatively small, isolated remnants.

The methodology for this assessment included:

- a desktop assessment where databases, previous studies and existing literature was reviewed,
- an assessment of the likelihood of occurrence of MNES species based on the desktop assessment,
- field surveys for which suitable locations were informed by pre-survey predictive habitat mapping and preliminary surveys,
- an update to the likelihood of occurrence of MNES species based on the field survey findings,
- habitat mapping based on ground-truthed data and expert consultation, and
- an assessment of significant residual impacts, offset quantification and cumulative impacts.

Desktop assessments identified that the Project footprint may contain eight threatened ecological communities (TEC), 22 threatened flora species, and 23 threatened fauna species known, likely or with the potential to occur in the Project footprint. Threatened species are those listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Following field surveys, four threatened TECs, eight threatened flora species, and seven threatened fauna species were considered known to occur in the Project footprint. A further four threatened flora species, and 10 threatened fauna species were considered potential or likely to occur, and four TECs, nine threatened flora species and 11 threatened fauna species were considered unlikely to occur.

Field surveys also assessed borrow pit sites and the site for Whetstone Material Distribution Centre (Whetstone MDC), surveyed aquatic ecosystems and waterways, and habitat types. Surveys of proposed borrow pit sites established that no impacts to MNES will occur. A survey of the Whetstone MDC also found that no MNES were present.

Aquatic surveys using the AusRivAS method identified that the waterways surveyed range from Band A (reference condition) to Band B (significantly impaired).

A total of eight broad habitat types were identified in the Study area during surveys:

- Natural grassland,
- Non-remnant disturbed pasture, cropping areas and other land uses,
- Remnant dry sclerophyll eucalypt woodlands,
- *Acacia harpophylla*-*Casuarina cristata* open forest,
- Regrowth eucalypt communities,
- Wetlands,
- Watercourses, and
- Groundwater dependent ecosystems.

Ground-truthing surveys determined the Project footprint (3,382.17 ha) to comprise of 16.9% or 570.75 ha of remnant vegetation; 0.5% or 16.48 ha of mature regrowth vegetation; 8.0% or 270.92 ha of immature regrowth vegetation; and 74.6% or 2,524.02 ha of non-remnant.

Without appropriate management and controls, the pre-construction, construction, commissioning, and operation phases of the Project have the potential to impact on ecological values, both terrestrial and aquatic, via the following mechanisms:

- Habitat loss through clearing,
- Fauna species injury or mortality,
- Reduction in biological viability of soil,
- Introduction and spread of weeds, pathogens and pest species,
- Habitat fragmentation,
 - Loss of connectivity in biodiversity corridors,
 - Barrier effects,
 - Edge effects,
- Noise and vibration,
- Air quality and dust,
- Lighting,
- Waste management,
- Altered hydrology and flooding,
- Erosion and sedimentation,
- Changes to groundwater resources,
- Contamination,
- Clearing of riparian vegetation,
- Modification of aquatic habitat,
- Waterway barrier effects, and

- Altered stream hydrology.

The nature of each unmitigated impact during each phase of the Project was considered in relation to identified ecological values, and the anticipated scale and duration of disturbance. This was utilised to identify mitigation measures and the scale at which they should be implemented.

The mitigation measures for the Project were developed using the four principles of ecologically sustainable development:

- Precautionary principle,
- Principle of inter-generational equity,
- Conservation of biological diversity and ecological integrity, and
- Improved valuation and pricing of environmental resources.

The revised reference design includes utilising existing cleared and disturbed areas, locating and positioning of the various project components in a manner that minimises impacts to ecological values, and implementation of measures to address specific impacts identified above.

Additional mitigation measures to be implemented post-approval include the following:

- Refinement of the revised reference design and Project footprint during detailed design to reduce ecological impacts.
- The identification of fauna connectivity measures to be incorporated in the Project's design to facilitate movement and mitigate connectivity impacts for target species. Measures have been based on verified important fauna connectivity areas identified within the Project from a regional ecological assessment (identified as priority connectivity zones), and include the provision of fauna crossing structures, fauna fencing to limit access to the railway and prevent wildlife-train collisions and funnel fauna to crossing structures, and targeted connectivity facilitation measures such as shrubs, groundcover and fauna furniture in the approach and within fauna crossing structures.
- A structured approach will be used to deliver a Project design which integrates fauna connectivity in design decisions progressively throughout detailed design and in conjunction with other requirements and constraints such as safety, cost, engineering and flooding to achieve connectivity performance outcomes. A Wildlife Connectivity Plan will detail the measures to mitigate the operational impacts of the Project on fauna connectivity based on the Fauna Connectivity Strategy (revised draft EIS Appendix P: Fauna Connectivity Strategy), allowing for integration of connectivity mitigations at the appropriate stage of design progression.
- Bridge crossings at watercourses will be designed to support fauna movement of confirmed target species through riparian zones along the bed and banks of watercourses by the incorporation at bridge spans and abutments, of heights and width clearances suited to the movement requirements of target fauna in accordance with the approach and rationale in the Fauna Connectivity Strategy.
- Bridge piers in the McIntyre River will be appropriately sized and located to avoid potential impacts to the Murray cod including avoidance of the low flow zone and not resulting in any changed velocity conditions.
- The incorporation of fauna connectivity principals in the on-going design of waterway and watercourse crossings to ensure the establishment of appropriately sized clearance zones

at priority connectivity zones such as riparian zones beneath bridge crossings, which have been identified for the site.

- Provision of fauna fencing including exclusion fencing, funnel fencing and fauna escape mechanisms such as jump outs and escape poles.
- Implementation of appropriately designed fauna crossing structures, including multi-use and dedicated fauna culverts, four bridges spanning 6 km of the Condamine River floodplain, and 17 glider poles, as detailed in the Fauna Connectivity Strategy.
- Ongoing monitoring for all mitigation measures to assess the effectiveness of the measures with contingency (under an adaptive management framework) to change/improve management strategies where deleterious impacts to the identified ecological values are observed and determined to be attributable to the Project.
- The development, finalisation and implementation of the following management plans:
 - Draft Koala Management Plan (revised draft EIS Appendix M: Draft Koala Management Plan) to establish best-practice mitigation and management measures to be implemented during design, construction and operation of the Project that reduce the risk of Koala injury and/or mortality, minimise losses to Koala foraging, breeding and dispersal habitat, and maintain connectivity between areas of important Koala habitat. The KMP defines key aspects of a Koala monitoring plan for all Project phases and provides a framework for adaptive management, including schedules and triggers for audits, management plan review and reporting.
 - Draft Fauna Management Plan (revised draft EIS Appendix N: Draft Fauna Management Plan) to outline the fauna monitoring, mitigation and management measures to be implemented to avoid or minimise the impact of Project activities on listed threatened fauna species, and comply with all relevant Commonwealth and State legislation, regulations, conditions of approval and permit requirements during all stages of the Project.
 - Wildlife Connectivity Plan in accordance with the Fauna Connectivity Strategy (revised draft EIS Appendix P: Fauna Connectivity Strategy) to maintain ecological connectivity and dispersal function through the landscape and minimise the risk of fauna injury and mortality as a result of the Project. The Wildlife Connectivity Plan will also outline fauna connectivity monitoring programs for each relevant species and guild.
 - Construction Environmental Management Plan (CEMP) in accordance with the Australian Government's Environmental Management Plan guidelines (DCCEEW, 2024) to detail how the performance, commitments and mitigations measures for the Project will be implemented and achieved during all stages of construction, including the following relevant sub-plans:
 - Biodiversity Management Plan, which will outline the management strategies, actions and controls to be implemented to avoid or minimise potential impacts of the Project during construction.
 - Biosecurity Management Plan, which will outline biosecurity risks associated with the construction of the Project and the processes that are to be used to manage those risks.
 - Rehabilitation and Landscaping Management Plan, which will be based on the Inland Rail Landscape and Rehabilitation Strategy, Inland Rail Landscape and Rehabilitation Framework and location-specific reinstatement commitments, it will

detail the actions needed to rehabilitate the areas within the temporary Project footprint that are for use during construction phase only. This plan will be developed in consultation with local councils and affected communities, including Traditional Owners.

- Soil Management Plan, which provides procedures and protocols for the management of potential impacts on land resources during construction. The Soil Management Plan will include soil conservation measures and erosion and sediment controls with specific reference to identified habitat for threatened flora (where they are found to occur).
- o Operational Environmental Management Plan (Operational EMP) in accordance with relevant guidelines to detail how the performance outcomes, commitments and mitigation measures for the Project will be implemented and achieved during operation, including the following programs and sub-plans:
 - Biosecurity Management Plan which will outline biosecurity risks associated with the operation of the Project and the processes that are to be used to manage those risks.
 - Biodiversity Management Plan, which will outline the management strategies, actions and controls to be implemented to minimise potential impacts of the Project during operation.

Following the incorporation of post approval mitigation measures to the revised reference design, an impact assessment was conducted as per the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE, 2013a). This assessment determined that the Project is likely to result in a significant residual impact to the following ecological values:

- TECs:
 - o Brigalow (*Acacia harpophylla* dominant and co-dominant);
 - o Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland; and
 - o White box-yellow box-Blakely's red gum grassy woodland and derived native grassland.
- Threatened flora:
 - o Belson's panic (*Homopholis belsonii*)
 - o Hawkweed (*Picris evae*)
 - o Small-flowered westringia (*Westringia parvifolia*);
 - o Winged peppercress (*Lepidium monolocoides*); and
 - o *Xerothamnella herbacea*.
- Threatened fauna:
 - o Australian painted snipe (*Rostratula australis*)
 - o Brigalow woodland snail (*Adclarkia cameroni*);
 - o Condamine earless dragon (*Tympanocryptis condaminensis*);
 - o Dunmall's snake (*Furina dunmalli*);
 - o Five-clawed worm-skink (*Anomalopus mackayi*);
 - o Koala (*Phascolarctos cinereus*);
 - o Painted honeyeater (*Grantiella picta*);
 - o South-eastern long-eared bat (*Nyctophilus corbeni*);

- Spotted-tailed quoll (*Dasyurus maculatus maculatus*); and
- Squatter pigeon (southern) (*Geophaps scripta scripta*).

Potential predicted cumulative impacts of projects within 50 km of the Project footprint were considered, totalling 23 projects that were included in the area of influence (AOI). Operational projects have been included in the assessment of ecological cumulative impacts due to the potential for such developments to continue to have an ongoing impact on ecological values and processes. Unmitigated, the cumulative impacts resulting from existing and proposed developments within the AOI area include some that can be considered irreversible and permanent. Without targeted mitigation measures, the potential cumulative impacts upon MNES within AOI area have been assessed to be low to moderate significance.

The significance of the predicted cumulative impact as a result of the Project and other similar projects has been found to be medium for:

- Reduction in biological viability of soil to support growth due to soil compaction;
- Habitat loss from vegetation clearing/removal;
- Edge effects;
- Habitat fragmentation;
- Barrier effects; and
- Reduction in connectivity of biodiversity corridors.

The Project will result in significant impacts on MNES, after the implementation of mitigation measures, including rehabilitation, and therefore will require offsetting. Each of the ecological values that have been identified as likely to have a significant residual impact are included in ARTC's Environmental Offset Delivery Strategy – which is contained in revised draft EIS Appendix Q: Environmental Offset Delivery Strategy. The Environmental Offset Delivery Strategy is based on the significant impacts of the Project on ecological values identified in this assessment, and details offsets to address these significant impacts. Property specific Offset Area Management Plans (OAMPs) will be developed and finalised in consultation with relevant Australian Government and State regulatory agencies prior to construction.

1. INTRODUCTION

1.1 PROJECT OVERVIEW

The Australian Rail Track Corporation (ARTC) proposes to construct and operate the New South Wales (NSW)/Queensland (QLD) Border to Gowrie Project (the Project) a section of the larger Inland Rail Program. This section consists of 217.48 km of new dedicated single track, open access freight railway with five crossing loops. The Project will be constructed to accommodate 1,800 metre (m) long double-stacked freight trains, and as such each crossing loop will be 2,200 m long. The Project will utilise a combination of existing and new rail corridors.

Vegetation clearing associated with the proposal, as assessed by the Environmental Impact Statement (EIS), is limited to that contained within the Project footprint.

The Project revised reference design responds to key environmental and social constraints and has been developed in line with engineering standards to produce a feasible rail design that will achieve the performance specifications for Inland Rail and the Project.

1.2 PROJECT OBJECTIVES

The objectives of the Project are to:

- Provide upgraded rail infrastructure that meets the Inland Rail Program specifications to enable trains using the Inland Rail corridor to travel from the NSW/QLD Border to Gowrie, connecting with other sections of Inland Rail to the north and south.
- Provide connectivity at points of interface with the existing Queensland Rail (QR) network, thereby enabling trains operating on the regional network to use sections of Inland Rail.
- Minimise the potential for environmental and community impacts by maximising use of existing rail corridor.
- Provide a rail link between Melbourne and Brisbane that is interoperable with train operations to Perth, Adelaide and other locations on the standard gauge rail network, to serve future rail freight demand and stimulate growth for inter-capital and regional/bulk rail freight.
- Provide an increase in productivity that will benefit consumers through lower freight transport costs.
- Provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor and deliver a freight rail service that is competitive with road freight services.
- Improve road safety and congestion and reduce environmental impacts by moving freight from road to rail.
- Bypass bottlenecks within the existing metropolitan rail networks and free up train paths for other services along the coastal routes.
- Act as an enabler for regional economic developments along the Inland Rail corridor.

1.3 PROJECT RATIONALE

The Inland Rail project provides an alternative mode of transportation for the equivalent of more than 200,000 truck movements annually from 2049–50. Currently road transport is the main mode of transport for most commodities produced or consumed in Australia. Compared with rail, road freight results in additional environmental costs, including from air pollution, greenhouse gas emissions and water pollution. An expected production of 750,000 fewer

tonnes of carbon and one-third of the fuel can be expected from rail for the project when compared to road transport. Approximately 1,100 km, or 70 per cent, of Inland Rail will use existing rail lines and corridors, making the best possible use of previous investments and minimising the impact on the environment and community.

- The development of Inland Rail is expected to:
 - Remove 200,000 long-haul truck movements from roads each year from 2049–50
 - Reduce congestion and created capacity on existing road and rail networks in metropolitan Sydney
 - Reduced burden on roads and improved safety
 - Reduced truck volumes in over 20 regional towns
 - Relocate mainline freight traffic from existing railways out of some town centres such as Inglewood, Pittsworth and Southbrook, providing for a safer environment with enhanced liveability
- The economic benefits assessment estimates that the Border to Gowrie Project is expected to provide a total of \$703.26 million (\$2022 present value terms) in incremental benefits (at a 7 per cent discount rate) to society. These benefits result from improvements in freight productivity, reliability and availability, and benefits to the community from crash reductions reduced environmental externalities and road decongestion benefits.
- The Border to Gowrie Project is one of the essential project segments of Inland Rail required to enable Australia's existing national rail network to be enhanced for interstate freight market.

1.4 THE PROPONENT

The ARTC was created as an Australian Government-owned statutory corporation in 1997 after the Australian Government and State governments agreed to the formation of a single point of contact for all operators seeking to access the national interstate rail network.

Since its formation, ARTC has developed into one of Australia's largest freight rail network owners with more than 20 years' experience in building, maintaining and operating rail infrastructure.

ARTC plays a critical role in the transport supply chain and the overall economic development of Australia. The ARTC network supports industries and businesses that are vital to the nation's economy by facilitating the movement of a range of products and commodities through NSW, QLD, South Australia, Victoria and Western Australia.

Across its network, ARTC is responsible for:

- Selling access to train operators,
- Developing new business,
- Capital investment in the network,
- Managing the network, and
- Infrastructure maintenance.

As the operator and manager of Australia's national rail freight network, ARTC has successfully delivered more than \$9 billion in capital upgrades to the national rail freight network. Having emerged from this period of significant investment and network growth, ARTC has now been

tasked with developing a program to deliver Inland Rail on behalf of the Commonwealth Department of Infrastructure, Transport, Regional Development, Communications and the Arts. Contact details for the Inland Rail Program are as follows:

Inland Rail
Australian Rail Track Corporation
ABN: 75 081 455 754
Level 16, 180 Ann Street
Brisbane QLD 4000

GPO Box 2462 Queen Street
Brisbane QLD 4001
Telephone: 1800 732 761

Further information on ARTC can be found at: <http://www.artc.com.au>.

1.5 SCOPE AND PURPOSE

1.5.1 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The purpose of this assessment is to support the revised draft EIS under Section 34D(1) of the *State Development and Public Works Organisation Act 1971* (QLD) (SDPWO Act). It addresses the *Terms of reference for an environmental impact statement: Inland Rail—Border to Gowrie project* dated November 2018 (the ToR) (revised draft EIS Appendix A2: Terms of Reference Cross-Reference Table). The Project is a controlled action requiring assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) (reference number EPBC 2018/8165). The controlling provision under the EPBC Act is listed threatened species and communities (sections 18 and 18A).

Assessment of the Project against the requirements of the EPBC Act will occur in accordance with the bilateral agreement with the State of Queensland. To enable this, the revised draft EIS must address the controlling provision for the Project and describe the particular aspects of the environment and the Project that are subject to the controlled action decision.

The principal purpose of the EIS is to provide sufficient information to enable the Coordinator-General (State Government) to evaluate and assess the Project under the SDPWO Act and EPBC Act, and to state conditions and make recommendations regarding approvals required by the Project under other legislation.

At the conclusion of the SDPWO Act EIS process, the Australian Minister for the Environment will receive a copy of the Coordinator-General's Evaluation Report for consideration when making a decision under the EPBC Act. The Australian Minister for the Environment will decide on whether to approve the Project and what conditions, if any will be required.

ARTC will obtain all other development approvals from local government authorities (e.g. for a local law) and Queensland Government departments (e.g. an environmental authority under the *Environmental Protection Act 1994* (EP Act) (QLD)), where applicable.

1.5.2 OBJECTIVES OF THIS REPORT

This Matters of National Environmental Significance (MNES) Report has been prepared to address Sections 11.1 to 11.35 of the ToR and additional information requested by the

Coordinator-General following the public notification of the draft EIS. It has been prepared as a “stand-alone” document that describes ecological values as it relates to MNES and assesses potential impacts on EPBC Act listed threatened species and communities during construction, commissioning, and operation of the Project. This assessment draws on other impact assessments completed for the EIS as relevant to assessing direct, indirect and cumulative impacts to EPBC Act listed threatened species and communities.

Facilitated impacts as a result of relocation of utilities will be managed through consultation with existing utility owners that will continue through the Detailed Design stage of the Project to further verify interface impacts and to confirm appropriate mitigation measures.

Specifically, this report:

- Identifies the relevant biodiversity constraints in the Study area with reference to MNES;
- Identifies potential impacts to ecological values as a result of construction and operation of the Project;
- Informs measures to avoid and minimise impacts throughout the detailed design phase; and
- Informs measures to mitigate impacts during the construction and operation phases.
- Assesses the potential for residual significant impacts in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (Significant Impact Guidelines) (DoE, 2013a); and
- Provides determination of offsets for residual significant impacts.

In accordance with Section 158A of the EPBC Act, significant impacts to MNES will be assessed in accordance with their EPBC Act status at the time of the referral decision (i.e. 9 April 2018). Species listed under the EPBC Act after the referral decision, and species listed under the Nature Conservation Act (QLD) (NC Act) which are not also listed under the EPBC Act, are addressed in revised draft EIS Appendix L: Terrestrial and Aquatic Ecology Technical Report.

1.5.3 STUDY AREA

Desktop ecological assessments were undertaken within the Project footprint with a 1 km buffer (the Study area). The Study area has changed in size through the development of the revised reference design. Field ecological assessments were undertaken within the Project footprint.

The assessment of potential impacts has focused on the Project footprint (Figure 1-1) but indirect impacts in the Study area are also considered.

The Project footprint (3,382.17 ha) is the land required to accommodate all permanent and temporary components of the Project, as described in Chapter 5 - Project Description, being:

- Temporary disturbance footprint (3,382.17 ha): the area required to accommodate construction activities and facilities of a temporary nature and duration to support the Project. The temporary footprint is generally wider than the permanent footprint to allow for the construction of project elements including fencing, drainage features including erosion and sediment control measures, temporary stockpiling of soil, and cleared vegetation, and to allow necessary construction access and turnaround provisions. Temporary project facilities include laydowns, site office areas, non-resident workforce accommodation, a material distribution centre, concrete batch plants and borrow pits.
- Permanent disturbance footprint (2,544.86 ha): the area required to accommodate permanent infrastructure associated with the project including rail, road and other

miscellaneous infrastructure. Rail infrastructure includes rail tracks, crossing loops, turnouts, earthworks, bridges, drainage, level crossings, grade separations, rail maintenance access roads, signalling and fencing. Road related works resulting from the Project encompasses new and upgraded roads, realignments and diversions, intersection improvements and closures.

The Project footprint includes all areas where vegetation will be cleared to accommodate both permanent infrastructure and temporary construction-related activities and facilities.

Cumulative, indirect and facilitated impacts occurring outside the Project footprint have been assessed at a scale relevant to the impact being assessed.



- Legend
- Chainage (km)
 - Study Area
 - LGA
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Watercourse
 - National Park
 - State Forest



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 2 4 6km
1:200,000



F1.1 (1) - Location of the Project and the Study Area

Appendix O - Matters of National Environmental
Significance Report
ARTC





- Legend
- Chainage (km)
 - Study Area
 - LGA
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Watercourse
 - Conservation park
 - National Park
 - State Forest

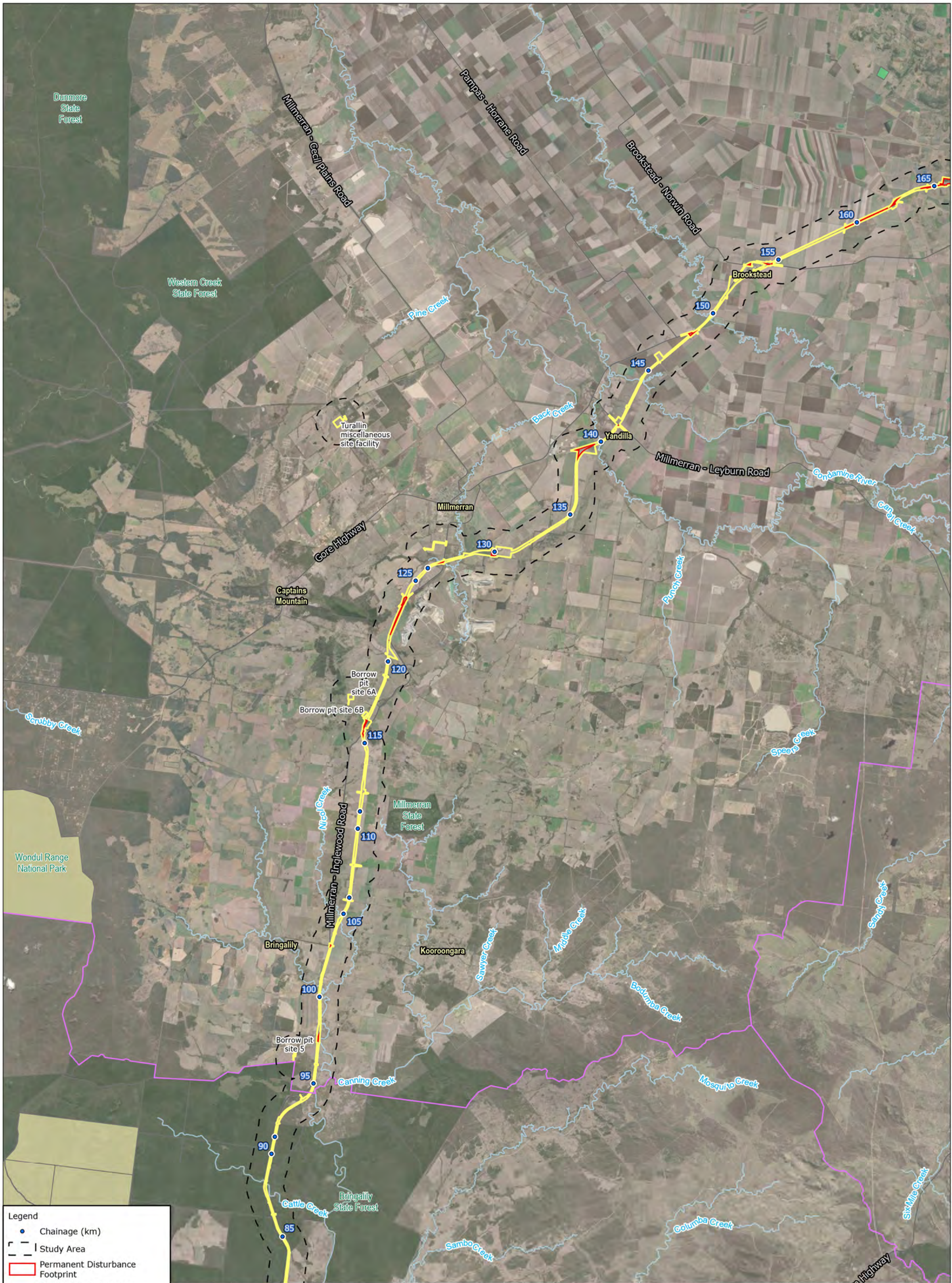


Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 2 4 6km
1:200,000

F1.1 (2) - Location of the Project and the Study Area

Appendix O - Matters of National Environmental
Significance Report
ARTC





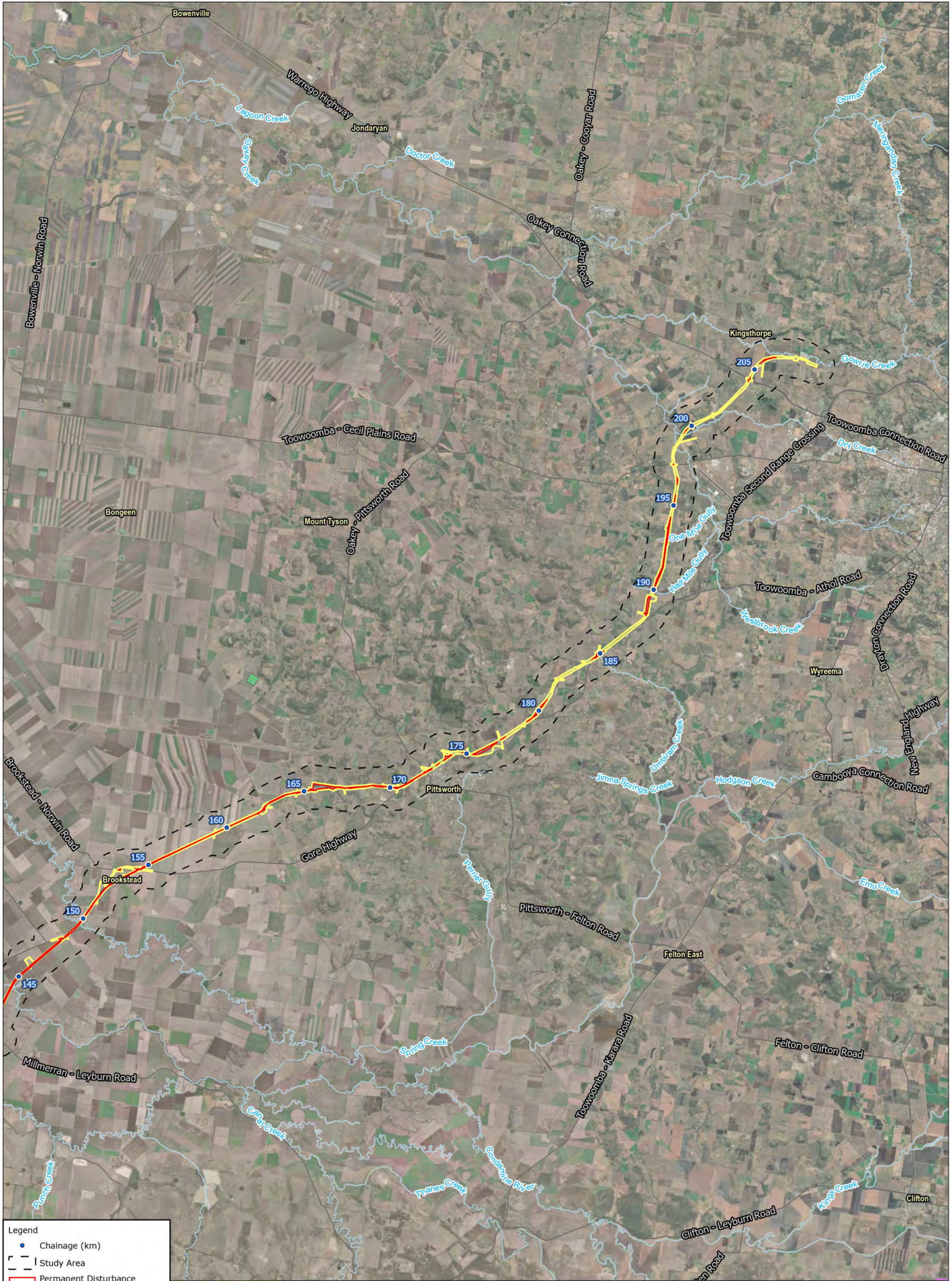
- Legend
- Chainage (km)
 - Study Area
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Watercourse
 - Conservation park
 - National Park
 - State Forest

Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 2 4 6km
1:200,000

F1.1 (3) - Location of the Project and the Study Area

Appendix O - Matters of National Environmental
Significance Report
ARTC





- Legend
- Chainage (km)
 - Study Area
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Watercourse
 - Conservation park
 - State Forest



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 2 4 6km



1:200,000

F1.1 (4) - Location of the Project and the Study Area

Appendix O - Matters of National Environmental
Significance Report
ARTC



1.6 PROJECT INFORMATION

1.6.1 PROJECT LOCATION

The Project starts at the NSW/QLD border approximately 18 km to the south-east of Goondiwindi, near Kurumbul. The Project ends in the Gowrie area, approximately 500 m east of Leasons Road.

The Project provides a link between the adjacent Inland Rail projects of:

- North Star to NSW/QLD border (NS2B) to the south at the Macintyre River, and
- Gowrie to Helidon (G2H) project in the north, which connects into QR's West Moreton Line.

Further information about the location and description of the Project is detailed in Chapter 5: Project Description.

1.6.2 REGIONAL CONTEXT

The Project is within the Brigalow Belt South bioregion. From west to east, the Project is within the Commonon Creek Floodout subregion (NSW/QLD border to Yelarbon), Inglewood Sandstones subregion (from Yelarbon to Millmerran) and the Eastern Darling Downs subregion (from Millmerran north to Gowrie). The Brigalow Belt South bioregion is characterised by a dry subtropical climate with no pronounced dry season with rainfall increasing with proximity to the coast. The bioregion has experienced a long history of human disturbance as a result of agricultural practices and resource development. At a regional level, most remaining areas of vegetation are now fragmented, occurring on the rockier hilly areas of ranges, as part of state lands (state forests), roadside vegetation (Plate 1-1 and Plate 1-2), or relatively small isolated remnants.

Within the Study area, the majority of lands are highly modified having been cleared for pasture, agricultural purposes (Plate 1.6) and for rural and urban residential settlements. Areas of planned future development on the western outskirts of Toowoomba include the Wellcamp Business Park, Witmack Industry Park, and Charlton Logistics Park which will be subject to future infrastructure and industrial development.

Agricultural activities are prominent within the low-lying floodplains associated with the Dumaresq River, Macintyre River, Macintyre Brook, and Condamine River, which have fertile soils and productive agricultural landscapes. Tracts of remnant vegetation are present (largely to the south of Millmerran), generally being limited to steeper terrain on isolated mountains and hills (typically associated with granite and basaltic outcrops and sandstone hills), road reserves and State forests.

Despite the disturbances within the Study area, the Biodiversity Planning Assessment (BPA) mapping for Brigalow Belt (Queensland Government, 2016) identifies regional and State corridors, which portrays vegetation that is significant for the connectivity and movement of flora and fauna. Both riparian and terrestrial State ecological corridors are mapped across the Project footprint.



PLATE 1-1 EXAMPLE OF MATURE TREES
RETAINED WITHIN A ROAD RESERVE,
SURROUNDED BY ANTHROPOGENIC
DISTURBANCE WITHIN THE MILLMERRAN
REGION



PLATE 1-2 EXAMPLE OF MATURE TREES
RETAINED WITHIN A ROAD RESERVE,
SURROUNDED BY ANTHROPOGENIC
DISTURBANCE SOUTH OF TOOWOOMBA

Source: FFJV (2018)

The Project footprint includes areas of agricultural land and state forest. The Project footprint has been subject to historical disturbance/clearing and approximately one third of its length is located within existing rail corridors (brownfield). The remaining greenfield portions of the Project footprint extend largely through areas subject to agricultural land uses (Plate 1-3, Plate 1-4, Plate 1-5 and Plate 1-6. Outside of the State forests in the Inglewood area, the remaining patches of vegetation within the Project footprint are highly fragmented.



PLATE 1-3 PORTION OF THE PROJECT FOOTPRINT ON THE CONDAMINE FLOODPLAIN



PLATE 1-4 PROJECT FOOTPRINT NORTH OF THE CONDAMINE FLOODPLAIN



PLATE 1-5 CABBAGE TREE CREEK ON THE CONDAMINE FLOODPLAIN, SHOWING THE NARROW BAND OF MATURE VEGETATION



PLATE 1-6 FERTILE SOILS OF THE CONDAMINE FLOODPLAIN ARE USED FOR CROPPING

Source: FFJV (2019)

In the southern extent of the Project footprint, between the NSW/QLD border and Inglewood, the landscape is dominated by dryland cropping, irrigated agriculture and intensive animal production on the fertile soils and floodplains associated with the Macintyre River, Dumaresq River, and Macintyre Brook. North of Inglewood, the Project passes through the undulating and densely forested landscapes of Whetstone and Bringalily State Forests. The Project then traverses the gently undulating agricultural areas near Millmerran before crossing the Condamine River floodplain (Plate 1-5 and Plate 1-6). The rail alignment deviates from the existing railway line north of Yarranlea to pass through the hilly landscapes surrounding Pittsworth, Southbrook, and Athol before crossing Westbrook Creek near Toowoomba Wellcamp Airport and joining the Gowrie to Helidon section of Inland Rail near Gowrie Junction.

Wondul Range National Park is located approximately 8 km from the Project footprint. This national park is not within the Study area.

There are two State forests that are intersected by the Project footprint:

- Bringalily State Forest (35,695 ha) (north of Inglewood)

- Whetstone State Forest (41,282 ha) (west of Inglewood).

There are five State forests within the vicinity of the Study area not directly affected by the Project. These are:

- McEwan State Forest (306 ha) – 1.25 km from Study area;
- Domville State Forest (228 ha) – 0.83 km from Study area;
- Millmerran State Forest (583 ha) – 1.3 km from Study area;
- Devine State Forest (4,665 ha) – 4.3 km from Study area; and
- Yelarbon State Forest (30,772 ha) – 3.7 km from Study area.

The Irongate Conservation Park (29 ha) protected under the NC Act, is located 6.5 km from the Project footprint, outside the Study area. Additionally, there is one council reserve, the Mount Basalt Environmental Park, located 5 km from the Project footprint, outside the Study area. These areas are dominated by eucalypt woodlands on sandy plains or shallow soils in areas of higher elevation. They support a high diversity of terrestrial fauna species.

The Project footprint traverses two river catchments, the Condamine and the Border Rivers. The Condamine River catchment is one of the largest catchments in the Murray Darling Basin (Murray-Darling Basin Authority, 2023). The main rivers of the catchment, the Condamine and the Maranoa, rise in elevated country in Queensland. However, two-thirds of the catchment is flat floodplain country, with a complex system of rivers and creeks joining and breaking away from the Balonne River. The catchment's extensive floodplains provide habitat for a diverse range of plants and endangered plant communities (Murray-Darling Basin Authority, 2023). The region is significant for its agricultural diversity, with a wide range of winter and summer crops produced on the Darling Downs, as well as very large cotton production areas in the west (Murray-Darling Basin Authority, 2023).

The Border Rivers catchment is one of the northern-most catchments in the Murray Darling Basin (Murray-Darling Basin Authority, 2023) and comprises a group of rivers in a region straddling the NSW/QLD border. The rivers of the catchment rise on the western slopes of the Great Dividing Range and run westward, gradually merging with one another to become the Barwon River on the floodplains upstream of Mungindi (Murray-Darling Basin Authority, 2023). The catchment encompasses approximately 450 km of rivers. The landscape of the Border Rivers catchment is diverse, containing tablelands and slopes as well as semi-arid plains (Murray-Darling Basin Authority, 2023).

Further information on geology, surface water and groundwater is reported in the Chapter 9: Land Resources, Chapter 13: Surface Water and Chapter 15: Groundwater.

The Project is located within the Goondiwindi and Toowoomba local government areas (LGAs) in the Brigalow-belt bioregion.

1.6.3 ALTERNATIVE LOCATIONS AND ROUTE OPTIONS FOR THE PROJECT

The route history of Inland Rail Program is documented in the Inland Rail Route History 2006-2019 (ARTC 2020), available at <https://inlandrail.com.au/information-hub/>. In regard to the B2G Project, it has undergone several route assessments since 2016, including:

- North Star to Yelarbon (5 alignment options);
- Yelarbon to Gowrie (6 alignment options);
- Corridor Options Report (4 alignment options);

- Forestry route via Cecil Plains (6 alignment options); and
- Design development and refinement – separated the B2G alignment into 12 project areas, each with multiple alignment options.

The outcome of these route assessments from 2016 to 2018 culminated in a preferred Study area for the Project. The Study area that was identified during the concept planning stage of the Project and provided to ARTC by the Federal Government was nominally 2 km wide. The Study area formed the basis of ARTC's application to the Queensland Coordinator-General for determination of the Project as a 'coordinated project' under the *State Government and Public Works Organisation Act 1971* (QLD), as documented in the initial advice statement (IAS) (ARTC, 2018). In response to community queries in mid-2018, ARTC focused investigations on a narrower area based on planning, environmental, and engineering findings. In determining the final project alignment and footprint, the Project continued to adopt consistent considerations in the route selection process used through previous phasing. Choosing a route involves evaluating:

- Enhancements to the Inland Rail Service Offering;
- Construction and operating costs; and
- Muti-Criteria Analysis (MCA).

The MCA framework ensures thorough consideration of:

- Engineering and technical factors;
- Social and community impacts;
- Number of affected properties;
- Environmental impacts; and
- Geotechnical and constructability issues.

In all instances, the guiding principles of ecologically sustainable development have been factored into the assessment and selection of corridor and alignment options for the Project. Environmental constraints guided corridor selection, integrating impacts into the MCA. Design intent strived to incorporate solutions to avoid, minimise, or mitigate impacts identified during route analysis and design development. Design and refinement assessments occurred from early 2018 across the entire B2G alignment, which was separated into discrete project areas for the purpose of the route assessment:

- NSW/QLD Border to Kurumbul;
- Kurumbul to Whetstone;
- Whetstone to Millmerran;
- Inglewood area;
- Millwood area (Millmerran–Inglewood Road);
- Commodore Mine area;
- Millmerran Alternative Alignment;
- Millmerran to Yarranlea;
- Brookstead;
- Yarranlea to Southbrook;
- Southbrook to Athol;
- Athol to Gowrie Mountain; and

- Warrego Highway to Gowrie Junction.

The two major route assessment principles utilised within the Study area were:

- Maximise use of existing rail corridors, where possible; and
- Co-locate adjacent to linear transport infrastructure, where possible.

Other design related optimisations included:

- Minimising property severance in greenfield areas;
- Minimising impacts to MNES;
- Mitigating impacts on landowners, businesses, and existing infrastructure;
- Avoiding floodplain areas to reduce flood impacts, cross-drainage and construction challenges; and
- Minimising impact on challenging topography to reduce earthworks and footprint impacts.

Furthermore, the Project also used the guiding principles, as established in the *National Strategy for Ecologically Sustainable Development* (Ecologically Sustainable Development Steering Committee, 1992), are as follows:

- Decision-making processes should effectively integrate both long- and short-term economic, environmental, social and equity considerations;
- Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- The global dimension of environmental impacts of actions and policies should be recognised and considered;
- The need to develop a strong, growing and diversified economy that can enhance the capacity for environmental protection should be recognised;
- The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised;
- Cost-effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms; and
- Decisions and actions should provide for broad community involvement on issues that affect them.

Concluding these route assessments resulted in an EIS temporary and permanent footprint, which was established to encompass all project elements as presented within the revised draft EIS.

1.6.4 DESIGN DEVELOPMENT AND REFINEMENT

This section provides a summary of the main alignment option assessments that were undertaken during the reference design and EIS development stage of the Project, from early 2018 to the present. The main overarching principles that were applied in positioning the alignment for the reference design were:

- maximise the use of existing rail corridors, and
- outside of existing rail corridors, seek to maximise co-location with existing linear transport infrastructure.

Through considering and applying these principles, additional considerations needed to be optimised through the design process. These included, but were not limited to:

- Minimising severance to properties in greenfield areas;
- Minimising impacts to MNES;
- Lessening impact to landowners, businesses and existing infrastructure;
- Minimising the extent of alignment located within floodplain areas, due to cross-drainage and constructability issues, and
- Avoiding challenging topography to lessen earthworks and footprint impacts to stakeholders and surrounding infrastructure.

1.6.4.1 STUDY AREA DEFINITION

As described in Section 1.6.3, in mid-2018, the community requested ARTC to provide more clarity about how the Project will impact landowners. In response, ARTC identified the focused area of investigation from preliminary results of planning, environmental and engineering investigations. The focused area of investigation, although narrower than the 2 km wide Study area in most parts, varied in width depending on the location, constraints and results from the initial design investigations. Further, more detailed technical investigations enabled the final rail corridor (30 m minimum, however it is wider, as required, to accommodate the earthworks associated with large cuts and fills, drainage works, rail infrastructure, access roads and fencing)) to be identified. If the Project is approved to proceed, it is ARTC's intention that the nominated rail corridor be gazetted as future railway land by the Queensland Government.

1.6.4.2 ENVIRONMENTAL DESIGN

Environmental design requirements were considered and assessed through the corridor selection process for the Project. For the revised reference design, criteria were established to guide design development, while avoiding or minimising environmental and social impacts. Development of the revised reference design has progressed in parallel with the impact assessment process. As a result, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the revised reference design as appropriate and where possible.

1.6.5 PROJECT DESIGN

The Project consists of the key permanent and temporary features listed in Table 1-1. Key features of the Project are also shown in EIS Appendix B1: Design Drawings.

Further information regarding key features of the Project is provided in Chapter 5: Project Description, including the works that form part of the Project activities.

TABLE 1-1 SUMMARY OF KEY FEATURES OF THE PROJECT

Aspect	Description
Permanent features	
New track	Approximately 217.48 km of new single-track railway, consisting of: • 7.0 km of standard gauge rail (1,435 mm) • 210.48 km of dual gauge rail (standard (1,435 mm) and narrow (1,067 mm) gauge).

Aspect	Description
	Railway infrastructure and the corridor will be constructed for 1,800 m long trains.
Rail corridor	- Establishment of approximately 149.48 km of new rail corridor (greenfield) and use of approximately 68.00 km of existing open access rail corridor (brownfield). - The rail corridor width will vary along the length of the alignment, with a minimum of 30 m to greater than 100 m. The rail corridor width is dependent on various elements in the corridor including: - embankment height or cutting depth, - crossing loop and/or maintenance siding, - structures (e.g. bridges, viaducts, concrete boxes, pipes etc.), - drainage and scour protection lengths, - railway maintenance access roads, - level crossings, and - Queensland Rail connections. - Brownfield corridor refers to locations where the Project is generally coincident with existing rail corridors to prioritise areas of existing pre-clearing and disturbance. This does not mean that the railway is located wholly within the existing rail corridor. Corridor widening and/or curve easing may be required to meet the requirements of the ARTC Basis of Design, resulting in some works outside the extent of the existing rail corridors.
Crossing loops and turnouts	- Crossing loops are places on a single-line track where trains in opposing directions can pass each other. Five crossing loops will be constructed as part of the Project, 2,200 m in length for each loop. - The proposed locations for the crossing loops are: - Yelarbon—Ch 16.3 km to Ch 18.5 km. - Inglewood—Ch 50.2 km to Ch 52.4 km. - Kooroongarra—Ch 89.2 km to Ch 91.4 km. - Yandilla—Ch 132.2 km to Ch 134.4 km. - Broxburn—Ch 176.1 km to Ch 178.4 km. - Turnouts allow the train to be guided from one section of track to another. Turnouts that connect in to crossing loops and QR's existing South Western Line, Millmerran Branch Line and sidings have been incorporated into the revised reference design.
Earthworks	- Excavations in the existing ground profile will be made where the final design level is lower than the surrounding land, these are known as cuttings. There are 23 cuts locations where the cuts are greater than 7 m in depth along the alignment to maintain the required track elevations. The total cut estimated for the Project is 11,368,000 m³. - Embankments and benching. - Structural fill and capping is required at the top of the formation to provide a solid foundation on which the railway ballast, sleepers and track can be placed.
Bridges	- Bridges to accommodate topographical variation, crossings of waterways or other infrastructure. - The Project involves the construction of 37 new bridge structures. These include: 14 rail-over-road bridges, 18 rail-over-watercourse bridges, and 5 road-over-rail bridges.
Drainage infrastructure	- Cross-drainage is provided by reinforced concrete pipe culverts and reinforced concrete box culverts. The Project includes 1,193 reinforced concrete box culverts, 2,134 reinforced concrete pipe culverts and a series of viaducts / bridge structures spanning approximately 11 km. - Scour protection measures will be installed around culverts and abutments to prevent erosion and sedimentation.

Aspect	Description
	- Longitudinal or track drainage is proposed at specific locations along the Project alignment where the gradient is steep enough to divert surface runoff to the nearest bridge or culvert location. The following two types of track drainage are proposed: - Embankment drains – longitudinal drains that run parallel to the railway and are located within the permanent footprint, at the foot of the railway embankment. - Catch drains – longitudinal drains that run parallel to the railway and are located within the permanent footprint, on the up-slope side of cuttings. - The Yelarbon levee will be augmented to mitigate flood impacts associated with the Inland Rail project and, at a minimum, maintain the current flood immunity offered by the levee.
Road-rail interfaces	- Road–rail interfaces are points at which the rail alignment intersects a public road. Road manager interfaces treatments include: - TMR – 9 - Goondiwindi RC – 16 - Toowoomba Regional Council (TRC) - 25
Road network changes	To facilitate the Project, changes to the local road network are required to safely accommodate the railway and maintain local and regional connectivity. The road network changes have been developed in consultation with DTMR and local council road managers and will be undertaken in accordance with relevant DTMR and local council design standards. The road network changes consist of road realignments or diversions, consolidations, and upgrades.
Rail maintenance access roads	Rail maintenance access roads are required to facilitate maintenance for critical infrastructure (e.g. turnouts), to enable construction in a safe manner and to provide access for emergency recovery during operation of the railway. Formation level access has been proposed for all turnout locations and, where reasonably practical, for the full extent of crossing loops.
Utilities and services	All utility owners have been consulted by ARTC during the revised reference design process to establish potential interface impacts and to identify initial design solutions. Permanent connections will be required during the operational stage.
Fencing	- To prevent public access to the Project's rail corridor, fencing will be provided for the majority of the rail corridor. Fencing will act to protect adjoining lands from trespass and to prevent livestock and wildlife from gaining access to the railway. Fencing is to extend between the corridor and private lots or property adjoining the railway. Specific fencing considerations will be discussed with relevant landowners as part of the detailed design process. - Fauna exclusion fencing will be installed to prevent wildlife access to the railway and guide wildlife towards fauna crossing structures. - The Project intersects the wild dog check fence at three locations, and will be realigned in two of these locations in consultation with Goondiwindi Regional Council (GRC) and Department of Agriculture and Fisheries (DAF): - From Springborg Road to Whetstone (Ch 37.7 km to Ch 43.5 km) the rail corridor runs parallel to the existing wild dog check fence and is impacted by the necessary corridor widening works of the existing QR South Western Line. - Direct severance from McDougalls Road and Cremascos Road (Ch 50.2 km to Ch 51.2 km) requiring a realignment along the rail corridor boundary fence. - Direct severance from Cremascos Road heading north-east (Ch 54.6 km to Ch 56.0 km) requiring a realignment along the rail corridor boundary fence.

Aspect	Description
	The Project intersects the DDMRB rabbit-proof fence when traversing through the locality of Clontarf, at approximately Ch 120.2 km. The rabbit proof fence will need to be reinstated and ARTC have undertaken consultation with the DDMRB to determine fencing requirements at this location.
Fish passage	The Fisheries Act and the Planning Act require that works within waterways that are considered waterway barriers, must be conducted in a manner to provide for adequate fish passage.
Signalling and communications	The Project will be operated initially using Centralised Train Control with the infrastructure installed upgradable to accommodate future deployment of the Advanced Train Management System (ATMS).
Construction features (temporary)	
Land	- Temporary access tracks will be used to access construction sites. Where possible, access tracks will be retained to serve as rail maintenance access roads during the operation of the Project. - Land requirements for construction will include temporary workspaces, site offices and laydown facilities. These requirements are encompassed within the nominated Project footprint. - Seventy-eight laydown areas to support construction activities, including site offices, material and equipment storage, and to facilitate bridge construction, will be located within the temporary footprint (avoiding 1% annual exceedance probability (AEP) floodplains, where possible, and areas of native vegetation). - Two facilities are required during construction for the dual activities of precast concrete structure storage (laydown) and on-site concrete batching.
Quarries and borrow pits	- Seven quarries and seven borrow pits at six locations (dual pits on one location) have been identified as potentially suitable for use during construction activities. - Established quarries are expected to be the primary source for ballast and capping and other high-quality aggregates for the Project. - Borrow pits are to supply fill for the Project construction.
Non-resident workforce accommodation facilities	Construction, use and decommissioning of temporary non-resident workforce accommodation facilities to support the construction workforce associated with the Project. Two camp locations have been identified, at Yelarbon and Inglewood.
Utilities and services	- Temporary connections will be required during the construction stage. Utilities and services such as water, sewerage, electricity and telecommunications will need to be supplied to laydown areas, the non-resident workforce accommodation sites and compounds for use in site offices and amenities as required. - Where these utilities are already located close to construction sites, the Contractor will engage with utility providers, with the objective of connecting to mains power, water, communications and sewerage. - Where connection to existing infrastructure networks is not possible or practicable, temporary portable alternatives will be adopted.
Whetstone Material Distribution Centre	A temporary material distribution centre (MDC) will be located in Whetstone approximately 18 km south-west of Inglewood and 59 km east of Goondiwindi. The facility is required to support construction of the Project. And will require a temporary change in land use from rural/agricultural to, work site, material storage and laydown areas. The site will be required for the duration of the construction of the B2G Project.

1.6.6 REVISED REFERENCE DESIGN

1.6.6.1 CHANGES TO THE REFERENCE DESIGN SINCE DRAFT ENVIRONMENTAL IMPACT STATEMENT

Since public notification of the draft EIS, the reference design has been revised in response to consultation with key stakeholders (including landowners, communities, contractors, Council and technical authorities), further assessment of scientific and field verified survey data and review of design opportunities aimed at increasing efficiencies and avoiding and reducing impacts. The updates to the reference design since notification of the draft EIS are illustrated in Appendix B3 and have included changes in vertical and horizontal alignments, modifications to road rail interfaces, and the inclusion of workforce accommodation and borrow pits. A summary of the main changes are below:

- Turallin facility: Inclusion of a 20 hectare (ha) site in the temporary footprint to be utilised for a laydown area, a training facility or native plants nursery and traditional land management training facility (proposed land use subject to on-going negotiations between the ARTC and the landowners);
- Whetstone Material Distribution Centre (MDC): As part of the track construction delivery strategy for the Project, ARTC is proposing to establish a temporary MDC in Whetstone, on land bounded by the South Western System Railway Line to the north and Cunningham Highway to the south. The site's ability to receive and distribute material via rail will increase efficiencies in the construction phases and significantly reduce the need for road transportation. Further detail regarding the site is contained in Chapter 5: Project Description; and
- Borrow pits: The cut and fill earthworks program for the Project were further optimised to reduce the Project's fill deficit and reliance on imported materials to support construction. Six borrow pit locations (with two smaller pits proposed at one location) have been identified to supply required fill materials.
- Stock route interfaces:
 - Realignment of two stock routes and crossing at Kildonan Road and South Kurumbal Road, to avoid stock interaction with road vehicles; and
 - Inclusion of suitably sized holding yards and corridors at key interfaces following consultation with DoR
- Inclusion of a pedestrian level crossing at Yelarbon: Millmerran realignment: Realignment of a portion of rail alignment and crossing loop and inclusion of a grade separated crossing in Millmerran to mitigate impacts and severance to an intensive animal and agricultural industry and improve safety;
- Non-resident workforce accommodation: Two 20 ha workforce accommodation sites have been included in the temporary footprint to accommodate the Project construction workforce requirements, one at Inglewood and another at Yelarbon. A third camp will be required in the northern extent of the Project around Millmerran and feasibility assessments will be undertaken to identify the optimal location for the site ensuring that environmentally sensitive areas are avoided; and
- Yelarbon levee: The existing levee was recategorised from Category 2 to Category 3 following further consultation with GRC.

- Project footprints: The temporary and permanent footprints have been based on consultation, field validated ecology results and a rationalization based on the revised reference design. .

The various design and construction elements of the project have been reviewed and modified in response to consultation with key stakeholders and analysis of field verified survey data. This was undertaken to ensure further opportunities to avoid and reduce impacts to ecological receptors, through reduced clearing requirements and configuration of project infrastructure, were incorporated in the revised reference design. Specific examples of adjustments to the permanent and temporary Project footprints in regard to ecological receptors are illustrated in Appendix B3 and include the following:

- Road Rail Interfaces: Six additional grade separations (rail over road or road over rail). These replace previously proposed level crossing treatments;
- Blackall Road white box-yellow box-Blakely's red gum grassy woodland and derived native grassland (box gum) threatened ecological community (TEC): Further targeted survey and redesign of construction vehicle access configurations was undertaken to reduce direct and indirect impacts and clearing requirements of box-gum grassy woodland TEC across two properties intersected by the alignment south of Blackwell Road (94DY180 and 3SP166689). A clearing reduction of 9,000 m² of box-gum grassy woodland TEC was achieved through the Project footprint reduction as demonstrated in Section 4.2.2 and Appendix B3;
- Semi-evergreen vine thicket TEC: An entire SEVT TEC has been avoided from direct and indirect impacts following further targeted field surveys and redesign of both the permanent and temporary Project footprint across 1SP204014. A Project footprint reduction of approximately 16,000 m² has resulted in a complete avoidance of an isolated patch of SEVT TEC as demonstrated in Section 4.2.2 and Appendix B3;
- Bringalily State Forest: Extensive areas of the Bringalily State Forest have been subsequently reduced following design refinement along the eastern extent of the Project footprint totaling approximately 21.5 ha reduction to reduce impacts to remnant vegetation communities and threatened species habitat (e.g., koala, south-eastern long-eared bat, spotted-tailed quoll). This refinement included removal and relocation of a laydown area outside the State Forest and into the adjacent road corridor. Although constrained by short-stacking requirements for location roads, the design achieved significant reduction in footprint across a length of 7.5 km, whilst ensuring all drainage infrastructure remained within the rail corridor. Refer to Appendix B3; and
- Canning Creek Offset Property: More than 40,000 m² of threatened vegetation communities including Brigalow TEC and threatened species habitat including brigalow woodland snail (*Adclarkia cameroni*), painted honeyeater (*Grantiella picta*), squatter pigeon (*Geophaps scripta scripta*), koala (*Phascolarctos cinereus*), south-eastern long-eared bat (*Nyctophilus corbeni*), Dunmall's snake (*Furina dunmalli*), and yakka skink (*Egernia rugosa*) has been avoided following redesign of the Project footprint predominantly along the eastern extent of the proposed Canning Creek Offset Property. Refer to Appendix B3.

There will be opportunity to further reduce Project impacts and clearing requirements in detailed design. It is not possible to incorporate further footprint reductions as part of the EIS revised reference design for Project approval due to the Project's known flooding mitigation

requirements which necessitate the modification and installation of additional flooding infrastructure such as new and changed configurations of bridges and culverts and the inclusion of scour protection. Flooding mitigations are required to be implemented in the detailed design and construction stages in line with the approach developed in consultation with the International Expert Flood Panel with respect to Flood Impact Objectives (FIOs). Project specific flooding design targets have been developed (FIOs comprising velocity, afflux and time of inundation) to identify areas where additional consideration is required and to determine whether the impact is appreciable, acceptable, and to guide mitigation options. Mitigations will be determined on a case-by-case basis subject to consideration of environmental, economic, engineering and landowner constraints.

1.6.6.2 RAIL CORRIDOR, CROSSING LOOPS AND BRIDGES

The Project requires establishment of approximately 149.48 km of new rail corridor (greenfield) and utilisation of approximately 68.00 km of existing rail corridor (brownfield), specifically the South Western Line and the Millmerran Branch Line which are components of QR's South Western System.

Brownfield corridor refers to locations where the Project is generally coincident with existing rail corridors to prioritise areas of existing pre-clearing and disturbance. This does not mean that the proposed railway is located wholly within the existing rail corridor. Corridor widening and/or curve easing is generally required to meet the requirements of the ARTC Basis of Design, resulting in some works outside the extent of the existing rail corridors.

The rail corridor is generally a minimum width of 30 m however, it is wider, as required, to accommodate the earthworks associated with large cuts and fills, drainage works, rail infrastructure, access roads and fencing.

Crossing loops are places on a single line track where trains in opposing directions can pass each other. These are double ended and connected to the main track at both ends. The Project includes five new crossing loops. The selection of crossing loop locations was informed by operational modelling for the Inland Rail Program and has taken into consideration proximity to MNES, interferences with existing infrastructure and flexibility for future extension. The proposed locations for the crossing loops are:

- Yelarbon – Ch 16.3 km to Ch 18.5 km;
- Inglewood – Ch 50.2 km to Ch 52.4 km;
- Koroongarra – Ch 89.2 km to Ch 91.4 km;
- Yandilla – Ch 132.2 km to Ch 134.4 km; and
- Broxburn – Ch 176.1 km to Ch 178.4 km.

The loops would be constructed as new sections of track roughly parallel to the existing track. They would each be 2,200 m long to accommodate 1,800 m long trains. Crossing loop track design assumes a 4.5 m spacing from the mainline track and incorporates an additional 250 m maintenance siding. The width of the corridor at crossing loops varies depending on the surrounding topography and earthworks, however a typical crossing loop may be approximately 2200 m wide.

Bridge structures are required so that water, vehicles and, in some cases, stock and pedestrians may cross the proposed rail corridor. The Project involves the construction of 37 new bridge structures, as summarised in Table 1-2.

TABLE 1-2 SUMMARY OF BRIDGE STRUCTURES FOR THE PROJECT

Crossing type	Number
Rail-over-road	14
Rail-over-watercourse	18
Road-over-rail	5

The type of bridge proposed for a location depends on a range of factors, including the local topography, road use, rail and road alignments at the crossing point and access requirements. Bridges have been provided at all major watercourse crossings along the Project alignment to minimise impacts to flow regimes and to avoid having to divert watercourses.

1.6.6.3 DRAINAGE INFRASTRUCTURE

Cross-drainage and longitudinal drainage structures have been incorporated into the revised reference design where the Project intercepts existing watercourses and other drainage features. The selection of cross-drainage structures including bridges and culverts in the design depends on various factors such as the natural topography, rail formation levels, design flow and soil type. Bridges are proposed at all major waterway crossings. In some instances, bridges are provided at locations that may have multiple drainage features passing under the rail corridor, such as across the Condamine River floodplain.

Cross-drainage structures, including culverts, have been incorporated into the rail embankment design to enable the Project to achieve the flood immunity specified in the design criteria of a 1% AEP event. This includes the re-built existing brownfields portions of the site which are currently 20% AEP. Culverts incorporated into the design are a mix of reinforced concrete pipe culverts and reinforced concrete box culverts. The design and location of culverts will be refined, if required, during the detailed design phase to reflect design changes through that process.

Scour protection or energy dissipation measures have been included around culvert entrances and exits, on disturbed stream banks and on land bound by a watercourse to avoid erosion.

Longitudinal or track drainage is used to remove water that has percolated through the track ballast and to divert surface runoff to the nearest bridge or culvert location before it reaches the subgrade. Without adequate track drainage, the subgrade may become saturated, leading to weakening and subsequent failure of the subgrade.

Two types of track drainage are proposed:

- Embankment drains – longitudinal drains that run parallel to the railway and are located within the rail corridor the foot of the railway embankment; and
- Catch drains – longitudinal drains that run parallel to the railway and are located within the rail corridor, on the up-slope side of cuttings.

Longitudinal drainage is proposed at specific locations along the alignment where the gradient is steep enough to divert surface runoff to the nearest bridge or culvert location. As with culverts, the design and location of track drainage will be refined, if required, during the detailed design phase.

The existing Yelarbon levee is an earthen embankment levee that runs from East Sawmill Road to the Cunningham Highway where it transitions into a walking track. It is estimated that the

existing levee provides the township of Yelarbon flood immunity for events up to between 5% and 10% AEP.

To mitigate flood impacts associated with the Inland Rail project it is proposed to install a combination of cross drainage under the proposed rail embankment and to raise the existing levee height in places. The objective of the Yelarbon Levee Augmentation work is to maintain the current flood immunity offered by the levee, at a minimum. Discussions between ARTC and GRC are ongoing with regards to the design criteria to be adopted for the Yelarbon Levee augmentation.

1.6.6.4 ROAD-RAIL INTERFACES

Road-rail interfaces are points at which the rail alignment intersects a public road. The Project requires the crossing of State-controlled roads and local government (GRC and TRC) roads. A summary of the number of interfaces with each public road type is presented in Table 1-3.

TABLE 1-3 SUMMARY OF PUBLIC ROAD INTERFACES IN THE REVISED REFERENCE DESIGN FOR THE PROJECT

Road type	Number of interfaces -level crossing or grade separation	Number of interfaces with alternative treatment -divert/realign/ no crossing provided
State-controlled (DTMR)	9	1
GRC	16	2
TRC	25	14
Queensland State (DoR)	2 (stock route realignment)	n/a

Treatments for public road-rail interfaces can be categorised as:

- Grade separated crossings - road and rail cross each other at different heights (above or below) with traffic flow unaffected;
- Level crossings – road and rail cross each other at the same level. Level crossings have either passive or active controls to guide road users:
 - Passive – have static warning signs (e.g. stop and give way signs) that are visible on approach. This signage is unchanging with no mechanical aspects or light devices;
 - Active – flashing lights with or without boom barriers for motorists, and automated gates for pedestrians. These devices are activated prior to and during the passage of a train through the level crossing; and
- Crossing consolidation, relocation, diversion or realignment - where existing road-rail interfaces may be closed, consolidated into fewer crossing points, relocated or diverted.

Further details on the proposed road-rail interfaces and treatments can be found in EIS Chapter 5: Project Description.

1.6.6.5 ROAD NETWORK CHANGES

To facilitate the Project, changes to the local road network are required to safely accommodate the railway and maintain local and regional connectivity. The road network changes have been developed in consultation with DTMR and local council and will be undertaken in accordance with relevant DTMR and local council design standards. The road network changes consist of road realignments or diversions, consolidations, upgrades at the following locations noted below. These are ancillary works associated with a road rail interface treatments:

1. Yelarbon Ch 25 km. As a result of the Cunningham Highway interface treatment: road over rail grade separation, several roads require realignment or upgrade:
 - Yelarbon Kurumbul Road and intersection with Cunningham Highway;
 - Railway parade realignment;
 - Yelarbon Keeta Road realignment with intersection onto Cunningham Highway;
 - Kera St cul-de-sac;
 - Bengalla Street connection to Yelarbon Keeta Road; and
 - Cunningham Highway vertical raise alongside Yelarbon levee.
2. Schwartens Road realignment Ch 126.6 km – realignment.
3. Pampas Ch 148.2 km. As a result of the existing short-stacking issues with Fysh Road, several roads require realignment or upgrade:
 - Closure of existing Fysh Road intersection and level crossing;
 - New realignment and intersection of Pampas Pit Road and Fysh Road; and
 - Harris Road and Gore Highway new intersection.
4. Brookstead Ch 154.4 km. As a result of the Gore Highway interface treatment: road over grade separation, several roads require realignment or upgrade:
 - Connection road realignment between Ware Street and Saal Road underneath the proposed grade separation; and
 - New road linking the Gore Highway and Saal Road with intersection.
5. Yarranlea area Ch 164.4 km to Ch 166.8 km:
 - New road connecting Glen Devon Road to Murlaggan Road
 - New road connection from Roche Road to Murlaggan Road with intersection.
6. Pittsworth Area:
 - French Road Ch 169.6 km realignment to Tip Road Ch 170.4 km;
 - Dallman Road Ch 172 km realignment to Quibet Road Ch 172.8 km with intersection upgrade on Oakey Pittsworth Road; and
 - Paint Mine Road Ch 175 km realignment back to McEwan Lane Ch 174.4 km and connects to Lochaber Road Ch 173.7 km grade separation (rail over road), which includes a road realignment and new intersection with the Gore Highway.
7. Bushy Lane Ch 184.1 km realignment to Biddeston Southbrook Road Ch 184.9 km grade separation (rail over road). These works contain new intersections with Bushy Lane and the Gore Highway.

8. Purcell Road Ch 188.5 km realignment to Athol School Road Ch 189.3 km grade separation (rail over road).

1.6.6.6 FENCING

Fencing will be provided for the majority of the rail corridor to limit access to the railway, mitigate impacts on wildlife and contribute to pest fauna management. The fencing approach has been detailed in Chapter 5: Project Description.

Fencing will protect adjoining lands from trespass and prevent stock on such adjoining land from gaining access to the railway. Fencing type, location and crossings will continue to be refined through detailed design, with any specific requirements to be designed in consultation with the adjoining landowner.

As the Project comprises substantial greenfield works in rural agricultural and grazing areas, standard rural fencing will typically be provided according to ARTC fencing procedure, Boundary Fencing ETM-17-02 (available on the ARTC Extranet: extranet.artc.com.au). Where ARTC proposes to construct within the QR corridor for all returned works (South Western Line and Millmerran Branch Line), ARTC shall comply with QR standards; this includes new and replacement fencing.

It is proposed that all existing fencing is removed and replaced. Where ARTC are proposing to construct new railway corridor that coincides with road manager or landowner fencing, this will typically be replaced following ARTC fencing procedure, Boundary Fencing ETM-17-02. Where superior fencing is required (for example where tracks are in close proximity to roads and/or communities, or where trespass is anticipated to occur) a 1.8 m chain link boundary fence may be provided.

Pest exclusion fencing

There are three types of barrier fences identified in the *Biosecurity Act 2014* (Qld) for the management of pest animals. These are the wild dog barrier fence, wild dog check fence and the rabbit proof fence. The Project intersects the wild dog check fence and the rabbit proof fence.

Wild dog check fences protect areas of grazing and cropping land in southern Queensland from wild dogs. Wild dog check fences do not physically link up to the wild dog barrier fence, however they play an important role in wild dog control in southern Queensland. GRC is responsible for the ongoing maintenance of approximately 283 km of the wild dog check fence.

The Project alignment affects the existing wild dog check fence from Yelarbon to Whetstone (Ch 28.9 km to Ch 43.5 km) and at two additional locations with GRC. The section of the wild dog check fence from Yelarbon to Springborg Road (Ch 28.9 km to Ch 37.7 km) is unmaintained and inactive. This section of the fence provides no functional or strategic benefit to the broader fencing network in wild dog control, nor provides additional protection to animals in the adjacent cropping and grazing lands.

The Project impacts operational sections of the wild dog check fence at three separate locations including:

- From Springborg Road to Whetstone (Ch 37.7 km to Ch 43.5 km) from rail corridor runs parallel to the existing wild dog check fence and is impacted by the necessary corridor widening works of the existing QR South Western Line;
- Direct severance from McDougalls Road and Cremascos Road (Ch 50.2 km to Ch 51.2 km) requiring a realignment along the rail corridor boundary fence; and

- Direct severance from Cremascos Road heading north east (Ch 54.6 km to Ch 56.0 km) requiring a realignment along the rail corridor boundary fence.

ARTC will reinstate the wild dog check fence at the three locations of impact on a like-for-like basis in consultation and agreement with the with relevant stakeholders, notably Department of Environment and Science, impacted landholders and lessees, DAF, and GRC. DAF consultation is required before any amendments to the wild dog check fence under Section S91(3) of the *Biosecurity Act 2014* (Qld).

The Darling Downs–Moreton Rabbit Board (DDMRB) fence is a 555 km long rabbit proof fence. The fence is managed and maintained by the DDMRB, stretching from Lamington National Park in the east, to Goombi in the south-west, where it connects to the wild dog barrier fence. The Project intersects the DDMRB fence when traversing through the locality of Clontarf, at approximately Ch 120.2 km. The rabbit proof fence will need to be reinstated and a rabbit trap will be set up in this location.

ARTC have undertaken consultation with the DDMRB to determine fencing requirements at this location. Detailed design drawings of ARTC's nominated fencing solution at Ch 120.2 km will be submitted to DDMRB for acceptance prior to construction commencing.

1.6.7 PRE-CONSTRUCTION ACTIVITIES AND EARLY WORKS

Pre-Construction Activities and Early Works include:

- Site preparation for construction;
- Establishment of access roads/tracks;
- Vegetation clearing and other ground disturbance activities in compliance with relevant legislative requirements, approval conditions, guidelines and plans;
- Additional surveys and geotechnical investigations to inform the Construction Works stage;
- Relocation or protection of QR assets that were not required to be undertaken well in advance as part of Enabling Works (works that are not defined as Project Works and not subject to assessment in the EIS, including works to inform the ongoing development of the Project design and inputs to the EIS, and works to existing utilities and rail infrastructure to be undertaken in advance of construction works);
- Utility/service interfaces that were not required to be undertaken well in advance as part of Enabling Works;
- Modification of biosecurity fencing;
- Installation of boundary fencing;
- Establishment of site offices and initial laydown areas including Whetstone MDC; and
- Establishment of non-resident workforce accommodation.

These activities will continue into the construction stage

1.6.7.1 CLEARING AND GRUBBING

Clearing will be undertaken within clearing limits clearly demarcated prior to clearing activities commencing. All turf, topsoil and other organic and unsuitable material will be stripped from the site. Wherever possible and appropriate, this material will be temporarily stockpiled and recycled within the immediate construction footprint.

Clearing and grubbing activities will commence on multiple work-fronts and will be ahead of the primary earthworks operations, but not so far ahead that exposed soil is left open for long periods of time. Protective measures will be enabled around creek and river banks to ensure that the existing profiles are preserved. Cleared vegetation will be stockpiled temporarily outside the earthworks footprint but within the permanent and temporary disturbance footprint. Mulched material will be temporarily stockpiled and managed to facilitate re-use, and to prevent combustion. If weed infestations are encountered, the cleared vegetation will be disposed of in an appropriate manner to minimise the risk of spread of infestation.

1.6.7.2 TOPSOIL STRIPPING

Topsoil stripping of laydown, stockpile and storage areas, access tracks, and haul roads will be undertaken as part of the initial site clearances. Stripping of the main alignment and road-works footprints will typically be undertaken by the bulk earthworks fleet and will proceed ahead of the earth-works at a controlled rate, to ensure that excessive areas are not stripped and left exposed to the weather for extended periods.

The stripped topsoil will be temporarily stockpiled at designated locations within the Project footprint, outside flood-prone areas, and where practical located at cut/fill transition zones where minimal bulk earthworks and material haulage are required.

1.6.7.3 ESTABLISHMENT OF ACCESS ROADS

Internal access roads within the rail corridor are designed to cater for construction vehicles transporting earthwork material and concrete elements within the rail corridor. Internal access roads designed in accordance with the conditions required for various construction activities including vehicle numbers, lengths and weights, and the location of underground services that may be affected by oversized loads or weights. The roads are typically 8 to 10 m wide, with sufficient areas for vehicle pull over and/or overtaking and constructed to approximately 100 to 200 m above the existing surface level.

External access roads predominantly connect laydown areas and the permanent footprint. These use a combination of local council roads and State-controlled roads with suitable access points into the permanent footprint.

1.6.8 CONSTRUCTION

The indicative construction timetable for the Project is shown in Table 1-4. The broad milestone dates for construction are indicative only and are subject to change during the Detailed Design and Construction Works stages as a result of a range of factors, including:

- Weather conditions,
- Changes to construction methods and materials, and
- Unexpected finds, such as contamination, threatened biodiversity species or cultural heritage values.

TABLE 1-4 BREAKDOWN OF INDICATIVE CONSTRUCTION ACTIVITIES

	Year 1				Year 2				Year 3				Year 4				Year 5			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Civil earthworks and drainage																				

1.6.8.1 HOURS OF WORK

- Monday to Sunday 6.00 am to 6.00 pm; and
- No work on public holidays.

- Monday to Friday 9.00 am to 3.00 pm;
- Saturday 9.00 am to 1.00 pm; and
- No blasting Sundays and public holidays.

- Works during rail corridor possession (where works are required within active railway corridors it is often necessary to undertake works under track possessions, when the Contractor has control over an operating railway. These works are often required to proceed during the evening and night time to conduct the works safely and minimise the disruption to rail services. Track possession of QR assets will generally be allocated over weekend periods, including the primary hours of construction, and with extended track possession occurring over public holiday periods); and
- Work where there are no sensitive receptors (where works are required outside of the primary hours of construction, and there are no sensitive receptors that would be adversely affected by the works, construction of the Project may be undertaken up to 24 hours a day, 7 days a week. Site-specific assessments, for example noise and vibration, would be undertaken to demonstrate the environmental impacts and risks associated with the works can be managed consistent with relevant guidelines and requirements. The assessments would determine the additional measures required to mitigate the identified impacts and support the justification of construction hours at the work locations).

1.6.8.2 WORKFORCE

A preliminary estimate of the workforce required to undertake the construction tasks for the Project to the nominated program is estimated to peak at 900 full-time equivalents (FTE) around week 80 of construction. The average number of FTE workforce on site across the full Construction Works stage is approximately 383 people.

1.6.8.3 NON-RESIDENT WORKFORCE ACCOMMODATION

An initial assessment of workforce demand and safe commutable distances has identified a potential need for non-resident workforce accommodation in the vicinity of Yelarbon, Inglewood, and Millmerran. Properties within the footprint at Yelarbon and Inglewood have been identified as suitable for the establishment of non-resident workforce accommodation (Table 1-5). The location for a Millmerran workforce accommodation has not been included in the revised draft EIS. The site selection and due diligence associated with locating a Millmerran workforce accommodation will be undertaken during the Detailed Design stage and be assessed separately.

TABLE 1-5 LOCATIONS FOR NON-RESIDENT WORKFORCE ACCOMMODATION

Lot and plan	Address
Lot 30 MH721	Cunningham Highway, Yelarbon
Lot 5 MH75	Millmerran–Inglewood Road, Inglewood

The Yelarbon non-resident workforce accommodation would be located approximately 2.5 km north-west of Yelarbon with access into the accommodation off the Cunningham Highway, a State-controlled road. The Inglewood non-resident workforce accommodation would be located approximately 12 km north-east of Inglewood with access from Millmerran–Inglewood Road, a State-controlled road. These camps will have an approximate construction pad area of 200,000 m².

Each non-resident workforce accommodation will be largely self-contained and will include accommodation units with kitchen, dining, ablution, and laundry facilities. Supporting and additional infrastructure associated with each accommodation will include:

- Potable water storage – approximately 3 ML (megalitres) of water per month of operation during peak occupancy, based on average usage of 250 L per person, per day;
- Water and wastewater treatment and collection facilities, including temporary package sewage treatment and adequate availability of land for treated effluent irrigation/disposal (estimated capacity of 300 equivalent population);
- Power generation (if not connected to the local electricity grid) by diesel-powered generators, in combination with solar panels, where appropriate;
- Solid waste-collection facilities;
- Offices; and
- Car parking and gatehouse/security.

The service life of the non-resident workforce accommodation sites is restricted to the duration of Construction for the Project, of up to five years.

1.6.8.4 WORKFORCE TRANSPORT

Project personnel will travel between their homes or temporary non-resident workforce accommodation and work sites using passenger vehicles. The use of buses will be considered to transport workers between non-resident workforce accommodation facilities and worksites, depending on the number of personnel at different times and the distribution of crews between worksites.

1.6.8.5 WHETSTONE MATERIAL DISTRIBUTION CENTRE

As part of the track construction delivery strategy for the Project, ARTC is proposing to construct a temporary MDC at Whetstone, Queensland, on land bounded by the South Western System Railway Line to the north and Cunningham Highway to the south. The land on which the MDC is proposed is described as Lot 2 on MH784.

The facility will include a narrow-gauge turnout to support construction activities as well as to accept and redistribute material via the QR South Western line.

To enable activities and receipt of material and equipment, the facility will require earthworks and drainage works, internal rail track, site office and facilities, rolling stock provisioning and maintenance facilities, the provision of gantries for rail logistic management, ballast unloading facilities and rail welding facilities. Infrastructure will include State and local road intersection works, turning lanes and upgrades. Further details can be found in EIS Chapter 5: Project Description.

1.6.8.6 SITE OFFICES

The Project will include five site offices within the Project footprint, which will be co-located with laydown areas. Eleven laydown areas (including Whetstone MDC) have been nominated as potential sites, however the locations of the site offices will be determined as detailed design and construction methodologies are refined. Potential locations have been proposed in EIS Chapter 5: Project Description along the Project footprint with an area large enough to contain a site office.

1.6.8.7 LAYDOWN, STOCKPILE AND STORAGE AREAS

Laydown areas are used for a variety of construction purposes, including site offices, material and equipment storage, and to facilitate bridge construction. At bridge locations there will be a dedicated laydown/work area that may include crane pads for the lifting of bridge members.

Laydown areas were initially selected based on investigations using aerial imagery and ground truthing to confirm general suitability and avoidance of environmental and social receptors.

Seventy-eight laydown areas and one MDC at Whetstone have been allocated within the construction footprint. Establishing temporary laydown areas will involve clearing, grubbing, topsoil stripping, installing environmental controls, laying hardstand material (assumed to be site won and treated to geotechnical requirements), and constructing parking areas and access tracks. All temporary laydown areas are intended to be used for the Project during construction.

Laydown area locations have been chosen to avoid areas that are within the 1% AEP floodplains where possible, and areas of native vegetation. However, by virtue of the requirement of laydown areas for constructing bridges, some laydown areas must be within floodplains and near watercourses or drainage features. In such instances, the following precautions will be taken:

- The site will be surveyed prior to site establishment to understand the exact extent of potential flooding impact to facilities and storage areas;
- The earthworks and temporary drainage will be designed to minimise flooding impacts; and

- Fuel storage areas will be bunded, capacity restricted to no larger than required for reasonable operations, and preferentially stored at the furthest point away from watercourses.

A full list of laydown areas and their planned uses is provided in Chapter 5: Project Description.

1.6.8.8 FUEL

Diesel is to be stored during construction at 15 nominated laydown areas as identified in Chapter 5: Project Description. Diesel will be stored in self-bunded, relocatable fuel pods with a nominal capacity of about 10,000 L, with up to 20,000 L stored at two nominated laydown areas. The storage and handling of diesel will be in accordance with AS 1940:2017 - *The storage and handling of flammable and combustible liquids* (Standards Australia, 2017) and any further approval conditions.

During refilling of fuel pods, they will be moved to or pre-positioned in an area with a drainage system capable of isolation from the surrounding area to contain spills.

During the Detailed Design stage, the Project will continue to investigate alternative opportunities for the bulk storage of fuel along the corridor, including mobile refuelling mechanisms.

Details regarding storage requirements, scale and intensity of use of materials is detailed in Chapter 5: Project Description and Chapter 21: Hazard and Risk.

1.6.8.9 OTHER HAZARDOUS MATERIALS

During construction, laydown areas will be used for the storage and distribution of hazardous materials required for construction purposes. The non-resident workforce accommodation facilities may also have a hazardous materials storage requirement to enable self-sufficient operation.

The dangerous goods and hazardous substances likely to be required for construction activities have been determined based on usage on similar rail projects. The types and indicative quantities are identified in Chapter 5: Project Description.

Generally, low volumes of hazardous chemicals would be stored in accordance with regulatory Australian requirements at construction work fronts and laydown areas near points of use for the short duration of time it is anticipated to be needed. The quantities stored will be equivalent to the demand for construction activities within that area of the Project footprint. As discussed in Section 1.6.8.7, each laydown has been positioned to avoid or minimise potential impacts to environmental constraints.

1.6.8.10 CONCRETE BATCHING

The concrete needs for the Project will be met through a combination of on-site batch plant production and pre-cast structures which will require temporary storage on laydown sites. Two facilities are required during construction for the dual activities of precast concrete structure storage (laydown) and on-site concrete batching. The proposed locations are laydown areas located within the Project footprint immediately north and south of the Condamine River floodplain outside the 1% AEP flood extents. Identified concrete facility and batch plant locations are detailed in EIS Chapter 5: Project Description.

1.6.8.11 BRIDGE CONSTRUCTION

All bridge structures will be formed from precast, pre-stressed concrete and in-situ concrete with galvanised steel ancillary elements. Bridge foundations will be piled unless an alternative approach is required due to local geological conditions. It is envisaged that all materials for concrete bridge structures will be delivered by public road network to the Project footprint.

The anticipated methodology for bridge construction is as follows:

- Establishment of bridge construction laydown areas;
- Construction of working platform access for piling rigs and cranes. It is assumed that temporary works solutions will allow for the staged construction of working platforms across watercourses, consistent with the accepted development requirements for operational work that is constructing or raising waterway barrier works. Where this is not feasible, temporary steel working stages will need to be constructed for access to the bridge piers;
- Ground improvement (preloading or controlled modulus columns/prefabricated vertical drains method) will be implemented before starting abutment bridge foundation works where required;
- Implementing three types of piling method are anticipated to address the various geological conditions along the Project alignment, including:
 - Cast-in-place – basic pile construction method applied in general field situations;
 - Mono pile – applied when the height of the pier is less than 10 m in height, which typically omits the need for pile cap construction and improves program;
 - Driven pile – utilised as an alternative for cast-in-place for bridges in low lying areas, where geotechnical conditions are suitable, and the load forces are acceptable.
- Effective construction methods for the various piers will be implemented based on the site conditions, including:
 - Piers of various column heights from 6 m to 20 m and hollow square columns;
 - A single circular cross-section column;
 - A circular column of varying cross-sections according to the height.
- According to the height of each column, the optimal construction method is used:
 - Column height up to 20 m: cast in-situ with traditional formwork and staged concrete pours;
 - Column height above 20 m: cast in-situ with jump-form. The formwork for jump-form construction is made of steel.
- Headstock and abutment construction using re-usable forms and conventional reinforced concrete
- Bridge superstructure and deck construction:
 - Deck structures are expected to be constructed via lifting precast beams into place with a conventional crawler crane.

1.6.8.12 PERMANENT DRAINAGE INFRASTRUCTURE

Culverts

Reinforced concrete pipe culverts and reinforced concrete box culverts are the main cross-drainage structure provided in the revised reference design. Precast concrete culverts will be delivered to the nominated construction laydowns and then further distributed to the required installation locations via trucks, using the established construction haulage routes. Culvert installation will generally involve the following activities:

- Preparing survey control points for planned excavations;
- Excavating to the required depth;
- Placing and compacting the culvert bedding material;
- Placing the precast culvert structures on the bedding material and fastening them together;
- Proceeding with track/road works over the top of the culvert; and
- Restoring, stabilising and revegetating disturbed areas.

Once installed, either side of culverts will be backfilled with support material for the culvert. Scour protection measures will also be installed.

Construction of drainage structures will require installation crews throughout the construction period. This construction effort will be a mix of installation before and after the bulk earthworks, so as not to delay the overall earthmoving program.

Longitudinal drainage

The construction of longitudinal drainage will generally involve the following:

- Preparing survey control points for planned excavations;
- Excavating material from the drain location;
- Trimming and compacting the base and sides of the drain;
- Lining the drain to prevent erosion (grass, rock or concrete are proposed to line longitudinal drainage); and
- Discharge points of all drains will include appropriate scour protection.

1.6.8.13 TEMPORARY WATERWAY CROSSINGS

Waterway and watercourse crossings are an essential component of the Project and have been incorporated into the design of bridges, viaducts and culvert arrays associated with permanent road, railway and railway maintenance infrastructure. Temporary waterway crossings will be necessary during construction to provide uninterrupted access for plant, vehicles and machinery along the construction footprint. In addition, temporary waterway crossings will be required to enable safe and efficient construction of permanent waterway crossing structures. Crossings have been designed to reduce impacts to riparian vegetation and the bed and banks of defined watercourses as much as possible whilst meeting the performance specifications for Inland Rail, including hydraulic and structural requirements of the crossing infrastructure in terms of structure's placement, size and design criteria.

Temporary waterway crossings typically consist of clean rock-filled embankments supporting the access track, with culverts providing continuity of stream flow through the embankment along with safe fish passage. Dimensions of the temporary barrier are limited to the minimum practicable for the site and purpose. The design immunity can vary from site to site based on

practical factors, site constraints and access requirements; however, this is typically a 20% AEP. Culverts will be of appropriate size and number to ensure there is no impoundment of water upstream of the crossing with a minimum diameter of 300 mm and more standard sizing of 600 mm diameter pipes. The culvert will also require a minimum cover of 300 mm rock layer to satisfy loading requirements and avoid damage or structural collapse.

There will be crossing locations where temporary construction bridges and work platforms are required such as for larger perennial watercourses, contingent on factors such as the size and location of the watercourse channel, the expected construction duration and environmental considerations such as waterway flow and riparian vegetation. The temporary bridge will consist of driven steel piles and cross bracing, steel headstocks and concrete bridge slab. The bridge span would be a minimum of 6 m centres between piers, providing at least 5 m clearance width within the channel.

Potential adverse impacts to the watercourse and its surroundings will be minimised during construction by:

- Scheduling construction works in watercourses and drainage features during periods of lower flow, where logistically possible and safe to do so;
- Reducing the duration of construction works in riparian zones of watercourses through sequencing of construction, where logistically possible and safe to do so;
- Constructing each waterway crossing in accordance with relevant regulations (refer to Section 2) and approval conditions;
- Avoiding unnecessary clearing of riparian vegetation and disturbance to the bed and banks of defined watercourses by limiting construction workspaces to no greater than what is needed to support the immediate area construction works and by maintaining minimum setback distances of 30 m for laydown area construction zones where there is flexibility in their location (e.g. machinery storage);
- Adherence to a maintenance and inspection program during construction works to ensure temporary watercourse crossings remain safe, reliable, and compliant with environmental regulations and conditions of approval. Inspections will be on a weekly basis and after significant changes in stream flow. Any necessary repairs or mitigation measures should be taken immediately to prevent further damage or compromise to the crossing's stability;
- Removal of debris trapped on or upstream of the crossing following inspections; and
- Repair of any damage caused by construction traffic.

Temporary waterway crossings will be removed as soon as possible after they are no longer needed to support construction works in accordance with conditions of approval, waterway barrier permits, environmental regulations and best practices. This process will begin once an alternative access is achieved, or the permanent bridge or culvert structure has been completed. All materials will be removed, reused and disposed in accordance with approval conditions and legislative requirements. The bed and banks of defined waterways will be restored to their original state to preserve the natural flow of water.

1.6.8.14 BULK EARTHWORKS

Construction of the foundation of the railway line will require earthworks and engineered fill to provide a stable platform designed to accommodate the performance specifications. It is anticipated that this will require 257 heavy vehicle trips during peak construction months. The amount of material required for construction has been minimised to reduce the number of

heavy vehicle trips. The earthworks will mostly involve the excavation of cuttings and the construction of formation. Each of these tasks is summarised as follows.

Cuttings

Excavation will progress depending on the in-situ material types. If the material is of sufficient quality, is rippable, and does not contain oversized rocks, then dozers and scrapers will move the material along the Project footprint to locations of embankment construction. If the material contains a high percentage of rock, it may be necessary to use excavators and trucks to process this material prior to use in embankment construction. Material use will be dependent on meeting the adopted Inland Rail material specifications (Earthworks Specification ETC-08-03, available on the ARTC Extranet: extranet.artc.com.au).

Non-rippable rock (rock that is not able to be broken down using smaller plant, e.g. excavators) will be broken via drill and blast or by hydraulic rock breakers. Broken rock will be loaded onto trucks by front-end loaders and excavators and transported along the Project footprint for temporary stockpiling or at its intended point of reuse within the Project.

The occurrence of non-rippable rock within some of the cuttings along the permanent footprint, has been identified in the northern part of the Project alignment. The extent of drilling and blasting will be confirmed through further geotechnical investigations in detailed design; however, based on currently available geotechnical information, it is anticipated that drill and blast may be required for the cuttings between:

- Ch 48.9 km to Ch 51.3 km;
- Ch 50.9 km to Ch 50.7 km;
- Ch 114.5km to Ch 114.7km;
- Ch 165.3 km to Ch 168.6 km;
- Ch 176.1 km to Ch 176.6 km;
- Ch 178.8 km to Ch 180.5 km;
- Ch 186.5 km to Ch 186.9 km;
- Ch 190.2 km to Ch 191.6 km; and
- Ch 193.5 km to Ch 194.6 km.

Where explosives are used during construction, the works will be undertaken by the appointed licenced blasting Contractor in accordance with the *Explosives Act 1999* (QLD) and *AS 2187.2:2006—Explosives—Storage and Use, Part 2: Use of explosives* (Standards Australia, 2006). The blasting contractor will need to maintain a Security Management System and prepare a Blast Management Plan for the task to ensure that potential impacts are properly assessed and managed.

The blasting contractor will be responsible for the security of the explosives for the duration of the task, including the segregation of incompatible products.

Further details on the potential impacts of blasting and the necessary controls are presented in EIS Appendix V: Noise and Vibration Assessment – Construction and Road Traffic and Chapter 21: Hazard and Risk.

Formation

The formation consists of structural fill and capping, which is then placed on top of the general fill embankment. The Basis of Design requires formation to be designed to accommodate 30 TAL at 80 km/h.

This section provides a description of how each of these formation components is prepared and constructed.

Subsoil and embankment

Initially, the native subsoils underlying the Project footprint will be inspected and tested to determine if these materials comply with the adopted Inland Rail material specifications (Earthworks Specification ETC-08-03, available on the ARTC Extranet: (extranet.artc.com.au)). Where native subsoils do not comply with the material specifications, one or more of the following broad treatment strategies may be applied to achieve compliance:

- Compaction;
- Lime treatment to reduce the dispersive/reactive nature of native material. This involves the spreading of lime and mixing it into the soil with a reclaimer/stabilizer, followed by compacting and rolling of the lime-treated material;
- Excavation and removal of material for treatment, such as drying, before being reused within the Project footprint, subject to suitability; and
- Excavation and removal, with replacement of unsuitable materials with suitable fill, which is then compacted. In this instance, unsuitable materials may still have a reuse within the Project footprint.

Once the subsoil has been prepared, the embankment can be constructed. Further information on embankment construction is detailed in Chapter 5: Project Description.

Earthworks cut to fill operation will utilise conventional earthmoving plant selected from the indicative list of plant provided in Chapter 5: Project Description. The major key plant will comprise of excavator and truck fleets and dozer and scraper fleets commensurate with compaction fleets that match cut productivities.

Structural fill and capping

In the first instance, structural fill will be sourced from cuts within the Project footprint. If there is a lack of suitable structural fill material from cuts, then this material may be sourced from borrow pits or commercial quarries.

Capping material is currently planned to be transported by existing road network from commercial quarries.

The following are the key strategies with regards to transport, handling, and placement for structural fill and capping material:

- Suitable material will be transported to the Project footprint and delivered directly to the construction area or stockpiled within the nominated laydown areas;
- The materials will be moisture conditioned and tipped directly onto the formation in suitable volumes to deliver the required thicknesses for compaction;
- Spreading and compaction of the material will be undertaken using graders and compactors; and

- Final trimming and profiling will be undertaken to allow rail construction.

1.6.8.15 QUARRIES AND BORROW PITS

Thirteen locations have been identified as potentially suitable for use during construction activities, including seven borrow pit sites at six locations and seven quarries. The viability and feasibility of accessing material from these nominated locations will be confirmed during the detailed design stage (post-EIS). The potential borrow pit and quarry locations are shown in Chapter 5: Project Description.

The bulk earthworks volumes and mass haul material balance for the Project have been presented in Chapter 5: Project Description (Table 5-30 and Table 5-31). There is a fill deficit for the Project which will be met through the importation of appropriate material type from existing operational licensed quarries and from borrow pits established for the Project.

Commercial quarries

In some instances, suitable ballast and capping material may be obtained through cut activities along the Project footprint. However, established quarries are expected to be the primary source for ballast and capping and other high-quality aggregates for the Project. The ballast capping and 'other' requirements for the Project are summarised in Chapter 5: Project Description (Table 5-27).

Borrow pits

The potential borrow pit locations are listed in Table 1-6 and were based on the following factors:

- Proximity to the Project footprint;
- Proximity to road access and accessibility;
- Minimal to no vegetation clearing, based on preliminary assessment; and
- Presence and size of existing borrow pit.

Standard earthmoving equipment such as bulldozers and trucks will be used to extract material from borrow pits. If required, mechanical screens will be used to screen and grade material. The material will then be transported to construction sites using the public road network and tipped directly onto the formation.

TABLE 1-6 LOCATIONS FOR PROPOSED BORROW PITS

Site ID	Location	Lot/Plan	Construction traffic main road access
1	Mooroobie Lane	Lot 2 on SP229051	Accessed off Mooroobie Lane
2	Taits Red Ridge	Lot 53 on MH233	Accessed off the Rail Maintenance Access Road (RMAR) to the site
3	Mosquito Road	Lot 116 on BNT467	Accessed off Mosquito-Creek Road
4	Millmerran-Inglewood Road	N/A: -28.338177°, 151.160512°	Access off the RMAR to the site

Site ID	Location	Lot/Plan	Construction traffic main road access
5	Kooroongarra-Andersons Road	Lot 22 on MA3499	Accessed from Kooroongarra-Andersons Road
6A	Heckendorfs Road	Lot 98 on DY182	Accessed from Heckendorf Road
6B		Lot 11 on DY182	

1.6.8.16 PLANT AND EQUIPMENT

The indicative plant and equipment required for different stages of the Construction Works are shown in Chapter 5: Project Description. Plant and equipment requirements will be refined and confirmed prior to construction, and consulted with relevant stakeholders.

1.6.8.17 EROSION AND SEDIMENT CONTROL

Erosion sediment controls will be implemented during the Construction Works stage of the Project to minimise the risk of offsite and downstream impacts.

It will be in accordance with the International Erosion Control Association's *Best Practice Erosion and Sediment Control* document (2008) and will:

- Minimise runoff and sedimentation from Project activities to existing watercourses and drainage features;
- Minimise disturbance to the water quality of existing watercourses and drainage features along the Project footprint; and

The revised reference design includes 20 sediment basins, as identified in Chapter 5: Project Description. All the proposed sediment basins are passive, which allows surface runoff from a catchment to flow into the sediment basin without the need for pumping.

The placement and sizing of sediment basins for the Project have been defined based on the landform, earthworks and 80th percentile 5-day storm event required to construct the revised reference design. Therefore, the placement and sizing of sediment basins will need to be reassessed and revised, as required, as part of the detailed design process. Sufficient allowance has been included in the Project footprint for sediment basins to be relocated and/or resized, as required, to support the detailed design.

1.6.8.18 WASTE DISPOSAL

Waste management practices during construction will maximise the reuse or recycling of Project waste to reduce the weight of total material that will otherwise be disposed of to landfill. Recycling/reuse targets will be identified and detailed waste tracking records will be kept. Consultation will occur with the local authority, commercial recycling organisations and community groups.

An onsite waste management area(s) for sorting and segregating wastes will be established where practicable. Waste management will include the provision of covered bins/containers which will be serviced regularly to avoid vermin and pests. Project waste, including site refuse

and any solid or liquid contaminants resulting from Project work, will be disposed of in accordance with all relevant statutory and local authority requirements.

Construction waste types are discussed in Chapter 22: Waste and Resource Management.

1.6.8.19 TRACK WORKS

The proposed method of track construction will be tailored to maintain maximum flexibility, so as not to be confined to the use of dedicated plant or equipment. The focus will be to prioritise the use of readily available plant and equipment that is easy to maintain and has low establishment and operating costs.

However, given the long linear nature of the Project, there will be significant advantages in using a track-laying machine for track Construction Works. This will increase productivity and reduce the cost per track metre installed.

Track-laying machine

Materials will be based at Whetstone MDC and will be distributed, via use of readily available plant or equipment, to connect to the Project at Ch 30.60 km (NS2B). Once the rail line is complete south of Whetstone, a track-laying machine has the capability to continue rail construction north of Whetstone to the alignment end at Gowrie. A track-laying machine consists of highly developed track laying mechanisms, involving the ability to work with multiple rail laying materials such as sleepers, ballasts, rail. These mechanisms provide the opportunity for the remaining sections of the alignment to be transported and constructed solely via rail.

Bottom ballast

Bottom ballast (laid prior to rail and sleeper installation) may be installed by one of the following approaches:

- Delivery by road or rail to designated stockpile locations situated along the length of the corridor. Deliveries will be staged to suit the construction program and minimise disruption on roads and to the travelling public.
- Directly discharged onto the formation via truck and trailer or stockpiled and locally moved via 18 dump trucks
- Installed along with the top ballast via a works train. This means skeleton track will be constructed directly on the formation, on which the ballast dropping works train would run.

Sleepers

Sleepers may be installed by one of the following approaches:

- By excavator, which will place the sleepers using an 'Octopus' sleeper grab, which can pick up to six sleepers at a time and spread them to the correct spacing; and
- Delivered to the Whetstone MDC to be loaded onto a material train for direct discharge onto the formation by the track-laying machine.

Rail

Rail may be installed by one of the following approaches:

- Rail will be distributed by rail via the closest QR and ARTC rail networks to Whetstone MDC. Approximately 10 per cent of rail has been allocated to be transported via road networks to

various points along the alignment. This caters for complex locations and components such as turnouts for loops and track panels at level crossings; and

- Delivered in short lengths (<30 m) to the Whetstone MDC situated within the construction laydown. This will allow the short rail to be welded into long welded rail and then loaded onto the material train in strings of approximately 400 m. The long welded rail can then be positioned along with the sleepers through the track-laying machine.

Top ballast

The most efficient method of unloading top ballast (applied post-track laying) will be via train using ballast hopper wagons, which would run on rails fastened to sleepers that are laid on the bottom ballast. Laydown areas with direct access to the rail alignment will be used to facilitate the loading of ballast onto a train with ballast hopper wagons can be designated in laydown areas that adjoin the rail alignment.

From Whetstone MDC, ballast can be delivered along the Project footprint by train. This train would not only distribute top ballast but could also distribute bottom ballast if installing skeleton track straight onto the formation is the desired method of track construction.

Tamping

Tamping machines operate by lifting the track to the required level, shifting the rails and sleepers laterally to the correct alignment, and then compacting the ballast beneath the sleepers. Compaction is achieved by the use of vibrating rods, which are inserted into the ballast on each side of the sleeper and squeezed together. Plain line tamping will be undertaken by a high output tamper fitted with guidance software, to implement the correct target track geometry. Turnout tampers will be used for the tamping of turnouts and will also be equipped with guidance software.

Depending on the required track construction tolerances and quality of constructed track, tamping operations could take anywhere from three to six passes. Correctly installed bottom ballast levels, adequately compacted bottom ballast and high-quality track installation dramatically reduces tamping operations and follow-up tamp requirements.

Turnouts

All crossing loop turnouts and sidings can be constructed in-situ to reduce lifting of switch and crossing panels. All turnout construction will be undertaken early enough in the construction schedule to ensure that any issues caused by incorrect or missing components can be rectified prior to the commissioning of the turnout.

All turnouts connecting to existing operational infrastructure will be pre-built and installed if the rail corridor possession window approved by QR does not provide enough time to construct in-situ. The pre-building and panelling-in method will also ensure that turnout componentry is complete and allows for some welding to happen prior to the rail corridor possession.

Track works are further discussed in Chapter 5: Project Description.

1.6.8.20 ROAD WORKS

Road-rail interfaces for the Project are identified in Section 1.6.6.4. Construction Works on these interfaces will comply with the asset owners' approved safety requirements and temporary works procedures. In most instances, this will be achieved through adherence to

the *Manual of Uniform Traffic Control Devices* (DTMR, 2024b) to manage potential impacts associated with light and noise.

The scope of roadwork activities will vary depending on location, however, will typically involve:

- For new builds/realignments:
 - Complete the land take;
 - Road corridor gazettal;
 - Earthworks;
 - Pavements;
 - Drainage works;
 - Lighting;
 - Line marking and centre line treatments; and
 - Protective barriers.
- For minor upgrades:
 - Seal/pavement upgrades;
 - Line marking and centre line treatments; and
 - Safety barriers.

1.6.8.21 UTILITIES AND SERVICES

Utilities and services such as water, sewerage, electricity, and telecommunications will need to be supplied to laydown areas, the non-resident workforce accommodation sites, and compounds for use in site offices and amenities as required. Where these utilities are already located close to construction sites, engagement with utility providers will occur, with the objective of connecting to mains power, water, communications, and sewerage. Where connection to existing infrastructure networks is not possible or practicable, temporary portable alternatives will be adopted, for example tanks (water), gen-sets and solar panels (power), cellular network amplifiers (communications), package sewage treatment plants and portable toilets. The utilities and services connections for the Project will be planned to avoid impacts to the supply of services to existing residential and commercial users.

1.6.8.22 CONSTRUCTION WATER

The construction of the Project will require water for earthworks, track works, revegetation activities, concrete batching and operation of the non-resident workforce accommodation facilities.

Non-potable water will be used for earthworks, track works and revegetation activities. The concrete batching and precast plant will require a water source of guaranteed quality. The concrete batching and precast plant facilities will have onsite water storage tanks, which would be filled by water trucks drawing water from either a potable or recycled source. Dependent on the quality of supplied water, recycled water may require further treatment prior to being suitable for use in concrete batching.

The non-resident workforce accommodation and site office facilities will require potable water for drinking, cooking and showering, however, recycled or non-potable water may be appropriate for other water uses (e.g. toilets, laundry).

Sources of construction water will be determined as the construction approach is refined during the detailed design phase (post-EIS). Through this process, refined water demand planning will be undertaken, including detailed contingency options for the event that protracted dry seasonal conditions prevail and water supply options become unavailable.

1.6.8.23 LANDSCAPING AND REHABILITATION

Landscape and rehabilitation requirements will include:

- Progressive and post construction installation of the Project landscape design;
- Establishment and ongoing maintenance and monitoring requirements; and
- Construction contract completion criteria for areas defined in the landscape design.

Landscaping treatments determined by reference to the key landscape characteristics and elements appropriate to the local context will be developed in accordance with ARTC's Engineering (Track and Civil) Code of Practice Section 17 Right of Way Requirements (ARTC, 2013). The Inland Rail Landscape and Rehabilitation Strategy and property-specific reinstatement commitments will provide direction for landscaping and rehabilitation requirements.

Monitoring for a specified period will be required to ensure that the Project landscaping is successfully established. Additional maintenance or intervention works may be required if monitoring demonstrates the landscape and rehabilitation completion criteria are not being achieved.

Inspections of reinstated, landscaped or revegetated areas will occur for an appropriate period.

1.6.8.24 DEMOBILISATION

All construction sites, compounds and access routes will be reinstated or rehabilitated progressively once available. Reinstatement and rehabilitation activities will include:

- Demobilising temporary site offices, laydown and stockpile areas and associated facilities (e.g. water supply, sewerage, power, telecoms and hardstands);
- Removing all materials, waste and redundant structures from the works sites;
- Decontaminating any impacted areas (e.g. around fuel transfer locations);
- Stabilising of landforms, where required;
- Decommissioning of all temporary work-site signs;
- Removal of temporary fencing;
- Progressive establishment of permanent fencing in coordination with rehabilitation and landscaping activities;
- Decommissioning of site access roads that are no longer required; and
- Restoration of disturbed areas as required, including revegetation where required.

Following the above, retained topsoil and, where available, retained mulch will be used as part of the rehabilitation activities in addition to other appropriate treatments.

During the reinstatement and rehabilitation activities, sediment and erosion control measures will be left in place, monitored and maintained until the catchment areas are stabilised.

1.6.9 COMMISSIONING

All Construction Works will be subject to approved testing and commissioning plans, as required, and appropriate, Inspection and Test Plans. Final testing and commissioning of the track and systems is programmed for approximately six months after completion of Construction Works.

Activities during this stage will support commissioning of the Project Works (excluding Returned Works), with the overarching objective of moving from a built asset to an operating railway.

Testing and commissioning (checking) of the rail line and communication/signalling systems will be undertaken to ensure that all systems and infrastructure are designed, installed and operating according to ARTC's operational requirements.

Commissioning of the track works will require completed inspection and test plans, clearance reports, weld certification, rail stressing records, as-built documentation, and track geometry reports. The commissioning period will also be used for driver training and test trains.

1.6.10 OPERATION

DTMR will be the owner of the land (i.e. holder of the perpetual lease) subject to the railway corridor under the TI Act, with ARTC sub-leasing the railway corridor from DTMR. As the railway manager for the Project, ARTC will be responsible for railway operations, for managing the railway infrastructure, along with a 'duty of care' for the land. ARTC does not operate trains but provides the infrastructure and systems for customers to do so safely.

Operations stage activities will include the use of the railway for freight purposes, signalling, and general track and infrastructure maintenance.

Road network changes as a result of the Project will be managed and maintained by the relevant road authority (i.e. DTMR or local council).

1.6.10.1 HOURS OF OPERATION

The railway will be operational 24 hours a day, 365 days a year, on a variable schedule.

1.6.10.2 WORKFORCE

It is anticipated that the ongoing operation and maintenance of the Project will require a workforce of approximately 10 to 15 FTE. The operational workforce will be based at provisioning centres outside the vicinity of the Project.

1.6.10.3 TRAIN OPERATIONS

The Inland Rail Program will be operational when all sections are complete; however, existing QR Network traffic may use the Project, subject to relevant infrastructure agreements, if it is completed prior to the other sections of the Inland Rail Program.

Train control will be managed via ARTC's existing control centres. Train services will be provided by a variety of operators. Trains will be a mix of grain, bulk freight, and other general transport.

The Project will involve operation of a single track with crossing loops to accommodate double-stacked freight trains 1,800 m long and 6.5 m high. Train speeds will vary according to axle loads and track geometry, and range from 80 to 115 km/h.

It is estimated that once fully operational, the Project will involve an annual average of 14 train services per day during initial years of operation. This is likely to increase to an average of 20 trains per day after 15 years, and up to 25 per day during peak operational periods.

ARTC will manage the B2G section of the Inland Rail network to allow for the transportation of dangerous goods and explosives as nominated by the haulage provider and Explosive Competent Authority. There are no tunnels along this section of the network. Hazardous chemicals (dangerous goods) will likely make up a significant portion of freight because they include many widely used commodities and products. Products potentially categorised as dangerous goods that are likely to be transported include medical supplies and fuel. These goods are commonly moved on all forms of transport (not limited specifically to rail freight). ARTC cannot provide an exhaustive list of the types and quantities of dangerous goods that will be transported on the network.

In Queensland, Rail Operators must comply with the Australian Code for the Transport of Dangerous Goods by Road & Rail in addition to various Australian Standards. This Code details the technical specifications, requirements, and recommendations applicable to the transportation of dangerous goods in Australia by road and rail. It must be noted that ARTC does not own or operate the rolling stock, however the transportation of dangerous goods on the Project by independent operators will require authorisation by ARTC. The quantities and types of dangerous goods which may be present as freight, and the allowance of bulk and packaged dangerous goods, will be managed in accordance with the requirements of the Australian Dangerous Goods Code.

1.6.10.4 OPERATIONAL MAINTENANCE

Standard ARTC maintenance activities will be undertaken during operations. Typically, these activities include:

- Minor maintenance works, such as:
 - Bridge inspections;
 - Culvert cleanout;
 - Sleeper replacement;
 - Rail welding;
 - Rail grinding;
 - Ballast profile management;
 - Track tamping; and
 - Clearing/slashing vegetation within the rail corridor. The rail corridor will be maintained free of woody vegetation.
- Major periodic maintenance, such as:
 - Ballast cleaning;
 - Formation work;
 - Reconditioning of track;
 - Adjustment;
 - Turnout replacement;
 - Correction of track level and line; and
 - Maintenance of structures including waterproofing, jointing etc.

These activities will occur on a scheduled basis, in addition to being in response to unplanned requirements, e.g. maintenance following adverse weather events. Rail maintenance activities will be managed according to the volume of works required:

- Track Maintenance – minor.
 - Day to day track maintenance is managed between the ARTC Network Assets/Maintenance teams and Network Controllers to ensure no major impacts on the daily train plan and train operations are incurred. These works are often short in nature and will be scheduled into vacant train paths (where no trains are scheduled) to prevent impact to train travel time.
- Track Maintenance – major.
 - Major track maintenance is managed via the ARTC possessions planning process, with any major track closures communicated to Customers 6 to 12 months in advance.

1.6.10.5 ROLLINGSTOCK MAINTENANCE AND PROVISIONING

No provisioning or rollingstock maintenance facilities are proposed to be provided within the Project footprint. Noting for emergency maintenance of rollingstock due to unforeseen failure or defects, the crossing loop and maintenance siding will be utilised as required.

1.6.10.6 FUEL

No permanent refuelling facilities are proposed within the Project footprint.

1.6.10.7 OTHER HAZARDOUS MATERIALS

Dangerous goods and hazardous chemicals that may be required during operation and maintenance of the Project are listed in Chapter 5: Project Description and have been determined based on usage on similar rail projects.

Operational usage of chemicals is expected to be on an 'as required' basis and will typically involve limited quantities during specific maintenance activities (e.g. application of pesticides in accordance with ARTC rail corridor maintenance protocols). There will be no permanent storage of dangerous goods or hazardous substances within the permanent footprint. All substances will be transported to site by maintenance crews, as required.

1.6.10.8 ELECTRICITY

Electricity supply will be needed for points, signalling and other infrastructure. It is anticipated that the supply of these services will be delivered by relevant providers under the terms of their respective approvals and/or assessment exemptions.

1.6.10.9 TELECOMMUNICATIONS

The Project involves new telecommunications and signalling infrastructure, initially using Centralised Train Control with the infrastructure installed upgradable to accommodate future deployment of the ATMS.

ATMS will be a digital train management solution with real-time monitoring of trains with GPS and mobile technology and will support ARTC's objectives of improving rail network capacity, operational flexibility, train service availability, transit times, rail safety and system reliability. Interfaces between the ARTC and QR Network, including signalling systems are subject to ongoing discussions between ARTC and QR now and during the Project's detailed design stage.

1.6.10.10 OPERATIONAL WATER SUPPLY AND MANAGEMENT

The Project's operational water requirements are anticipated to be minor, relative to the Construction Works stage requirements. Water may be required to support localised maintenance activities, such as high-pressure cleaning of culverts. The volumes required will be dependent on the specific activities and frequency of undertaking and supplied via external sources.

Vegetation planted as part of the landscaping design for the Project will be self-sustaining and will not require watering once established.

An assessment of the suitability of each source will need to be made for each maintenance activity requiring water, based on the following considerations:

- Legal access;
- Volumetric requirement for the activity;
- Water quality requirement for the activity; and
- Source location relative to the location of need.

1.6.10.11 OPERATIONAL STORMWATER MANAGEMENT

Stormwater will be managed through the drainage structures incorporated into the detailed design.

1.6.10.12 ROAD TRANSPORT

The existing road network will be used by maintenance crews to travel to the Project. Once in the permanent footprint, the RMAR will be used for project maintenance activities. To access a waterway crossing, a turnaround pad will be incorporated into the design of the RMAR, allowing vehicles access to bridge abutments for inspections. Access tracks will not continue across the waterway.

1.6.10.13 WASTE MANAGEMENT

Site maintenance activities during operations will generate small quantities of waste. Quantities of waste would depend on operational frequencies of maintenance regimes, which are not currently available. As such, quantities of operation stage waste have not been estimated.

1.6.10.14 LANDSCAPING AND REHABILITATION

Ongoing monitoring is to ensure that the Project landscaping continues to be successful. Additional maintenance or intervention works may be required if monitoring demonstrates that landscape and rehabilitation completion criteria are not being achieved.

The ongoing maintenance of the Project will include management of weeds, pests and vegetation (e.g. for bushfire and safe access), fauna furniture and fencing, and other infrastructure. These works will be managed in accordance with operational environmental management documentation consistent with the Inland Rail Environment and Sustainability Policy and the Inland Rail Landscape and Rehabilitation Strategy.

1.6.11 TIMING

Table 1-7 shows the Project's anticipated timing of stages. The commencement of Year 0 is marked by the receipt of the Coordinator-General's evaluation report and EPBC Act controlled action determination, and Year 1 marks the commencement of physical works in the Pre-Construction Activities and Early Works stage.

Indicative construction dates have been adopted to enable the Project to demonstrate conservative assessment of potential impacts and mitigation measures.

TABLE 1-7 ANTICIPATED TIMING OF THE PROJECT STAGES AND ACTIVITIES

Duration (quarterly years)	Year 0				Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Detailed design																								
Project Approvals and Corridor Acquisition																								
Pre-construction Activities and Early Works																								
Construction works																								
Commissioning																								
Operations																								

The broad milestone dates for construction are indicative only and are subject to change during the Detailed Design and Construction Works stages due to a range of factors, including:

- Weather conditions,
- Changes to construction methods and materials, and
- Unexpected finds, such as contamination, threatened biodiversity species or cultural heritage values.

Variations to the construction sequences in relation to program optimisation, constructability, resource availability, local conditions (weather and industry) and adjacent Inland Rail projects will be investigated during the detailed design stage.

1.6.12 DECOMMISSIONING

The Project is expected to be operational for at least 100 years. The design life of structures is 100 years to support this operational objective. The decommissioning of the Project cannot be foreseen at this juncture and is therefore not considered further as a Project phase.

If the Project, or elements of it, were subject to plans for decommissioning, it is envisaged that the works would be developed in consultation with relevant stakeholders and regulatory authorities.

2. REGULATORY ENVIRONMENT

The legislation, policy, and management framework for the Project, as applicable to the assessment of MNES at the Commonwealth level, is summarised in Table 2-1. A complete list of regulatory guidelines applicable to all threatened species (including MSES) can be found in revised draft EIS Appendix L: Terrestrial and Aquatic Ecology Technical Report, Section 2.

TABLE 2-1 COMMONWEALTH LEGISLATION AND POLICIES RELEVANT TO THE PROJECT

Legislation/ policy/plans	Legislative jurisdiction	Intent	Applicability
Commonwealth			
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth)	Australia and its Territories. Specifically, projects that involve or have the potential to impact upon nationally and internationally important flora, fauna, ecological communities, and heritage places – defined under the Act as MNES.	The EPBC Act is the Australian Government’s central piece of environmental legislation and provides the legal basis for the management and protection of nationally and internationally important flora, fauna, ecological communities, and heritage places. Under Section 45 of the EPBC Act, the Australian Government and Queensland Government have implemented a bilateral agreement relating to environmental assessment. This agreement allows the Australian Government Minister for the Environment and DCCEEW to rely on specified environmental impact assessment processes of Queensland in assessing actions under the EPBC Act. The bilateral agreement specifically aims to achieve the following objectives: • Protect the environment in accordance with the requirements of the EPBC Act, • Promote the conservation and sustainable use of natural resources, and • Ensure an efficient, timely and effective process for environmental assessment and approval of actions.	ARTC submitted an EPBC Act referral to the DCCEEW in February 2018 (EPBC 2018/8165). The Minister for the Environment determined the Project a ‘controlled action’ on 9 April 2018. The controlling provisions for the controlled action are: • Listed threatened species and communities. No Project works that are part of the referred action will commence prior to the Minister’s decision on the EPBC Act controlled action. The EPBC Act controlled action will be assessed under the bilateral agreement with the Queensland Government. In accordance with Section 158A of the EPBC Act, MNES will be discussed and assessed in accordance with their EPBC Act status at the time of the referral decision (i.e. 9 April 2018). However, in accordance with Section 139, the Minister must have regard to approved conservation advice, recovery plan or threat abatement plan for listed species relevant to the current listing status, therefore the current conservation advices (e.g. for something that was V at the controlled action decision time, and is now E) must be considered in the impact assessments. Offsetting for significant impacts will be done based on the current listing status rather than the relevant status at the controlled action decision date.

Legislation/ policy/plans	Legislative jurisdiction	Intent	Applicability
EPBC Act Environmental Offsets Policy (2012) (EPBC Act Offsets Policy)	Areas subject to the EPBC Act	Developed to support the management and protection of MNES under the EPBC Act and outlines the Australian Government's approach to the use of environmental offsets for impacts to MNES. Eight principles for the use of environmental offsets under the EPBC Act have been developed by DCCEEW. These principles are used to assess any proposed environmental offset for MNES to ensure consistency, transparency and equity under the Act. The Australian Government's position is that environmental offsets must: • <i>Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.</i> • <i>Be built around direct offsets but may include other compensatory measures.</i> • <i>Be in proportion to the level of statutory protection that applies to the protected matter.</i> • <i>Be of a size and scale proportionate to the residual impacts on the protected matter.</i> • <i>Effectively account for and manage the risks of the offset not succeeding.</i> • <i>Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of State or territory offsets that may be suitable as offsets under the Act for the same action).</i> • <i>Be efficient, effective, timely, transparent, scientifically robust and reasonable.</i> • <i>Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced (Australian Government 2012).</i>	The Project will implement avoidance and mitigation measures to minimise the significant impacts on the MNES. Implementing mitigation measures including offsets will be consistent across the Inland Rail Program. Offsets provided for under the policy include direct offsets, and other compensatory methods (or indirect offsets). It is likely that a combination of methods will be applicable to the Project, based on the extent of the significant impacts on MNES. Where a significant impact to MNES has been identified, the Project will compensate for it in accordance with the EPBC Act Offsets Policy. ARTC's Environmental Offset Delivery Strategy – B2G is contained in EIS Appendix Q: Environmental Offset Delivery Strategy of the revised draft EIS. This Strategy informs the development of offset delivery components for B2G including specific management intent to drive matter specific conservation outcomes across each relevant offset property presented in the Strategy. Property specific OAMPs will be developed and implemented by ARTC prior to construction commencement subject to approval under the EPBC Act.

Legislation/ policy/plans	Legislative jurisdiction	Intent	Applicability
		The Australian Government defines offsets as measures that compensate for the significant impacts of an action on the environment (Australian Government 2012).	
<i>Matters of National Environmental Significance: Significant Impact Guidelines 1.1</i> (DoE, 2013).	MNES	The purpose of the Significant Impact Guidelines is to assist any person who proposes to take an action to decide whether they should submit a referral to the DCCEEW for a decision by the Australian Government Environment Minister on whether assessment and approval is required under the EPBC Act. The Significant Impact Guidelines outline a 'self-assessment' process, including detailed criteria, to assist persons in deciding whether referral may be required. Important terms and phrases are explained in the guideline.	Assessment of MNES against the Significant Impact Guidelines will facilitate the determination of a significant impact to MNES. This has been undertaken in Sections 7.1, 7.1.4, and 0.
Recovery plans	MNES	Recovery plans for listed threatened species and ecological communities have been made or adopted under the EPBC Act. These plans remain in force until their legislated sunseting date (1 April or 1 October 10 years after the creation or adoption) unless the species is removed from the threatened list. A recovery plan is a document stating the research and management actions necessary to stop the decline, support the recovery and enhance the chance of long-term survival in the wild, of a protected community, animal, or plant species. In deciding on whether to approve an action, the Australian Government Minister for the Environment and Water (Minister) must not act inconsistently with the recovery plan that is in force.	Species recovery plans, threat abatement plans and approved conservation advice documents have been considered for all MNES relevant to this project where available.
Threat abatement plans	MNES	Threat abatement plans provide for the research, management, and any other actions necessary to reduce the impact of a listed key threatening	

Legislation/ policy/plans	Legislative jurisdiction	Intent	Applicability
		process on native species and ecological communities. Implementing the plan should assist the long-term survival in the wild of affected native species or ecological communities	
Approved conservation advices	MNES	Approved conservation advices are developed to assist with the recovery of MNES under the EPBC Act. They are documents that guide recovery planning and identify actions required for the conservation and recovery of the MNES. They are approved and come into force from the time of any new species or ecological community listing. Although only intended to be used as a guide, the Minister must take advices into consideration when making an assessment of whether to approve an action.	

3. METHODS

3.1 OVERVIEW

The methodology for this MNES assessment includes a compilation of data from the numerous investigations that have been undertaken for the Project between 2016 to 2023.

This assessment has been prepared in accordance with the *Terrestrial ecology – EIS information guideline* (DES, 2022a, Version 1.02) and *Aquatic ecology – EIS information guideline* (DES, 2022b, Version 1.02).

The methodology undertaken included to support the initial draft EIS released in 2021 included a desktop analysis of available datasets, existing literature and previous studies for listed threatened flora and fauna species and other MNES that potentially occur in and surrounding the Project footprint. Following development of the potential threatened species and ecological communities list, ecological field surveys to validate mapped habitat and desktop-based mapping and to identify baseline conditions to inform the reference design of the Project.

The updated desktop assessment (Section 3.2) in this report includes the following information available from the initial draft EIS (released in 2021):

- Field surveys conducted and discussed in the initial draft EIS and appendices, treated as preliminary field studies; and
- Knowledge gaps.

The results of the updated desktop assessment and gap assessment were then used to design a subsequent detailed field program for within the Project footprint. This informed the field surveys (Section 3.3).

Whilst field-based assessments assessed species listing and status at the time of survey, this assessment report uses the most up to date species listing and status.

The field program included a strategy to secure land access to enable field verified environmental assessment based on site-specific survey and supporting information in accordance with the ToR requirements. For the purposes of the SIA, MNES listed species are considered and assessed in accordance with their listing at the time of the Project's controlled action determination, 9 April 2018.

The likelihood and impact assessments completed are informed by the complete set of available information for the Study area and Project footprint. The methodologies employed for each stage of the ecological assessment process are discussed in further detail in the following sections:

- Desktop assessment (Section 3.2);
- Field surveys (Section 3.3);
- Habitat mapping (Section 3.4);
- Impact assessment (Section 3.5); and
- Cumulative impact assessment (CIA) (Section 3.5.4).

3.1.1 FAUNA AND FLORA NOMENCLATURE

The sources of nomenclature for fauna are:

- Ingram, McDonald, and Nattrass (2002) for frogs;
- Wilson and Swan (2010) for reptiles;
- Pizzey and Knight (2012) for birds;
- Menkhorst and Knight (2011) for mammals;
- Duncan et al. (1999) Action Plan for Australian Bats for microbats; and
- Pusey, Kennard, and Arthington (2004) for freshwater fish.

The source of nomenclature for flora is the Census of the Queensland Flora (Queensland Government, 2023). The botanical names comply with the rules of the current International Code of Botanical Nomenclature (McNeill et al., 2006) and the International Code of Nomenclature for Cultivated Plants (Brickell *et al.* 2004). Author abbreviations follow Brummitt and Powell (1992).

3.2 DESKTOP ASSESSMENT

A desktop assessment was conducted to identify information on existing terrestrial and aquatic ecological values within the Study area. The data was reviewed to identify the presence or potential presence of listed TECs, threatened species and other MNES. The desktop assessment included a review of previous ecological studies, collation of environmental databases and searches, maps and scientific literature. Initial likelihood of occurrence assessments were undertaken based on the desktop review and updated following the completion of field surveys.

The objectives of the desktop assessment were to:

- Identify MNES known, likely or potentially present within the Study area;
- Identify all relevant information related to the Study area and all known and potential impacts;
- Identify gaps in data in relation to MNES in the Study area; and
- Allow refinement of the field survey methodology to ensure relevant species, ecological communities and their habitat were targeted appropriately.

3.2.1 DATABASE REVIEW

A database review was initially undertaken in 2017 prior to preliminary field investigations. Searches were re-run in 2019, 2022, and 2024 to enable any relevant updates, or additional species observations to be incorporated into the assessment. Details of the relevant database sources, the most recent search dates, and the purpose of the data are summarised in Table 3-1.

Limitations of the database information are addressed in Appendix A. Limitations were minimised wherever possible by ensuring that the most recent datasets were used and datapoints with ambiguous metadata or with very low precision were excluded from analysis. In addition, specimen backed records in excess of 20 years of age were generally excluded from analysis due to concerns related to currency and recent human induced disturbance to the broader area. Where older records have been used, their recency is noted. Any Project based ground-truthed data was used in preference over those from desktop-based datasets.

TABLE 3-1 DATABASE REVIEW SUMMARY

Database/data source name	Database search date	Database search areas	Data type
EPBC Act Protected Matters Search Tool (Australian Government)	24/03/2022 and 08/11/2024	Study area	Provides a “predictive” account of MNES identified within a specific area. Includes MNES listed threatened species and communities (controlling provision).
Species Profile and Threats Database (DCCEEW, 2020)	24/03/2022 and 02/2024	Study area	Location of MNES, including: - Threatened species - Threatened ecological community (TEC) - Critical habitats.
Atlas of Living Australia (ALA)	12/2023 and 01/2024	Study area	Records of flora and fauna, including MNES threatened species.
National Flying-fox monitoring viewer and DESI Flying Fox Monitoring Program	06/11/2024	Study area	Shows the location of flying-fox roosts in Australia (recorded by DESI in Queensland) and includes monitoring data of continuously and periodically (seasonally or irregularly) used roosts. The exact location of roosts may vary within a small, localised area.
Birds Australia	29/03/2019	Study area	Records of avian fauna, including threatened species listed under the EPBC Act.
Wetland <i>Info</i> database (DES, 2019)	07/04/2022	Study area	Provides interactive maps, species records, case studies and legislation associated with Queensland wetlands.
Wildlife Online database (Queensland Government)	07/04/2022 and 01/2024	Study area	Records of flora and fauna including conservation significant species listed under the EPBC Act.
Wildlife Online modelled potential habitat (Queensland Government)	07/04/2022 and 05/06/2024	Study area	Modelled potential habitat of state listed conservation significant flora and fauna including conservation significant species listed under the EPBC Act. Models taken from records of fauna species occurrence compiled for the purpose of Biodiversity Assessment by DESI (EPA, 2002) and specimen backed flora records compiled from the Queensland Herbarium’s Herbers database.

3.2.2 PRELIMINARY MAPPING OF THREATENED ECOLOGICAL COMMUNITIES

To develop preliminary mapping of TECs for the Study area, a desktop level assessment was undertaken using geospatial datasets, administered by the State of Queensland. The preliminary mapping development also used REs associated with the TEC, as identified in the relevant approved conservation advice, or listing advice for each TEC. TECs relevant to the Project and the associated REs are presented in Table 3-2.

TABLE 3-2 THREATENED ECOLOGICAL COMMUNITIES AND ANALOGOUS REGIONAL ECOSYSTEMS

TEC name	EPBC Act status	Habitat requirements or analogous REs used for desktop mapping
Brigalow (<i>Acacia harpophylla</i> dominant and co dominant) ecological community	E	The following REs are analogous to this TEC: 6.4.2, 11.3.1, 11.3.1a, 11.3.1b, 11.3.1d, 11.4.3, 11.4.3a, 11.4.3b, 11.4.7, 11.4.8, 11.4.8a, 11.4.9, 11.4.9a, 11.4.9b, 11.4.10, 11.5.16, 11.5.16a, 11.9.1, 11.9.5, 11.9.5a, 11.9.6a, 11.9.6, 11.11.14, 11.12.21, 12.8.23, 12.9-10.6 and 12.12.26.
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	E	The following REs are analogous to this TEC: 11.3.3, 11.3.3a, 11.3.3b, 11.3.3x1, 11.3.3c, 11.3.15a, 11.3.15, 11.3.16, 11.3.28, 11.3.37
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	CE	The following REs are analogous to this TEC: 11.3.21, 11.3.24
Lowland Rainforest of Subtropical Australia (Note: within QLD, only identified as occurring within Bioregion 12: South-east QLD)	CE	The following REs are analogous to this TEC: 12.3.1, 12.5.13, 12.8.3, 12.8.4, 12.8.13, 12.11.1, 12.11.10, 12.12.1, 12.12.16
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E	The following REs are analogous to this TEC: 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.13, 11.9.4, 11.9.8, 11.11.18, 11.8.3, 11.8.6, 11.3.11x1, 11.9.4a, 11.9.4c, 11.10.8, 11.11.5, 11.11.21, 11.12.4
Weeping Myall Woodlands	E	The following REs are analogous to this TEC: 11.3.2, 11.3.28, 11.3.2a, 11.3.2b, 11.3.2c
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (also known as Box-Gum Grassy Woodland and Derived Grassland)	CE	The following REs are analogous to this TEC: 11.8.2a, 11.8.8, 11.9.9a, 13.3.1, 13.11.8, 13.12.8, 13.12.9, 11.3.23, 12.8.16 (west of bioregion) 13.3.4, 13.11.3 and 13.11.4

Table notes:

CE = Critically endangered E = Endangered V = Vulnerable

3.2.3 PRE-SURVEY PREDICTIVE HABITAT MAPPING

Predictive habitat mapping was prepared by FFJV to identify and map potential habitat for threatened flora and fauna within the Study area. This was conducted following preliminary surveys, but prior to targeted field surveys. The aim was to use this mapping to undertake an initial Likelihood of Occurrence assessment and to target field surveys.

The predictive habitat mapping is a geographic information system (GIS) layer and is based on known habitat associations, as defined in scientific literature and approved conservation listing advice/recovery plans available and other sources for each species.

After development of predictive habitat mapping, detailed field surveys were undertaken within the Project footprint (Section 3.3.2). This ground-truthed habitat mapping now supersedes the predictive habitat mapping within the Project footprint.

Predictive habitat mapping within the Study area and a larger buffer of 50 km (excluding the Project footprint) was used to inform the assessment of cumulative impacts. A distance of 50 km from the Project was selected as many of the ecological values of relevance to the Project do not extend beyond this area, and if they do occur, any cumulative impacts associated with the Project are not considered to be relevant beyond this extent.

3.2.4 LIKELIHOOD OF OCCURRENCE ASSESSMENT

An initial likelihood of MNES occurring within the Project footprint was determined based on the results of the desktop assessment and preliminary field surveys as described in Section 3.3.1.

During the desktop assessment, the likelihood of occurrence assessment was based on historic datasets, consideration of a species distribution range, the presence, condition, and function of habitat in the Project footprint and preliminary field survey results. Each TEC or species in the likelihood of occurrence was assigned to one of the categories in Table 3-3.

TABLE 3-3 LIKELIHOOD OF OCCURRENCE CRITERIA

	Preferred habitat exists⁴	General habitat exists⁵	Habitat does not exist⁶
Recent ¹ records within the Project footprint ²	Known	Known	Known
Recent records in the Locality ³	Likely	Potential	Unlikely
No records within the Locality, but the Project footprint is within the distribution ⁷	Potential	Unlikely	Unlikely
No records in the Locality, and the Project footprint is outside of the distribution	Unlikely	Unlikely	Unlikely

¹Recent records are those that have been recorded in the last 20 years.

²'Project footprint' is the land required to accommodate all permanent and temporary components of the Project as described in EIS Chapter 5: Project Description.

³'Locality' refers to a 10 km buffer around the Project footprint and is inclusive of the Project footprint.

⁴Preferred habitat includes breeding, denning, roosting, and/or foraging habitats for fauna species; and habitat containing associated floristic species, vegetation communities, suitable substrates, and/or landforms for flora species.

⁵General habitat includes dispersal habitat and other areas where the species may occasionally be found, but do not contain all required habitat features to constitute preferred habitat.

⁶Based on sources reviewed and/or field survey results.

⁷Distribution is defined as the may/likely distribution as per the SPRAT profile.

If the likelihood of occurrence was uncertain, for example where the habitat preferences of the species are not well known or because the species is highly cryptic, a precautionary approach was taken, and the species was considered to have potential to occur within the Project footprint. The results of the desktop and likelihood of occurrence assessment were used to identify gaps in the knowledge of the identified ecological values, especially in areas where reliable field data was not available. Field surveys (Section 3.3) were designed to address these gaps. Following the field surveys (detailed in Section 3.3), the likelihood of occurrence assessment was re-visited to incorporate field verified habitat assessments and flora and fauna records using the same criteria utilised above.

The draft LoO was provided to DCCEE/OCG for review prior to being finalised. This review resulted in the addition of one threatened flora species, being the slender darling pea (*Swainsona murrayana*) which has been assessed as unlikely to occur.

The results of the likelihood of occurrence assessment for threatened flora and fauna species is presented in Appendix D: Likelihood of Occurrence Assessment Results.

3.3 FIELD SURVEYS

3.3.1 PRELIMINARY SURVEY FIELD METHODS

The preliminary field surveys undertaken for the Project are summarised in Table 3-4 and their methods are discussed in the following sections. The findings of each of the studies were used to supplement knowledge gaps identified from database searches, particularly in relation to MNES.

Not all studies in the literature review and preliminary field surveys that inform the desktop assessment were undertaken within the current Project footprint, partly because the footprint has evolved over time. Changes to the Project reference design since the initial draft EIS are presented in EIS Appendix B3: Changes to reference design since draft EIS. However, observations from the surveys were still of use in confirming the presence of threatened species or their habitat, other MSES and MNES and other habitat types in proximity to the Project footprint and were sufficient to determine the potential nature and magnitude of the impact on MNES and MSES as a result of the Project.

TABLE 3-4 PRELIMINARY FIELD SURVEYS FOR THE PROJECT

Document/investigation title	Consultant/year	Timing of investigations	Summary of methods, significant findings and notes
Border to Gowrie summary of ecological constraints to inform the initial advice statement	Eco Logical Australia (2016)	26 to 29 April 2016	Survey of alignment and corridor options. Included identification of REs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment at three sites.
		12 to 15 September 2016	Survey of further corridor options. Included identification of REs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment at two sites.
		25 to 28 October 2016	Survey of further corridor options. Included identification of REs, TECs, opportunistic searches for flora species and fauna habitat assessments.
Terrestrial ecology report for the EIS	Future Freight Joint Venture (FFJV) (2018a)	16 to 23 April 2018 1 and 4 to 10 September 2018 17 to 19 April 2018	• Active searches for cryptic species • Opportunistic fauna observations • Census of flora species • Habitat assessment
Pre-clearance and Protected Plant surveys associated with geotechnical investigations	FFJV (2018b)	April 2018 November 2018	• Protected plant surveys (meander surveys – minimum 30 minutes) throughout alignment • Habitat surveys • Confirmation of vegetation communities
	FFJV (2019)	April 2019	• Protected plant surveys (meander surveys – minimum 30 minutes) throughout alignment • Habitat surveys • Confirmation of vegetation communities
Inland Rail (Border to Gowrie) Aquatic Ecology Report	Eco Logical Australia (2020)	June and November 2018 May 2019	Aquatic ecology surveys (34 sites) including targeted fish surveys (12 sites)

3.3.1.1 INITIAL ADVICE STATEMENT ECOLOGY SURVEYS – 2016

Terrestrial ecological surveys were undertaken by Eco Logical in 2016 to inform the initial advice statement for the Project. These field surveys included a total of 134 sites across the preliminary alignment over three surveys (totalling 12 days). It is noted that the Project footprint has changed since that time; however, survey findings are still relevant to inform the presence of MNES within the region.

The methodologies undertaken for these field surveys included identification of REs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment to identify ecological constraints and inform revisions to the Project footprint.

3.3.1.2 TERRESTRIAL ECOLOGY SURVEYS – 2018

Following initial surveys undertaken in 2016, the Project footprint was revised and further terrestrial ecological surveys were undertaken (FFJV, 2018a). Following desktop assessment, sites were selected for targeted ecological surveys which were specifically identified as containing features of interest. The 44 survey locations included:

- Areas containing a representative example of a distinct vegetation community (i.e. areas contained within mapped remnant vegetation, regrowth vegetation, and non-remnant vegetation areas);
- Areas containing landscape features that were considered likely to support EPBC Act listed communities and species when viewed from aerial photography (i.e. gilgai areas, wetlands and escarpments);
- Areas known or predicted to support EPBC Act listed communities and species;
- Waterways which will be potentially impacted by the Project; and
- Areas that had not been subject to previous ecological investigations.

At each terrestrial sampling location, a vegetation survey, a fauna habitat assessment, active searches for cryptic fauna and opportunistic observations were undertaken as a minimum. In instances where wetland indicators were present (e.g. macrophytes, topography consistent with wetlands or areas mapped as a wetland), an assessment of the potential of the area to be a wetland was undertaken, recording site-based attributes as required. Detailed methodologies are provided below.

Flora survey methods

At each targeted terrestrial survey site, a list of all flora species observed was compiled. In addition, opportunistic observations across the Study area were used to supplement site specific datasets. MNES flora species that were not previously encountered, or species that were unidentifiable in the field (when sampling occurred), were collected and lodged at the Queensland Herbarium for formal identification (Appendix B).

The following approach to Regional Ecosystem verification was applied:

- Within a representative of each different vegetation community, an intensive survey occurred, including an assessment of the relative species density and diversity within the emergent (E), canopy (T1, T2, T3), shrub (S1, S2, S3) and ground (G) strata layers were present. Methodologies used were consistent with the tertiary level as described by Neldner *et al.* (2017). Survey transects approximated 100 m in length and 20 m in width.

- Verification of the remaining map units of the same type was undertaken at the quaternary level as described by Neldner *et al.* (2017).

All species of flora incidentally observed were identified to the species level where possible (Appendix C).

Fauna habitat assessments

Terrestrial fauna surveys and habitat assessments by FFJV were conducted using the following methods as described in relevant survey guidelines:

- A general habitat assessment and record of all fauna encountered (i.e. observed/heard) was undertaken at every vegetation assessment survey site during different seasons (Eyre *et al* 2018);
- Localised validation of the predictive habitat mapping was undertaken, where possible, and
- Use of specific techniques to identify possible presence of conservation significant species (e.g. identification of scats, specific scratch marks and diggings).

At each vegetation assessment location, an assessment of fauna habitat features, and a record of all fauna species incidentally encountered was undertaken (a total of 41 sites). Fauna habitat features recorded included, but were not limited to:

- Level of disturbance relating to fire, grazing, clearing and erosion;
- Presence and abundance of tree hollows, fallen logs (>10 cm diameter), coarse woody debris (<10 cm diameter) and trees with decorticated bark;
- Percentage of groundcover that is leaf litter, bare ground, grasses, soil cracks, surface rocks or non-native flora species (e.g. weeds);,
- Presence of soil banks (e.g. river beds/road cuttings) and wetlands or drainage features; and
- Abundance of flowers and fruit.

All species of fauna observed were identified to the species level where possible (Appendix C).

Targeted fauna survey methods

Where areas were identified as containing habitat considered likely to support threatened species (i.e. both within vegetation assessment areas and at opportunistic locations), specific techniques were employed to increase the likelihood of detecting these species. Location selection was optimised to maximise fauna detection by selecting sites along drainage lines and fauna pathways within bushland. Remote sensing techniques were used to ensure maximum chances of detecting threatened species. Specific techniques adopted as part of the ecological assessments (including survey effort where applicable) and their relevance to target fauna species included:

- Anabat devices (targeting Microchiropteran bats) were deployed at five sites (overnight) for a total survey effort of seven detector nights;
- Standardised surveys for birds recording observation or calls for 20 minutes over a 2 hectares (ha) survey area. The Birds Australia census technique described by Loyn (1986);
- Active searches for koala (*Phascolarctos cinereus*), their pellets and tree scratches were undertaken at all assessment sites where food trees were present;

- Active searches for reptiles. This involved 20 minutes of searching by two people over 1 ha within suitable microhabitats such as beneath rocks and fallen logs and amongst leaf litter and woody debris;
- Spotlighting and night driving for species such as Dunmall's snake (*Furina dunmalli*), along with other amphibians, reptiles, birds and mammals – outside of formalised survey locations; and
- Infra-red remote motion-sensing cameras (overnight) at watering points and/or at baited feeding stations (mammals and birds) – nine sites.

Other fauna species encountered during these works were recorded, along with opportunistic observations (all fauna species).

3.3.1.3 PRE-CLEARANCE AND PROTECTED PLANT SURVEYS – 2018 AND 2019

Pre-clearance and Protected Plant surveys were undertaken by FFJV at sites within and adjacent to the Project footprint associated with vegetation clearing for geotechnical works (largely boreholes and access tracks) in 2018 and 2019. Surveys were carried out at 91 locations.

Protected Plants

Protected plant surveys were undertaken in accordance with the *Queensland Flora survey guidelines - Protected Plants* (DES, 2020) regardless of whether the location was mapped as a high-risk area on the Queensland Government Protected Plants flora survey trigger map. At each site, the random meander survey method was implemented for a minimum of 30 minutes, or until no new flora species were identified. As per the guidelines, surveys were carried out within the targeted clearing area as well as an additional 100 m buffer area.

Pre-clearance habitat surveys

The pre-clearance surveys were carried out to further inform the ecological assessment and to identify approval requirements under Queensland legislation for vegetation clearing for the geotechnical works in 2018 and 2019.

The surveys included the following methods:

- Searches for potential breeding habitat for threatened species such as:
 - Recording of all burrows/dens, logs, rocks, caves and suitable leaf litter that may contain breeding habitat for threatened species;
 - Recording of hollow bearing trees noting hollow attributes such as size, angle, height in the tree and orientation; and
 - Recording of bird nests and potential for active nesting;
- Habitat suitability assessments for threatened species with key habitat types recorded; and
- Incidental fauna observations recorded.

3.3.1.4 AQUATIC FIELD SURVEYS – 2018, 2019 AND 2021

Aquatic ecology surveys were carried out on three discrete survey events in June 2018, November 2018 and May 2019 across 13 sites, varying from major rivers to intermittent streams (Eco Logical Australia, 2020). Surface water sampling was conducted at these 13 sites and an additional 21 sites (34 sites in total). Field survey methods were conducted in accordance with the Australian River Assessment System (AUSRIVAS) protocols and included

aquatic habitat assessment, surface water quality assessment (physico-chemical, nutrients, chlorophyll, and dissolved metals), macroinvertebrate sampling, macro-crustacean surveys, and freshwater turtle surveys and targeted fish surveys. The methods relevant to MNES are described in detail in the following sections (for further details see Appendix A).

Four surface water field surveys were undertaken in June 2018, November 2018, February 2019 and April 2019 and additional water quality data were collected at five sites in May 2019, to assist with the interpretation of macroinvertebrate data. Another aquatic field survey was undertaken on 4 November to 5 November 2021, to address potential impacts related to proposed non-resident workforce accommodation areas for the Project. This investigation included field surveys at six sites, each comprised of one upstream, one downstream and one at the proposed impact location.

Information on habitat suitability for freshwater turtles and incidental observations during field surveys were collected to inform the likelihood of occurrence of turtle species.

Additionally, waterway barrier works were assessed by collecting on ground physical and hydrological attributes aimed at determining if a particular feature is a defined waterway that provides for fish passage.

Aquatic habitat assessments

AUSRIVAS habitat assessment was completed at each site (Eco Logical Australia, 2020). A detailed list of the habitat variables recorded is provided in Appendix C. The habitat value of each aquatic ecology assessment site was used to predict the nature of faunal assemblages utilising the watercourse and to inform an assessment of the suitability of aquatic habitats for key species of interest, such as the Murray cod (*Maccullochella peelii*), silver perch (*Bidyanus bidyanus*), Bell's turtle (*Wollumbinia belli*) and southern snapping turtle (*Elseya albagula*). General site observations and photographs of aquatic habitats were also recorded.

Targeted fish surveys

In June 2018 a targeted fish survey was undertaken, involving the deployment of baited box traps and dip-netting, targeting small fish at sites containing water (Eco Logical Australia, 2020). At each site, up to seven baited box traps were deployed for approximately one hour, followed by dip-netting watercourse edge habitats for a period of approximately 10 minutes with an Environet®.

In December 2018 and May 2019, a range of additional survey techniques were applied to assess fish assemblages at suitable aquatic ecology sites. Methods were selected from the *Survey Guidelines for Australia's Threatened Fish* (DSEWPAC, 2011a) and included backpack electrofishing (where water depth was <0.5 m), seine netting (2 to 5 mm mesh) and use of fyke nets. Where fyke nets were used, two nets were deployed overnight (one 3 mm stretched mesh and one 4 mm stretched mesh). Nets were dual wing in design, with each wing 4 m in length with a 0.6 m drop. Survey methods were adapted to suit the local conditions of the watercourse, with the primary considerations being water depth and presence of woody debris which may foul nets.

3.3.2 REVISED DRAFT EIS FIELD SURVEYS

Following the preliminary surveys, a field survey program was designed within the Project footprint to assess and validate the ecological values. Survey methods were based on the

results of database assessments and preliminary surveys. Detailed methodologies for these investigations are provided in the respective reports in Appendix A, and summarised in the following sections. The timing of these surveys is presented in Table 3-5.

The field assessment methodologies were implemented in accordance with the following survey guidelines:

- Commonwealth published guidelines for threatened species and threatened ecological communities where applicable (<http://www.environment.gov.au/epbc/policy-statements>);
- *Methodology for survey and mapping of REs and vegetation communities in Queensland* (Neldner et al., 2023);
- *Terrestrial vertebrate fauna survey guidelines for Queensland* (Eyre et al., 2018; Eyre et al., 2022);
- *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (DSEWPC, 2011d; surveys were conducted prior to the update to this document in 2024 (DCCEEW, 2023));
- *Guide to greater glider habitat in Queensland* (Eyre et al., 2022);
- *Flora survey guidelines – protected plants, Nature Conservation Act 1992* (DES, 2020);
- *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland – version 2.2* (Eyre et al, 2015); and
- *Guide to Determining Terrestrial Habitat Quality – version 1.2* (DEHP, 2017a) in conjunction with MHQAT by agreement with DCCEEW and OCG.

Aquatic surveys conducted by Hydrobiology were undertaken using modern eDNA methods that are more efficient and effective than current aquatic fauna survey guidelines. An assessment of the adequacy of surveys undertaken against relevant survey guidelines is provided as Appendix E.

3.3.2.1 LOCATIONS AND TIMING

Seasonal sampling in spring (mid-September to mid-December) and autumn (late February to April) is recommended for the Brigalow Belt South bioregion (Eyre et al. 2018). Field surveys were undertaken within both periods (Table 3-5).

The field surveys undertaken were primarily concentrated within the Project footprint, however targeted field surveys were also undertaken in areas adjoining the Project footprint to determine the extent of potential indirect impacts to relevant TECs. Field survey locations (Figure 3-1) considered the revised reference design, and locations of previous survey sites, aiming to undertake comprehensive field surveys within the Project footprint. Targeted fauna surveys in Figure 3-1 include locations of pit fall traps, Elliott traps, cage traps, harp traps, funnel traps, camera traps, hair tube traps, bird surveys, call playback surveys, spotlighting, and stag watching as conducted by Cardno (see section 3.3.2.3). Field survey sites were positioned in areas which had not been previously subject to adequate surveys as part of the preliminary field surveys, ensuring inclusion of:

- Representative examples of each distinct vegetation community (RE) and, where appropriate, accounting for remnant, regrowth and non-remnant areas;
- Landscape features that were considered likely to support threatened species based on known habitat preferences; and
- Areas known or predicted to support threatened species or other ecological values.

TABLE 3-5 SUMMARY OF REVISED DRAFT EIS FIELD INVESTIGATIONS

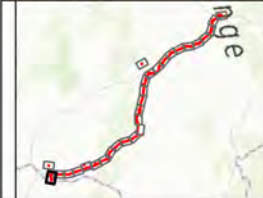
Study/investigation	Consultant/year	Timing of investigations	Season	Methodologies and notes
Terrestrial Ecological Assessment Report	Cardno (2021)	19 October to 13 November 2020 15 February to 27 March 2021 26 February to 13 March 2021	Spring, summer, autumn	- Verified presence of RE's within the Project footprint - BioCondition assessments - Targeted threatened flora and fauna surveys - Incidental recording of animal breeding places
Supplementary Terrestrial Ecological Assessment Report	Ausecology (2023)	30 August to 3 September 2021 6 to 11 September, 27 to 29 September 2021 5 to 7 October, 25 to 28 October 2021 2 to 5 November, 11 November, 23 November 2021 6 December, 9 to 11 December, 14 December, 30 December 2021 15 to 17 March 2022	Winter, spring, summer, and autumn	- Verified presence of REs within the Project footprint - BioCondition assessments - Detailed habitat assessments - Incidental recordings of threatened species - Incidental recording of animal breeding places
Fauna survey report: Targeted survey for Brigalow Woodland Snail <i>Adclarkia cameroni</i> , Queensland	Boobook Consulting (2022)	November 2022	Summer	Targeted survey within selected parts of the Project footprint for Brigalow Woodland Snail (<i>Adclarkia cameroni</i>)
Ecology Assessment Whetstone Temporary Material Distribution Centre	Umwelt (2022)	20 September 2022	Spring	- Quaternary assessments - Opportunistic threatened flora searches - Fauna habitat assessments - Active searches, bird surveys and opportunistic fauna sightings
eDNA Survey	Hydrobiology (2023)	20 to 25 November 2022	Summer	eDNA sampling of waterways within the Study area targeting Murray cod, silver perch and other aquatic species.

Study/investigation	Consultant/year	Timing of investigations	Season	Methodologies and notes
Microbat Surveys and Research Inland Rail: N2N and B2G	Williams (2023)	24 February to 10 March 2023 16 March to 6 April 2023	Summer, autumn	- Targeted microbat surveys and tracking research within two forested segments of Project footprint - Two threatened microbat species south-eastern long-eared bat (<i>Nyctophilus corbeni</i>) and large-eared pied bat (<i>Chalinolobus dwyeri</i>)
ARTC Inland Rail Border to Gowrie (B2G) Ecology Partnership	UniSQ (2024)	Various January 2023 to 30 June 2024	Winter, spring, summer and autumn	- Ecological fauna surveys, monitoring and research targeting threatened fauna including koalas (<i>Phascolarctos cinereus</i>) and reptiles (yakka skink, Dunmall's snake, collared delma, five-clawed worm skink and Condamine earless dragon) - Dietary analysis of koalas (<i>Phascolarctos cinereus</i>) - Habitat assessments - Genetic assessments - Threat assessment of wild dogs to koalas
ARTC Inland Rail Border to Gowrie (B2G) Threatened Species Flora Studies	UniSC (2024)	Various July 2023 to June 2024	Winter, spring, summer, autumn	- Document populations sizes, demographic attributes, and locations of populations of <i>Eucalyptus virens</i>, <i>Xerothamnella herbacea</i>, <i>Lepidium monoplacoides</i>, and <i>Thesium australe</i>, <i>Westringia parvifolia</i> and <i>Acacia lauta</i> - Test propagation approaches for <i>Eucalyptus virens</i>, <i>Westringia parvifolia</i> and <i>Acacia lauta</i> - Genetic assessments
B2G Borrow Pit Ecological Surveys	Ausecology (2024a)	5 – 6 September 2023	Spring	- General vegetation assessment at proposed borrow pit sites (inclusive of access tracks) - Incidental recordings pf threatened flora and fauna
B2G Supplementary Ecology Survey Report Memo	ERM (2024a)	December 2023	Summer	- Targeted survey within selected parts of the Project footprint for greater glider (<i>Petauroides</i> spp.) - Verification of TEC within the Project footprint.

Study/investigation	Consultant/year	Timing of investigations	Season	Methodologies and notes
White Box TEC Potential Offset Site Assessment	Ausecology (2024b)	14 – 15 March 2024	Autumn	Verification of box-gum (white box) TEC outside of the Project footprint.
Telstra/Nextgen cable realignment, Gowrie Junction Protected Plant Survey Report	EMM (2024)	18 – 19 December 2023 22 February 2024	Summer	- Targeted threatened flora survey as prescribed by the NC Act - Verified presence of RE within Project footprint
Koala Genetics Study Project: Inland Rail Program	ERM (2024b)	- June 2022 - July 2023	Winter	- Targeted surveys utilising detection dogs within previously identified hotspot areas to identify koala scats for collection. - Targeted vegetation and habitat assessments.



- Legend**
- ▲ Quarternary Assessment
 - ★ Fauna Transect
 - ▲ Habitat Quality Assessment
 - ◆ Greater Glider Spotlighting
 - ★ Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
 - Protected Plant Survey
 - Temporary Disturbance Footprint
 - Permanent Disturbance Footprint
 - Protected Area
 - Watercourse
 - Study Area
 - Chainage (km)



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F3.1(1)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
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- ▲ Quarternary Assessment
- ★ Fauna Transect
- ▲ Habitat Quality Assessment
- ◆ Greater Glider Spotlighting
- ★ Flora Survey
- Snail Survey
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F3.1(2)- Preliminary Field Survey Locations

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 - ▲ Habitat Quality Assessment
 - ◆ Greater Glider Spotlighting
 - ★ Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - ⬠ Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
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 - Temporary Disturbance Footprint
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 - Protected Area
 - Watercourse
 - ▭ Study Area
 - Chainage (km)

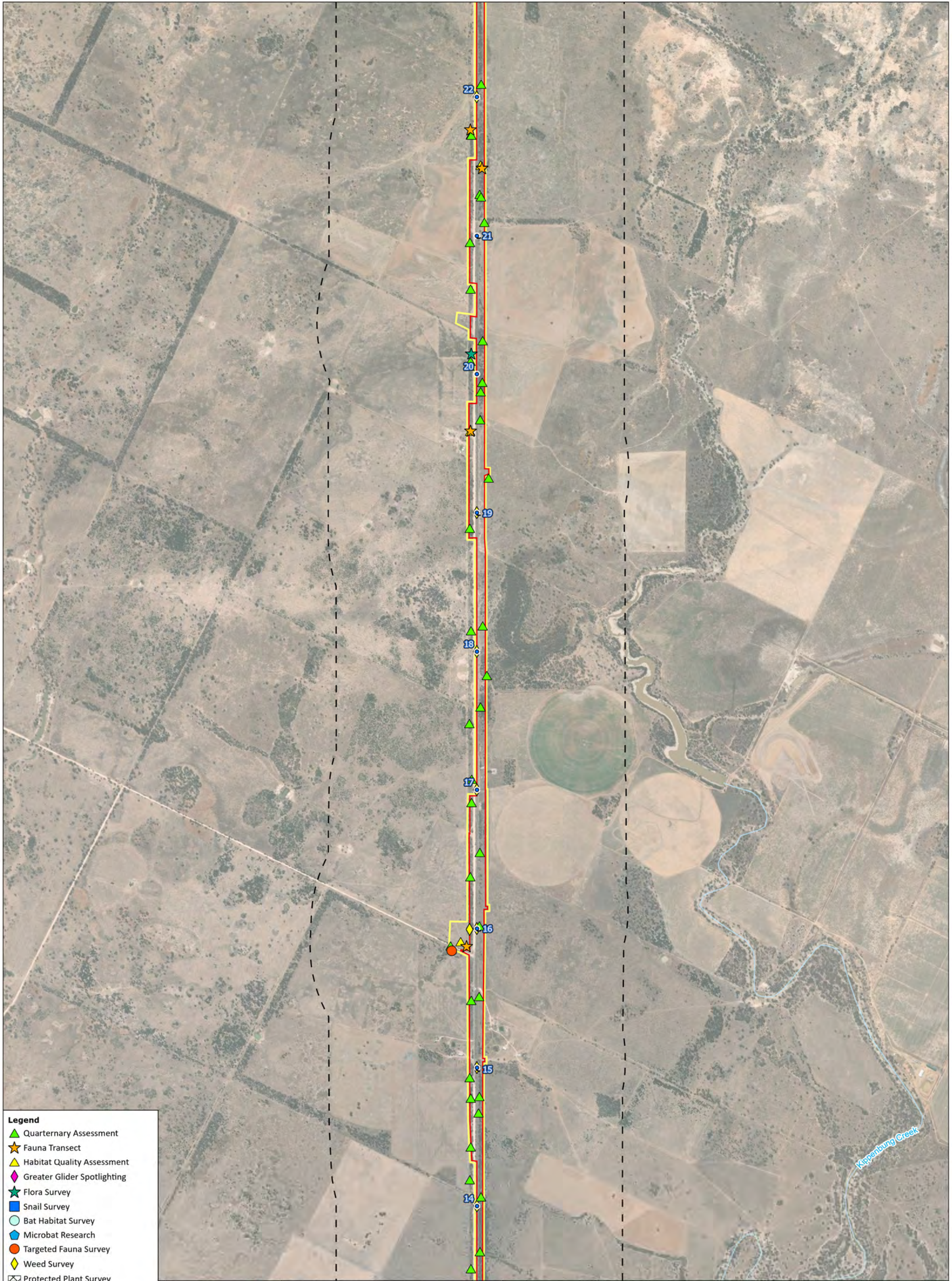
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F3.1(3)- Preliminary Field Survey Locations

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- Legend**
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 - ◆ Greater Glider Spotlighting
 - ★ Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - Microbat Research
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 - ◆ Weed Survey
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 - Permanent Disturbance Footprint
 - Protected Area
 - Watercourse
 - ▭ Study Area
 - Chainage (km)

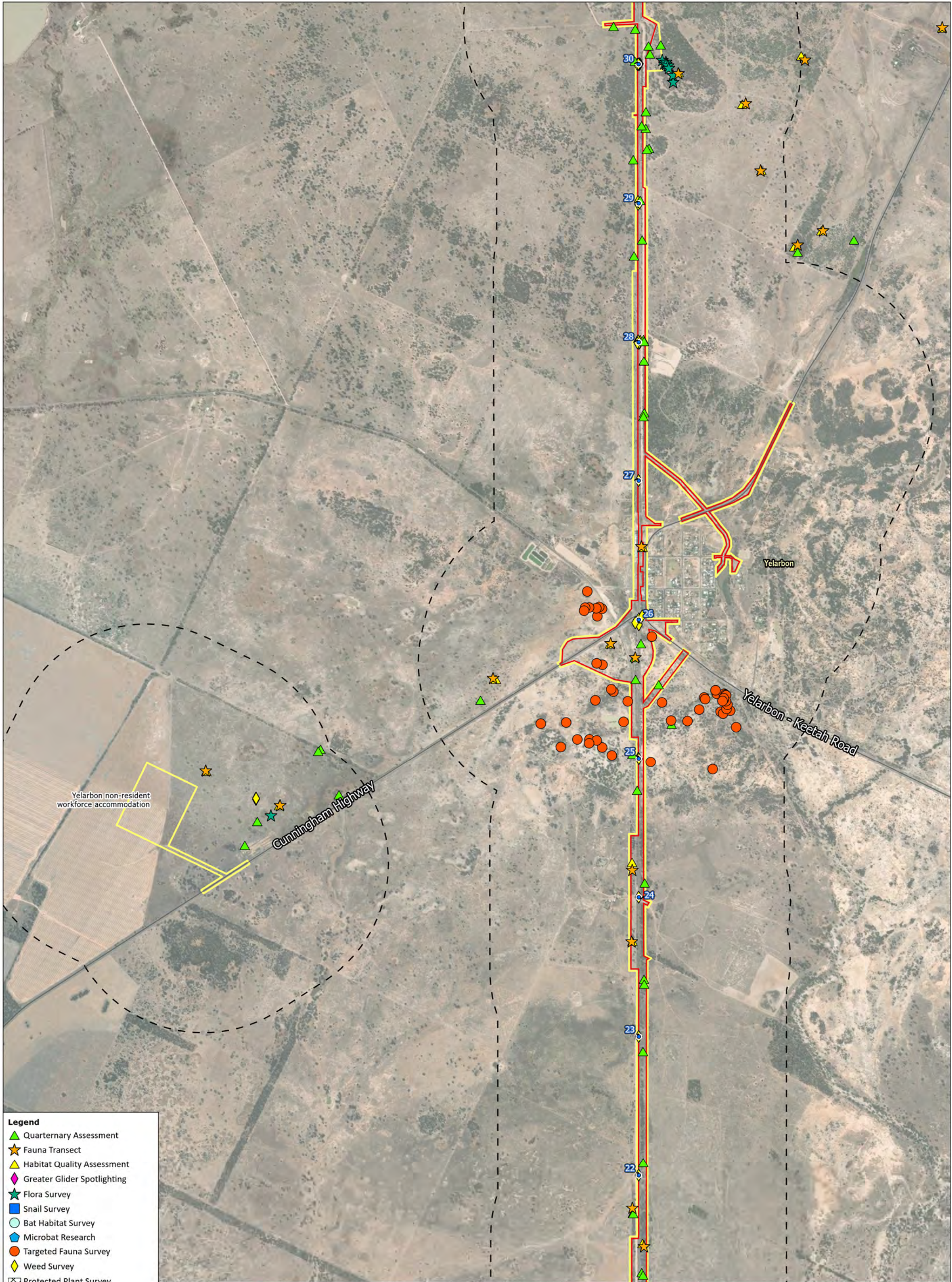
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F3.1(5)- Preliminary Field Survey Locations

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 - ★ Flora Survey
 - Snail Survey
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 - Watercourse
 - Study Area
 - Chainage (km)

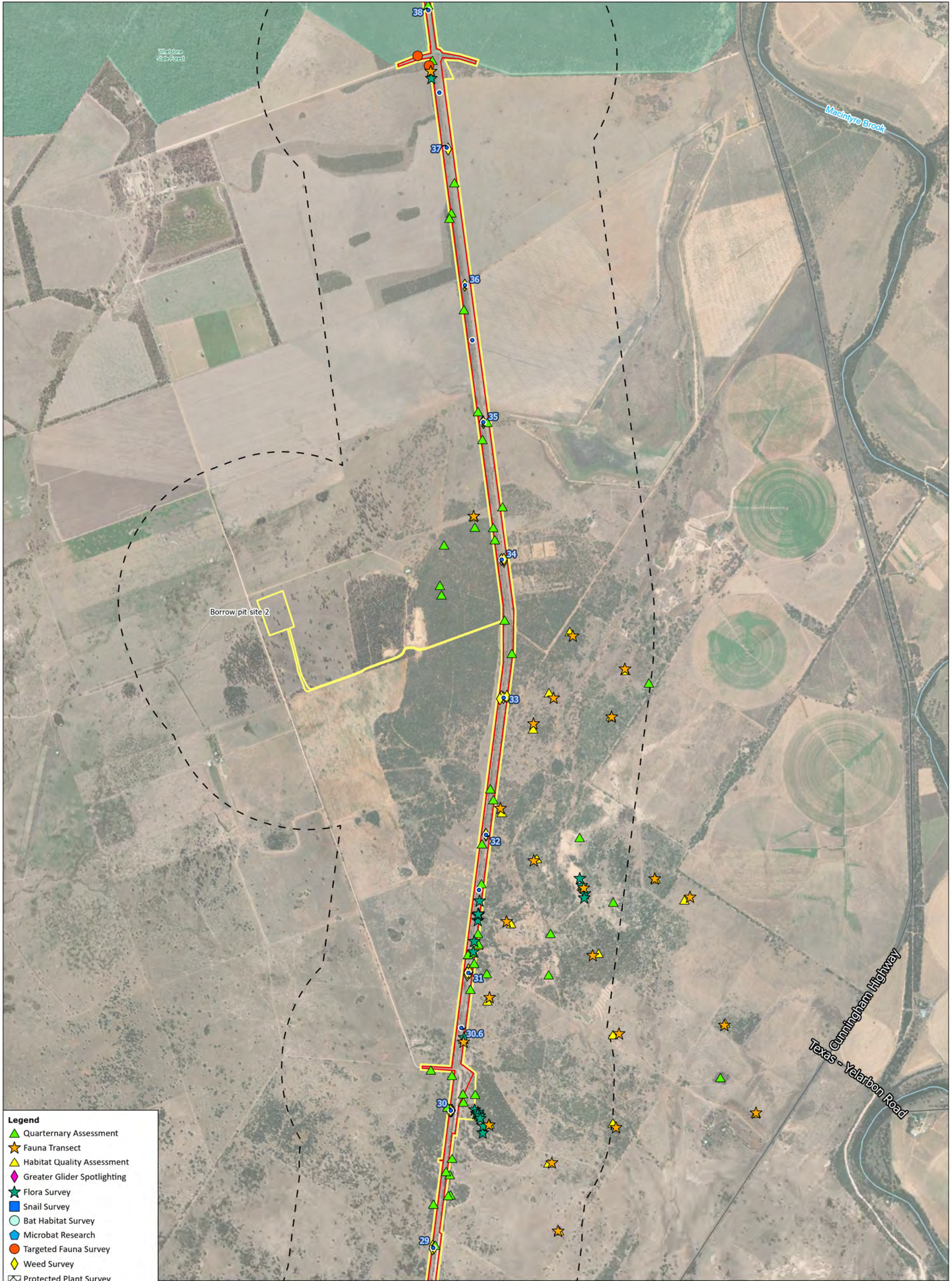
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F3.1(6)- Preliminary Field Survey Locations

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 - ★ Flora Survey
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 - Bat Habitat Survey
 - Microbat Research
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 - ◆ Weed Survey
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F3.1(7)- Preliminary Field Survey Locations

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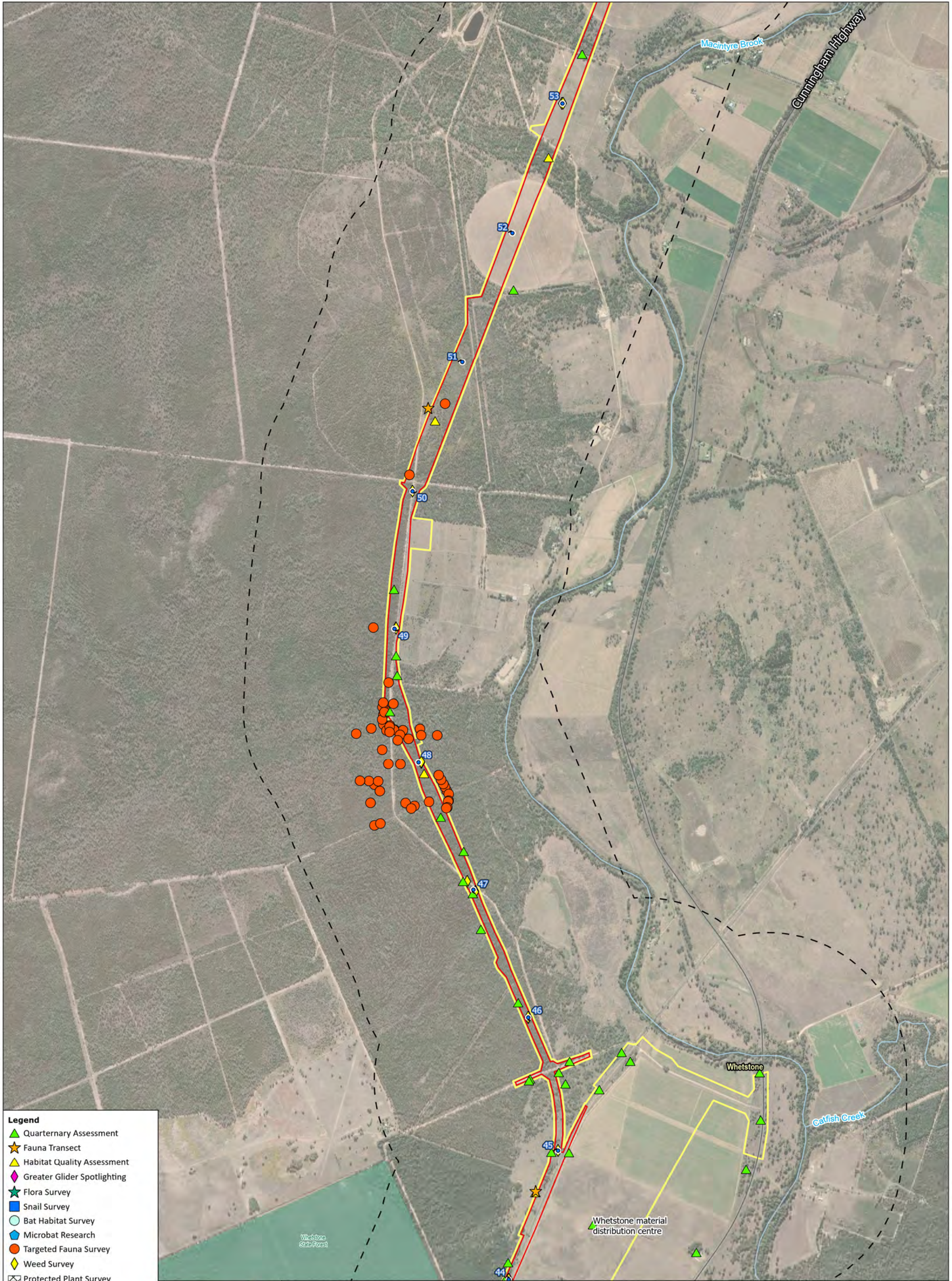
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 - ⬠ Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
 - ▨ Protected Plant Survey
 - ▭ Temporary Disturbance Footprint
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 - ▭ Watercourse
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 - Chainage (km)

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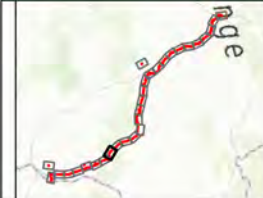
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 - ▨ Watercourse
 - ▨ Study Area
 - Chainage (km)



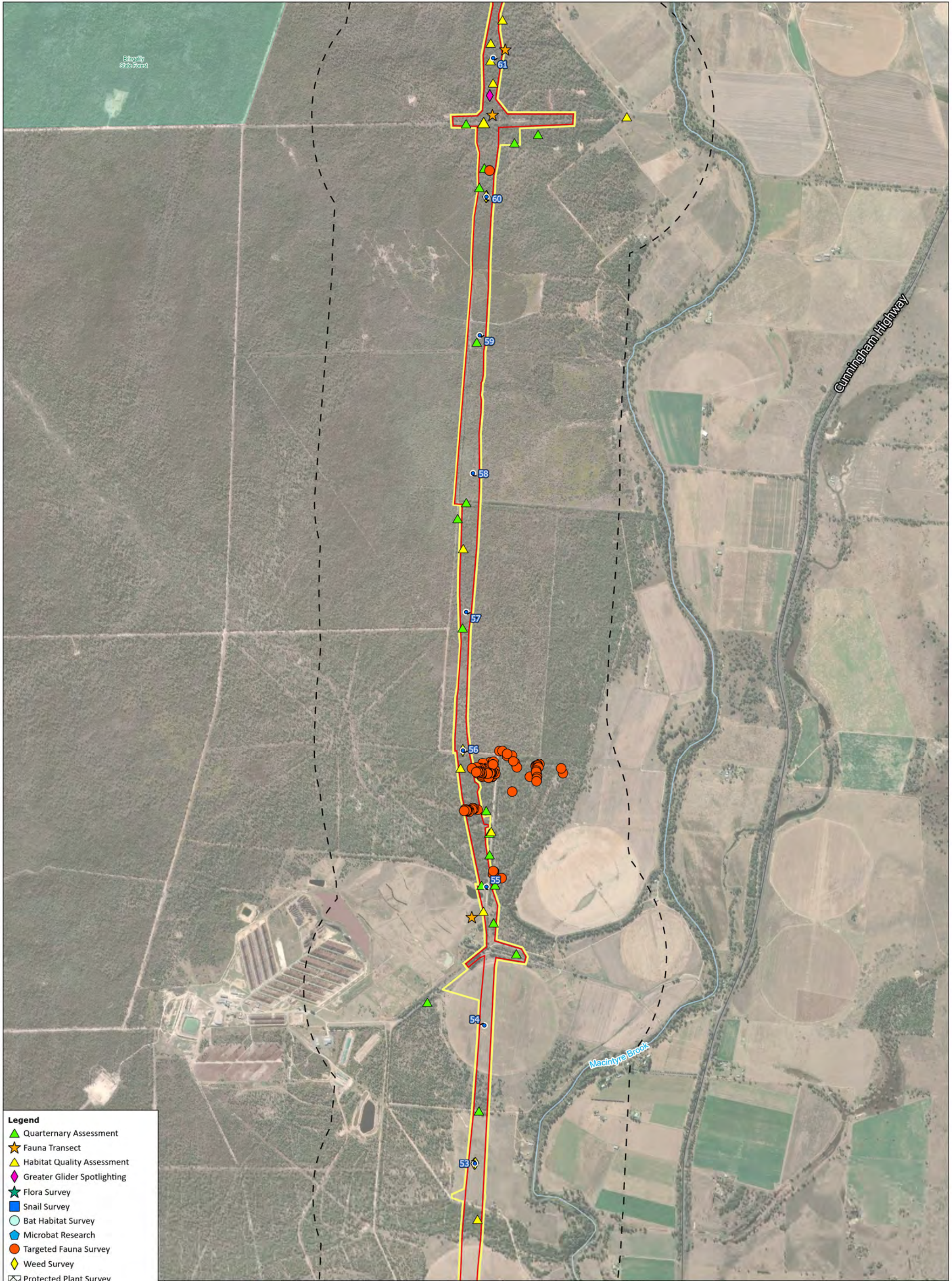
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F3.1(9)- Preliminary Field Survey Locations

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- Legend**
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 - Snail Survey
 - Bat Habitat Survey
 - Microbat Research
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 - ◆ Weed Survey
 - ▨ Protected Plant Survey
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 - ▬ Permanent Disturbance Footprint
 - ▬ Protected Area
 - ▬ Watercourse
 - ▬ Study Area
 - Chainage (km)



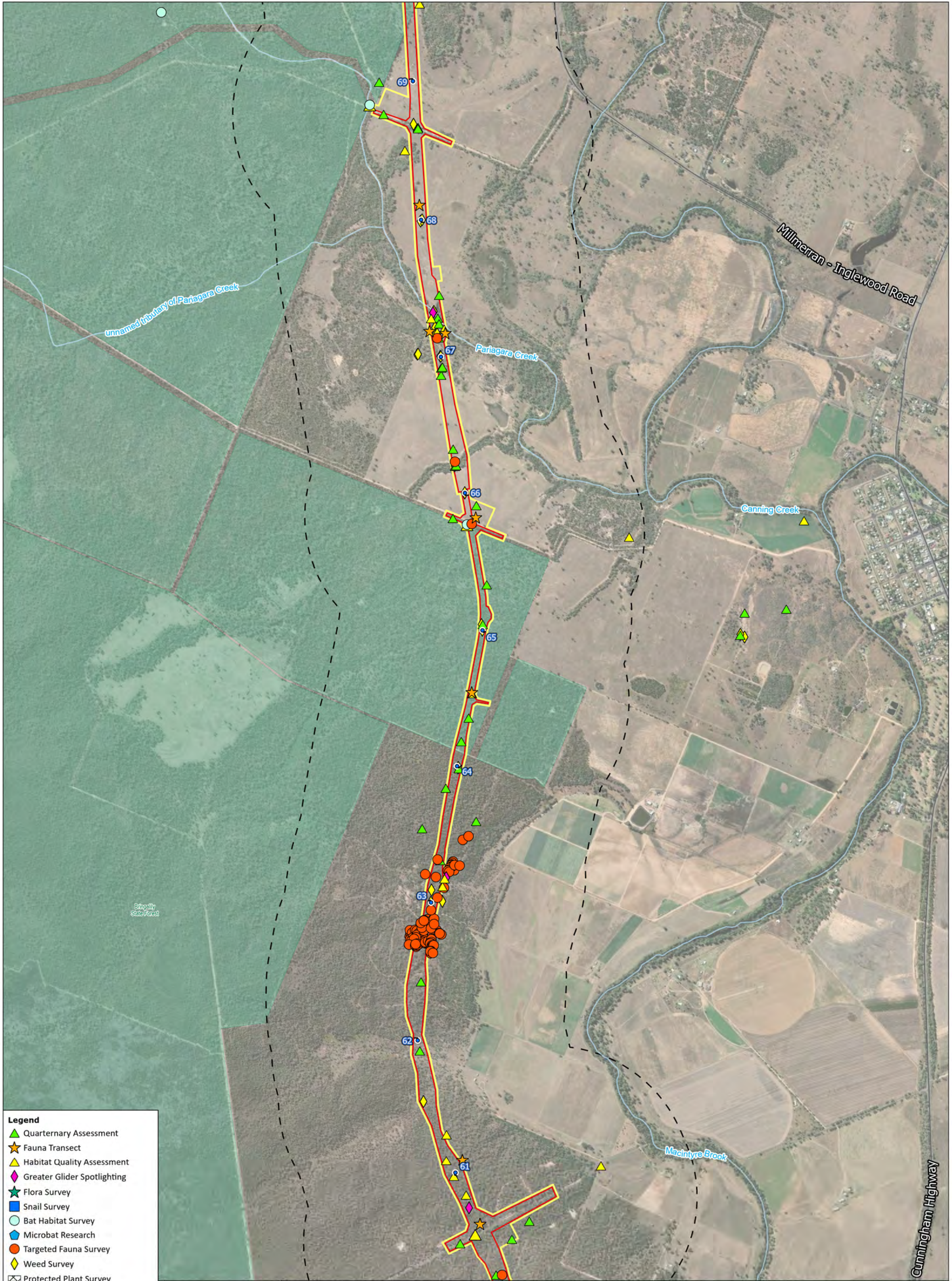
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F3.1(10)- Preliminary Field Survey Locations

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- ▲ Habitat Quality Assessment
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- ★ Flora Survey
- Snail Survey
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- Microbat Research
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- ◆ Weed Survey
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- ▬ Protected Area
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- Chainage (km)



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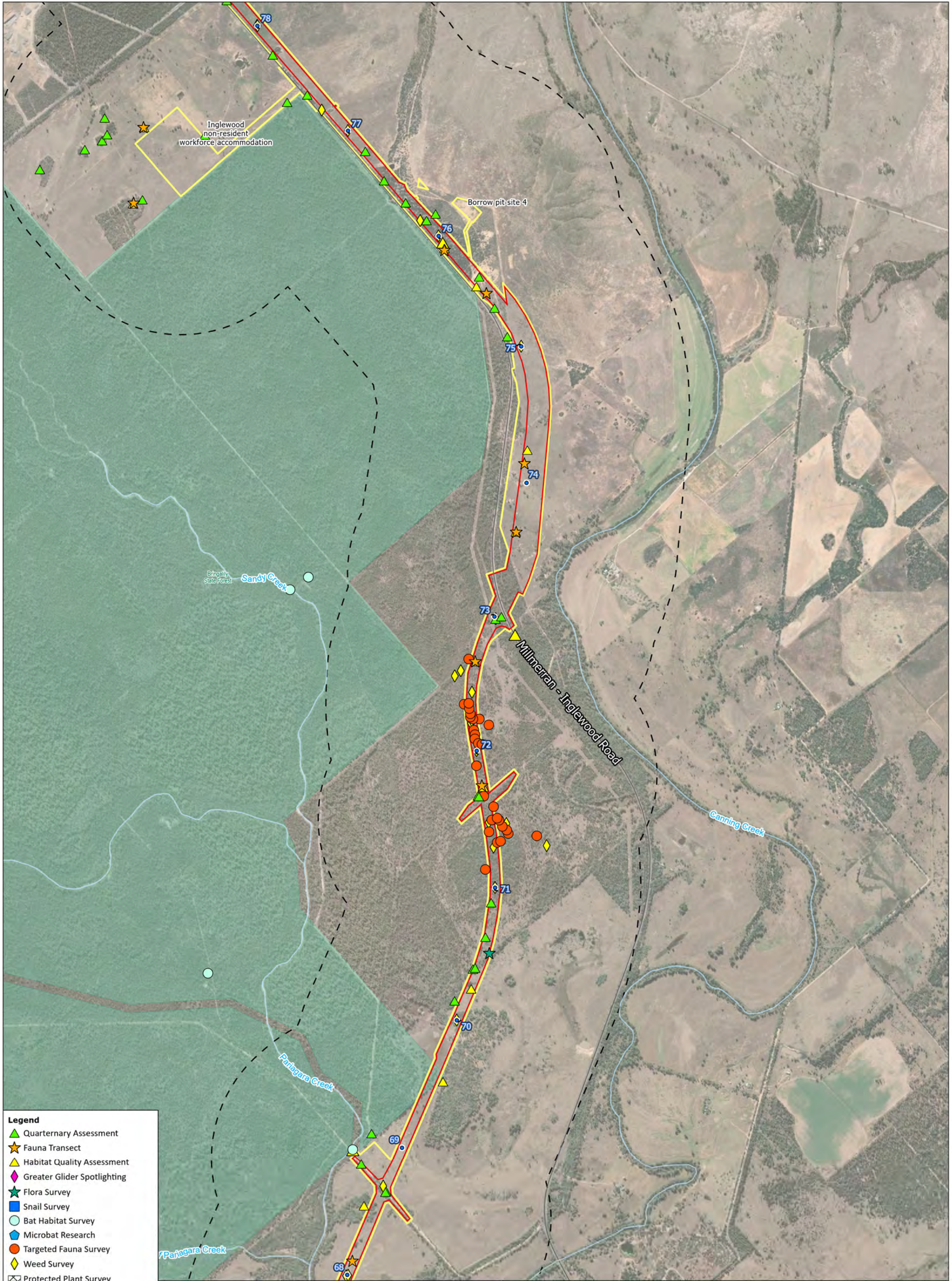
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F3.1(11)- Preliminary Field Survey Locations

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- Quarternary Assessment
- Fauna Transect
- Habitat Quality Assessment
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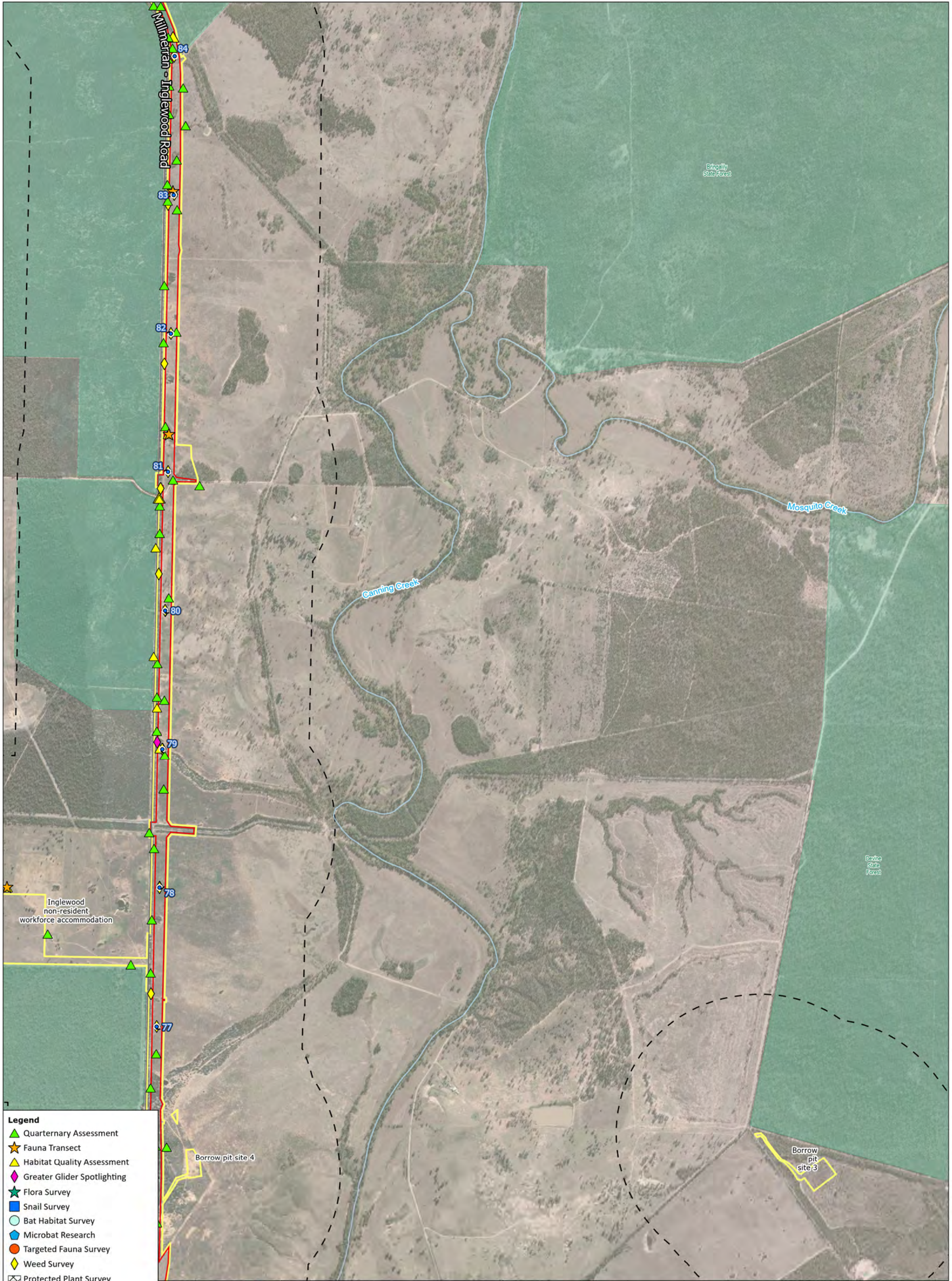
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F3.1(12)- Preliminary Field Survey Locations

Appendix O - Matters of National Environmental Significance Report

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- Legend**
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 - ▲ Habitat Quality Assessment
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 - ▬ Watercourse
 - ▬ Study Area
 - Chainage (km)

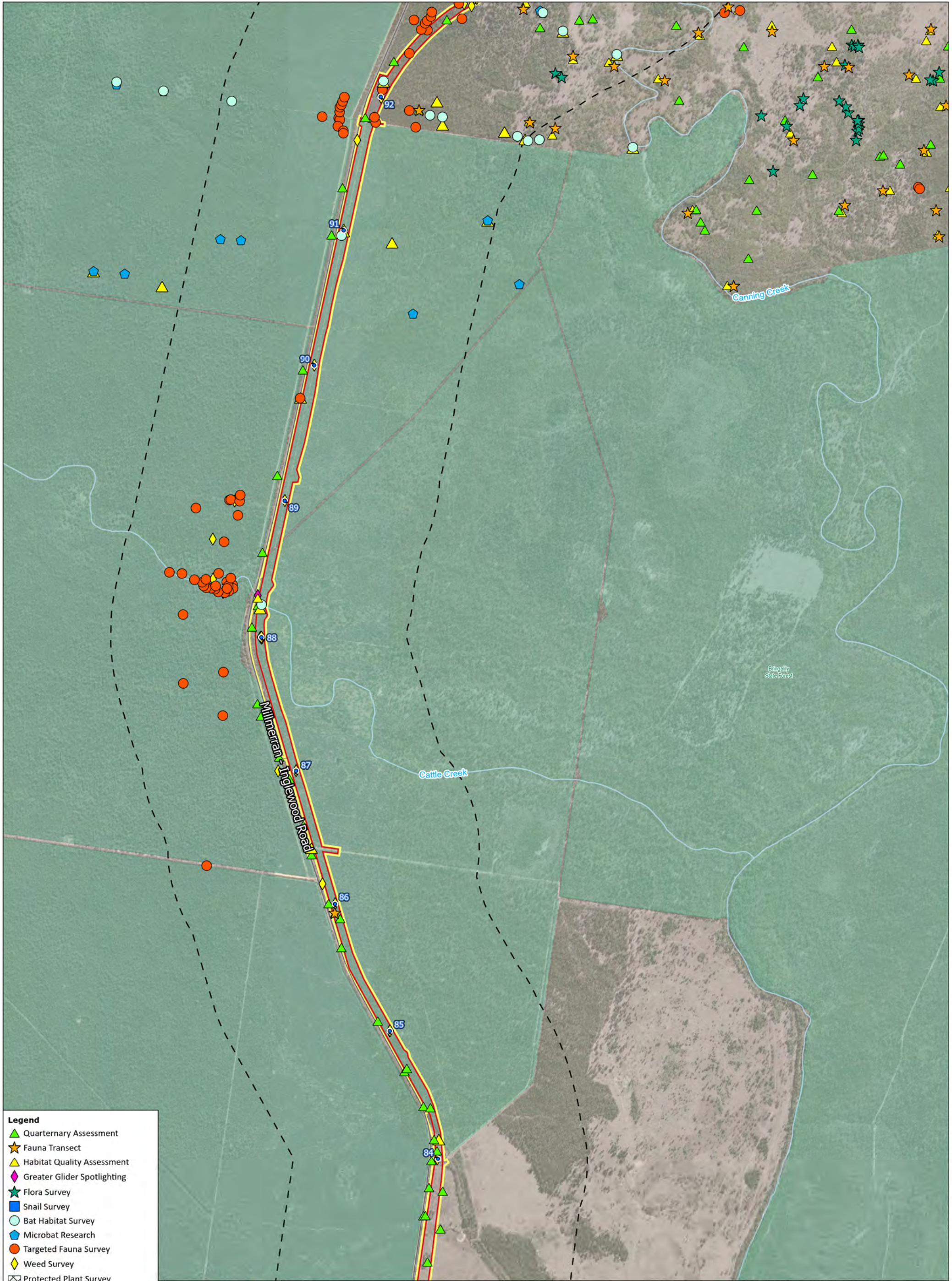
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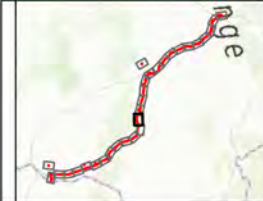
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Appendix O - Matters of National Environmental Significance Report
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- Legend**
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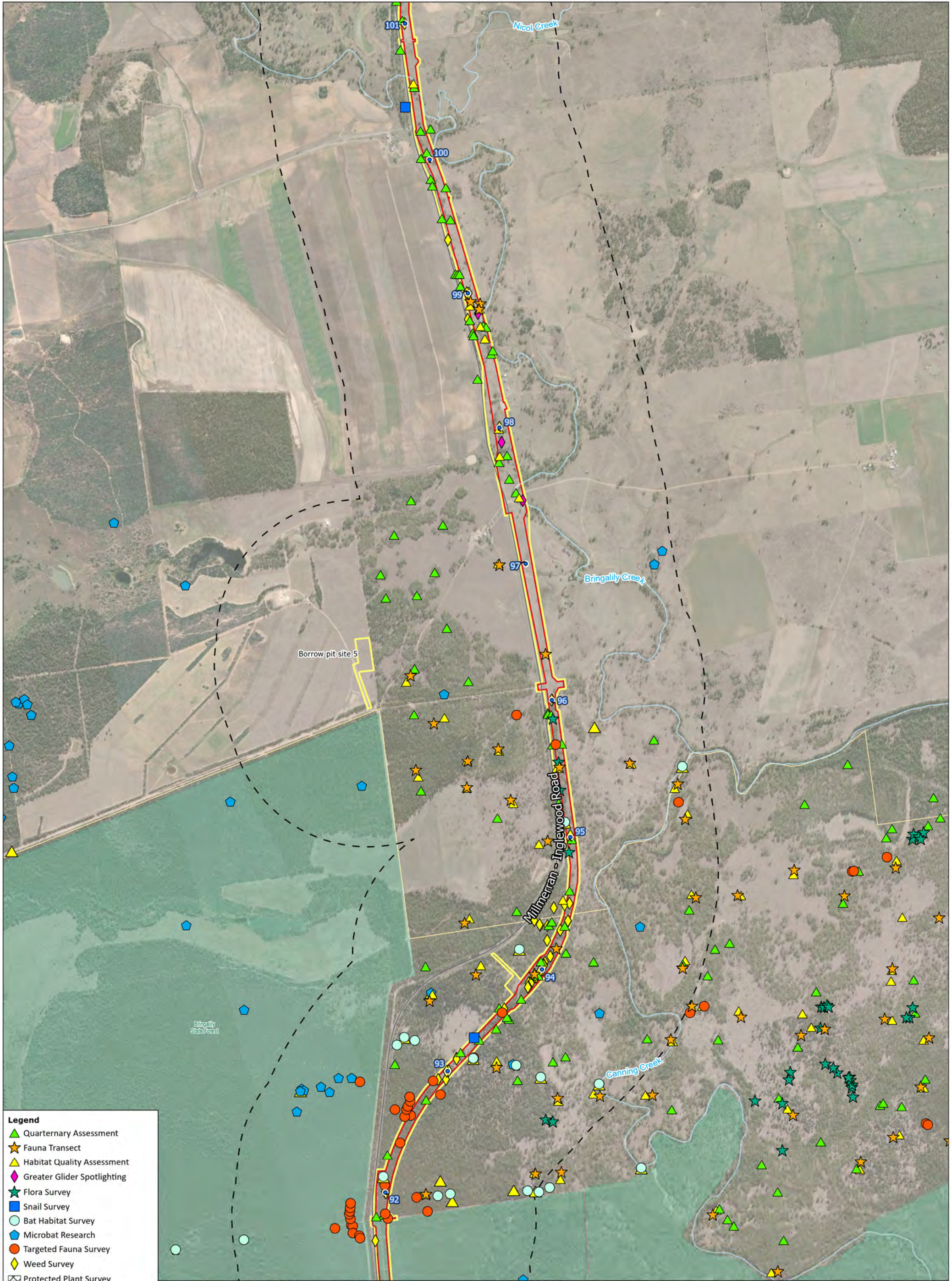
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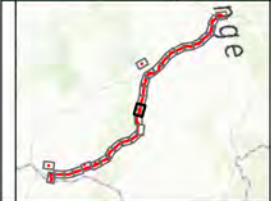
Appendix O - Matters of National Environmental Significance Report
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Legend

- Quarternary Assessment
- Fauna Transect
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F3.1(15)- Preliminary Field Survey Locations

Appendix O - Matters of National Environmental Significance Report

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 - ★ Fauna Transect
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F3.1(16)- Preliminary Field Survey Locations

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- Legend**
- ▲ Quarternary Assessment
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 - Chainage (km)

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F3.1(17)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
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- Legend**
- Quarternary Assessment
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F3.1(18)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
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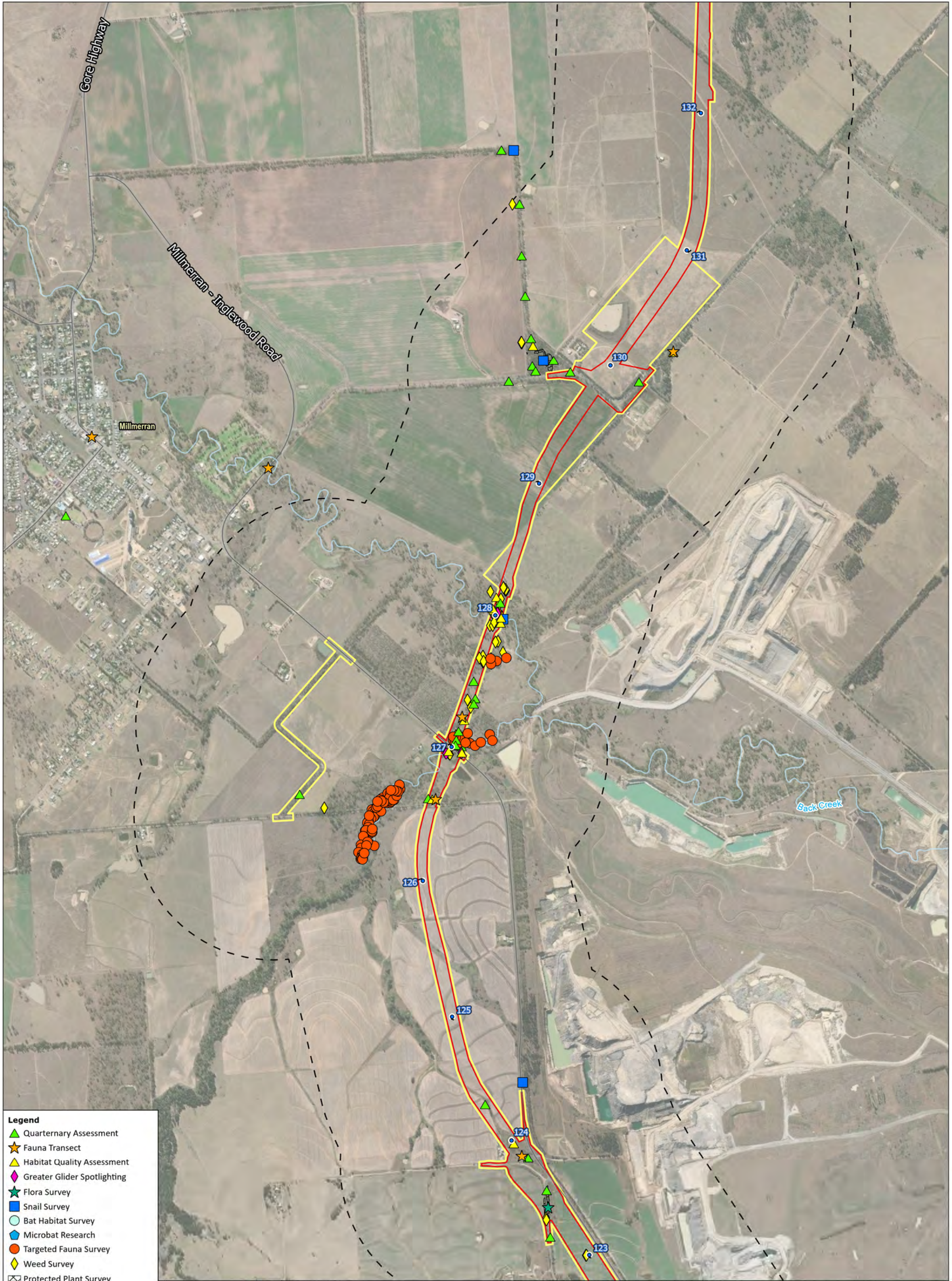
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F3.1(19)- Preliminary Field Survey Locations

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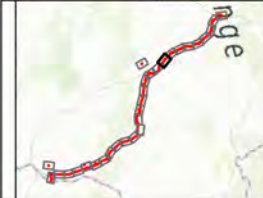
F3.1(21)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
ARTC





- Legend**
- Quarternary Assessment
 - Fauna Transect
 - Habitat Quality Assessment
 - Greater Glider Spotlighting
 - Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - Weed Survey
 - Protected Plant Survey
 - Temporary Disturbance Footprint
 - Permanent Disturbance Footprint
 - Protected Area
 - Watercourse
 - Study Area
 - Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
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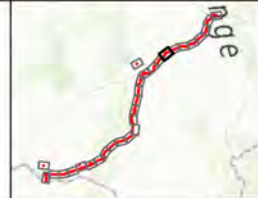
F3.1(22)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
ARTC





- Legend**
- ▲ Quarternary Assessment
 - ★ Fauna Transect
 - ▲ Habitat Quality Assessment
 - ◆ Greater Glider Spotlighting
 - ★ Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
 - ▨ Protected Plant Survey
 - ▨ Temporary Disturbance Footprint
 - ▨ Permanent Disturbance Footprint
 - ▨ Protected Area
 - ▨ Watercourse
 - ▨ Study Area
 - Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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Drawing Size: A3

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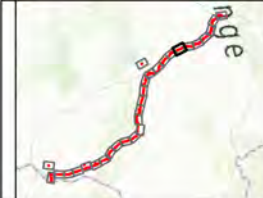
F3.1(23)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
ARTC





- Legend**
- ▲ Quarternary Assessment
 - ★ Fauna Transect
 - ▲ Habitat Quality Assessment
 - ◆ Greater Glider Spotlighting
 - ★ Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
 - Protected Plant Survey
 - Temporary Disturbance Footprint
 - Permanent Disturbance Footprint
 - Protected Area
 - Watercourse
 - Study Area
 - Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
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F3.1(24)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
ARTC





Legend

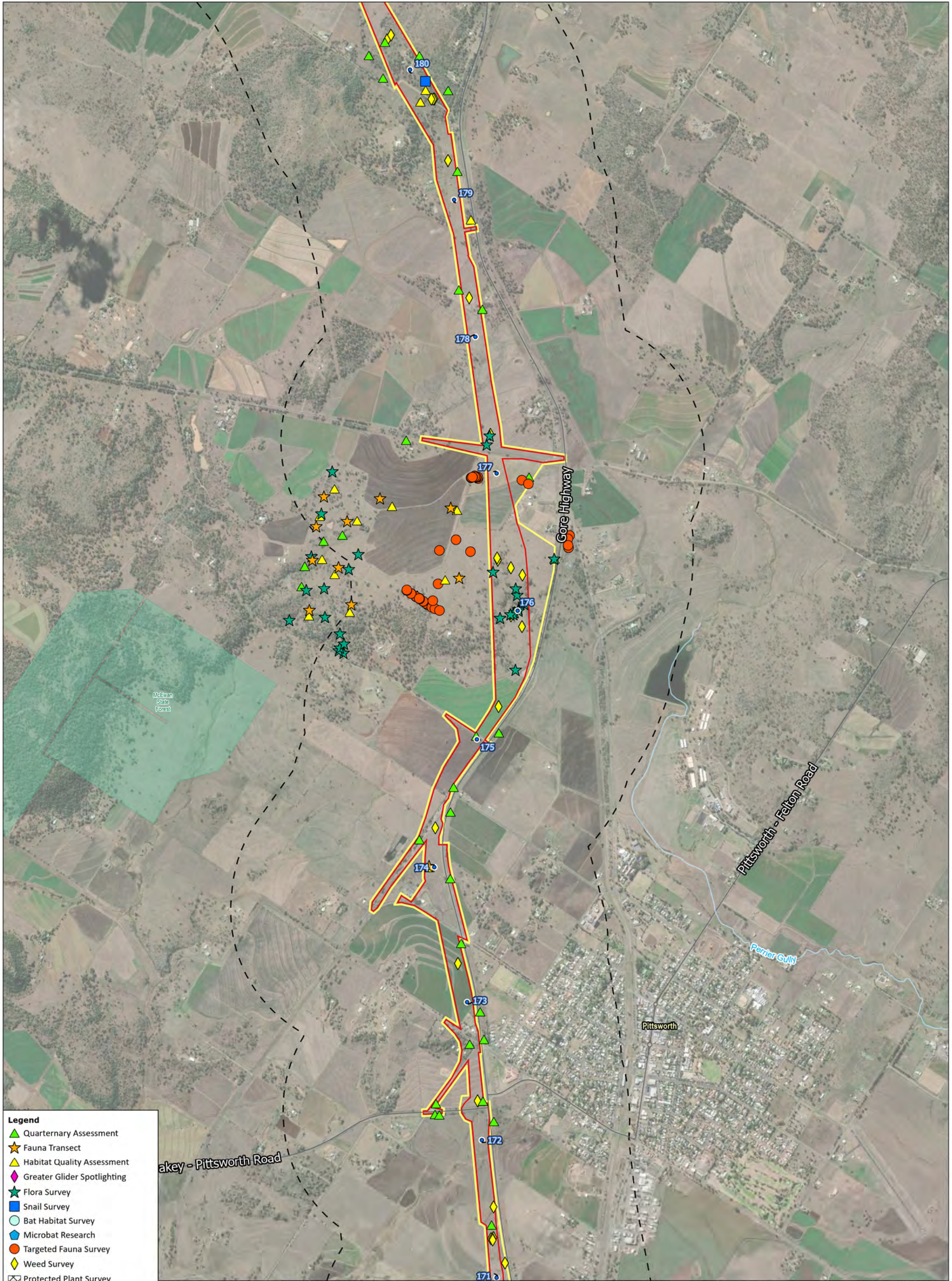
- ▲ Quaternary Assessment
- ★ Fauna Transect
- ◆ Habitat Quality Assessment
- ◆ Greater Glider Spotlights
- ★ Flora Survey
- Snail Survey
- Bat Habitat Survey
- ⬠ Microbat Research
- Targeted Fauna Survey
- ◆ Weed Survey
- ⬠ Protected Plant Survey
- Temporary Disturbance Footprint
- Permanent Disturbance Footprint
- Protected Area
- Watercourse
- Study Area
- Chainage (km)

Coordinate System:
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Date: 17/10/2024
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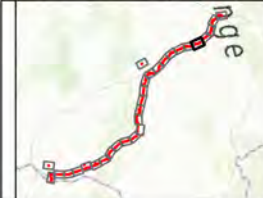
F3.1(25)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
ARTC





- Legend**
- ▲ Quaternary Assessment
 - ★ Fauna Transect
 - ▲ Habitat Quality Assessment
 - ◆ Greater Glider Spotlighting
 - ★ Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - ◆ Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
 - ▨ Protected Plant Survey
 - ▨ Temporary Disturbance Footprint
 - ▨ Permanent Disturbance Footprint
 - ▨ Protected Area
 - ▨ Watercourse
 - ▨ Study Area
 - Chainage (km)



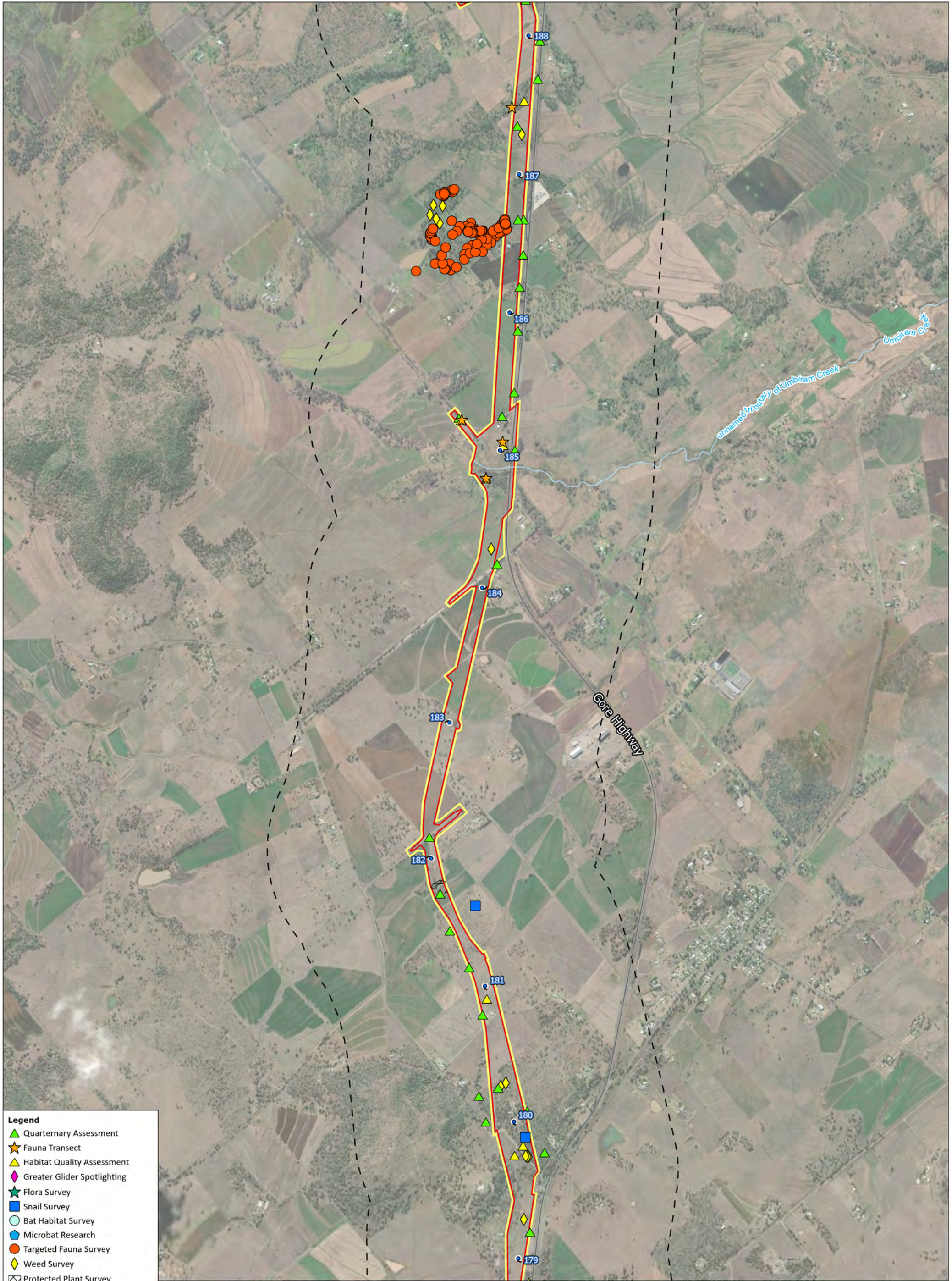
Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



F3.1(26)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
ARTC





Legend

- Quarternary Assessment
- Fauna Transect
- Habitat Quality Assessment
- Greater Glider Spotlighting
- Flora Survey
- Snail Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- Protected Plant Survey
- Temporary Disturbance Footprint
- Permanent Disturbance Footprint
- Protected Area
- Watercourse
- Study Area
- Chainage (km)

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F3.1(27)- Preliminary Field Survey Locations

Appendix O - Matters of National Environmental Significance Report
ARTC





Legend

- Quarternary Assessment
- Fauna Transect
- Habitat Quality Assessment
- Greater Glider Spotlighting
- Flora Survey
- Snail Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- Protected Plant Survey
- Temporary Disturbance Footprint
- Permanent Disturbance Footprint
- Protected Area
- Watercourse
- Study Area
- Chainage (km)

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

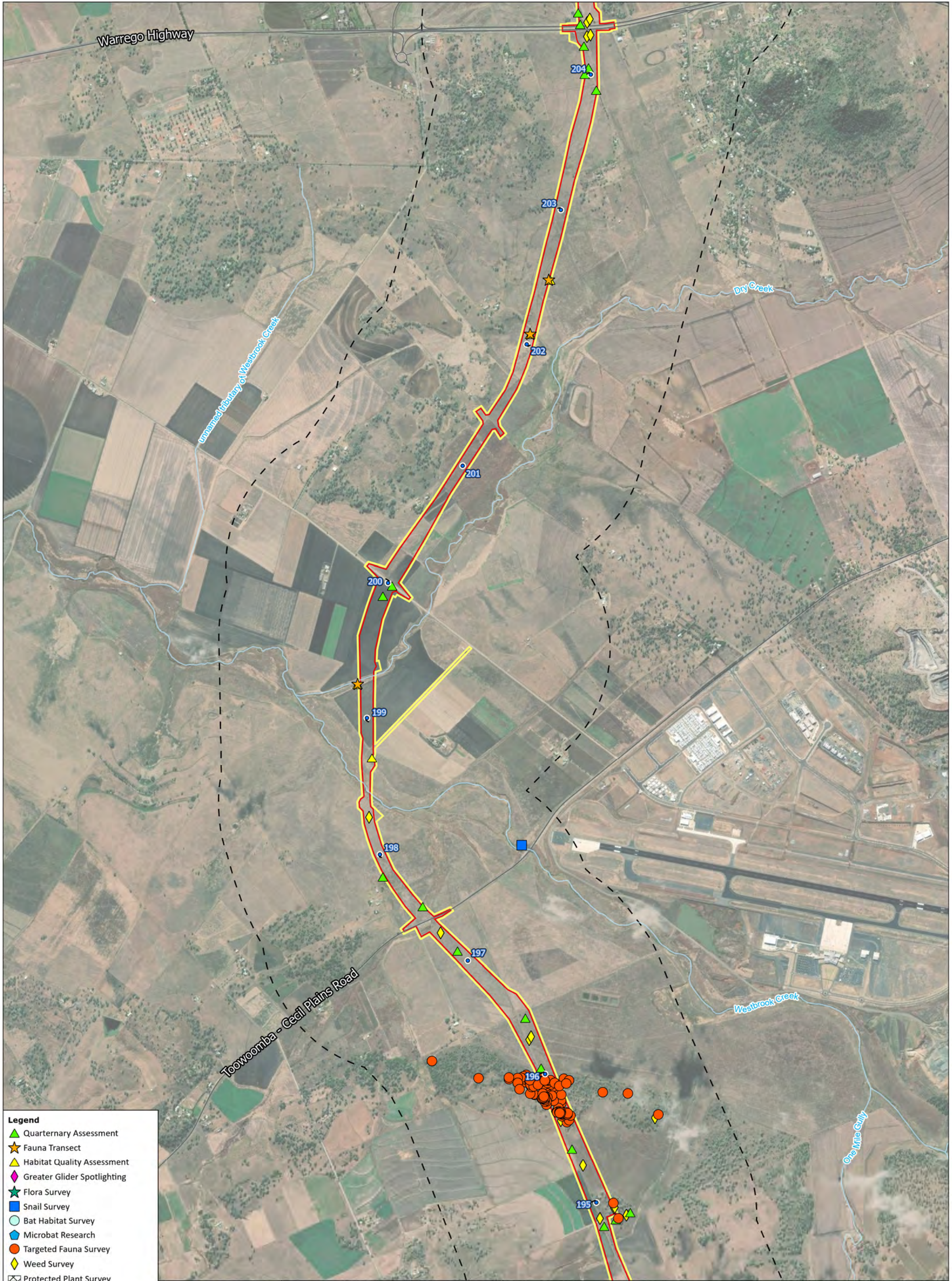
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F3.1(28)- Preliminary Field Survey Locations

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- ▲ Quarternary Assessment
 - ★ Fauna Transect
 - ▲ Habitat Quality Assessment
 - ◆ Greater Glider Spotlighting
 - ★ Flora Survey
 - Snail Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
 - ▨ Protected Plant Survey
 - ▨ Temporary Disturbance Footprint
 - ▨ Permanent Disturbance Footprint
 - ▨ Protected Area
 - ▨ Watercourse
 - ▨ Study Area
 - Chainage (km)

Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m
1:25,000

F3.1(29)- Preliminary Field Survey Locations

**Appendix O - Matters of National Environmental
Significance Report**
ARTC





Legend

- Quarternary Assessment
- Fauna Transect
- Habitat Quality Assessment
- Greater Glider Spotlighting
- Flora Survey
- Snail Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- Protected Plant Survey
- Temporary Disturbance Footprint
- Permanent Disturbance Footprint
- Protected Area
- Watercourse
- Study Area
- Chainage (km)

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 200 400 600m

1:25,000

F3.1(30)- Preliminary Field Survey Locations

Appendix O - Matters of National Environmental Significance Report
ARTC



3.3.2.2 FLORA FIELD SURVEYS

Targeted threatened flora surveys and ground-truthing of vegetation and habitat were undertaken by Cardno (2021), Ausecology (2022), EMM (2024) and UniSC (2024, ongoing) within the Project footprint to address knowledge gaps from the desktop assessment and preliminary field surveys. Reporting and methodologies associated with each of these surveys is summarised in following sections and provided in detail within Appendix A.

Regional ecosystem validation

Regional ecosystem validation was conducted by Cardno (2021) and Ausecology (2023). Quaternary assessment were conducted as per the *Methodology for Surveying and Mapping Regional Ecosystems and Vegetation Communities in Queensland Version 5.1* (Neldner et al., 2023). A total of 653 quaternary sites were assessed.

At each quaternary point, RE classification was confirmed using the definitions of remnant, regrowth, and non-remnant vegetation, as defined under the VM Act and using the relevant BioCondition benchmark. RE validation was undertaken to inform habitat mapping.

BioCondition assessment

BioCondition assessments were undertaken by Cardno (2021) and Ausecology (2023) in accordance with the *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland – version 2.2*. (Eyre et al., 2015) to assess vegetation quality and assign BioCondition Scores. Following collection of field data, further analysis was conducted to calculate landscape attributes to be assessed in conjunction with site-based attributes to determine the overall BioCondition Score for each site and habitat quality scores as required and defined within EIS Appendix Q: Environmental Offset Delivery Strategy.

Threatened ecological communities

The EPBC Act definition of each potentially occurring TEC was examined and, following ground-truthing of REs, any RE likely to be associated with one (or more) TECs were further assessed against the descriptions, key diagnostic characteristics, condition categories and thresholds as detailed in the respective approved conservation advice documents and provided in further detail in the methods of the technical reports (Appendix A).

TEC assessments were undertaken by Cardno (2021) and Ausecology (2023). Areas adjacent to the TEC impact areas were assessed for viability post impact.

A further survey for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC was conducted by ERM in summer 2023 in an isolated patch within the Project footprint. Previous surveys had been unable to confirm the extent of the patch. Further detail on this survey has been provided in the technical memo in Appendix A.

Ausecology undertook TEC assessments in 2023 to verify the SEVT community boundary to inform the updated TEC extent.

Additional TEC surveys were undertaken by Ausecology in March 2024. This area is contiguous with the box-gum grassy woodland TEC within the Project footprint (Ausecology, 2024b).

Targeted flora surveys

Surveys conducted by Cardno (2021) targeted habitat considered suitable for several threatened plant species which were searched for and mapped within the Project footprint and a wider (100 m) buffer. The survey effort for threatened flora species focused on habitat considered suitable for the target species identified by the desktop assessment (Section 3.2). The detailed targeted flora survey methodology employed by Cardno (2021) is provided in Appendix A, including a summary of the survey effort for threatened flora species known or likely to occur in Appendix A: Field Action Plan of the Cardno report Appendix A: Additional Ecological Investigations.

Ausecology (2021-2022) also recorded incidental observations of threatened flora while undertaking field surveys within the Project footprint. For areas subject to detailed flora surveys these were conducted in accordance with the *Flora Survey Guidelines – Protected Plants* (DES, 2020). Survey methodology followed that of a meander survey, with properties traversed on foot. During traversal, ecologists maintained approximately 10-25 m spacing between search lines, walking at a pace where species remained detectable. Any potential threatened species that could not be identified in the field were collected and lodged at the Queensland Herbarium for formal identification (Appendix B).

EMM (2024) conducted two protected flora surveys on 18-19 December 2023 and 22 February 2024, in accordance with the *Flora Survey Guidelines – Protected Plants* (DES, 2020). The area surveyed overlapped with a small section of the Project footprint at its northern extent. Within the Project footprint, EMM recorded three threatened plant species under the EPBC Act.

UniSC is undertaking ongoing targeted flora surveys within the Study area and broader region, however the final report issue of these surveys is expected in November 2024. These surveys targeted winged peppergrass (*Lepidium monophlooides*), small-flowered westringia (*Westringia parvifolia*), Tara wattle (*Acacia lauta*), shiny-leaved ironbark (*Eucalyptus virens*), Austral toadflax (*Thesium australe*) and *Xerothamnella herbacea*.

Weed surveys

General abundance and the location of weeds listed under the Biosecurity Act were recorded within the Project footprint by Cardno (2021). An average density cover for each weed species observed was recorded every 1 km through the Project footprint. Averages were based on criteria listed in the Spatial Pest Attributes Standard (Calvert, 2012) where:

- densities were calculated from a percentage of ground-cover for grasses and herbs, vines, aquatic weeds and cacti, and
- densities were calculated from the number of woody stems/10 m² for woody vegetation.

3.3.2.3 FAUNA FIELD SURVEYS

Fauna surveys were completed within the Project footprint. Methodologies associated with each of the surveys is summarised in following sections and provided in detail within Appendix A: Additional Ecological Investigations.

Habitat assessments

Habitat assessments were completed by Ausecology (2022) and were generally co-located with BioCondition assessment sites. Additional habitat assessments were undertaken

opportunistically within the Project footprint to capture particular habitat features and/or provide a comprehensive sample of the condition of a BioCondition assessment unit and the supporting habitat. The details of these assessments and their locations are presented in Figure 3-1A-D.

Habitat assessments were undertaken in accordance with *Guide to determining terrestrial habitat quality – version 1.2* (DEHP, 2017a). This included identification of notable habitat features representative of the general area, such as soil type, presence of watercourses/wetlands, groundcover features and presence and abundance of key habitat features that were representative of the general area, such as:

- Soil type,
- Presence of watercourses/wetlands,
- Groundcover features, and
- Presence and abundance of key habitat features including hollow-bearing trees and stags, fallen logs/woody debris, and mistletoes.

Targeted fauna survey methods

Targeted threatened fauna surveys were undertaken by Cardno (2021), Boobook Consulting (2022), Hydrobiology (2023), BAAM (Williams, 2023), ERM (2024a) and UniSQ (ongoing) to ground-truth the Project footprint and target threatened fauna species. Methodologies employed as part of these targeted fauna surveys followed the guidelines of relevance and are summarised in following sections and provided in Appendix A: Additional Ecological Investigations and summarised in Table 3-6.

Cardno surveys

Cardno established 12 targeted terrestrial fauna survey sites, each of which was surveyed over five days and four nights during each of two seasonal surveys (spring, October and November 2020, and post-wet, March 2021). Methods employed at all fauna survey sites included a mix of fauna survey techniques including:

- call playback;
- spotlighting;
- stag watching;
- dawn/dusk surveys;
- habitat assessments;
- indirect detection;
- active diurnal searches;
- camera traps;
- hair tube traps;
- pitfall traps;
- Elliott traps;
- cage traps;
- artificial burrows;
- bat detectors (Anabat or Songmeter);

- harp traps;
- funnel traps; and
- pest animal assessments.

A further ten 'additional sites' were surveyed within the Project footprint, each of which was surveyed over a single day over the duration of the survey periods. Methodologies employed at the 'additional sites' were limited to 'passive' surveys consisting of habitat assessments and opportunistic observations only (i.e. did not involve trapping of fauna).

Following initial observations regarding the availability and location of suitable habitat for the Condamine earless dragon (*Tympanocryptis condaminensis*), additional survey effort targeting this species was undertaken during the post-wet survey period (March 2021). Based on a desktop assessment of the suitability of habitat for this species, two sites were identified for the placement of species-specific traps in the form of small artificial arthropod burrows in accordance with the methods by Osborne (2018). A total of 28 traps were installed per site and checked twice daily with walking visual transects also undertaken in the surrounding habitat.

Elsewhere along the alignment, fauna and habitat observations (including wildlife corridors and habitat features) were recorded opportunistically.

Brigalow woodland snail surveys (Boobook)

Targeted surveys for the Brigalow woodland snail (*Adclarkia cameroni*) were completed by Boobook Consulting in 2022. The field survey was conducted over a five-day period in August 2022 and included survey of 20 sites between Wellcamp (near Toowoomba) and Canning Creek (between Millmerran and Inglewood), as seen as invertebrate fauna survey sites on Figure 3-1. The methodology included targeted snail searches using active searching (rolling logs, rocks, fallen bark and raking through leaf litter), soil/leaf litter sampling, collection and analysis of dead land snails and microhabitat assessments.

Aquatic ecology surveys (Hydrobiology)

Hydrobiology (2023) undertook an eDNA survey to build on the survey effort for aquatic species already undertaken. These surveys targeted numerous species, including Murray cod and silver perch. A total of 10 sites were assessed, based on the location of preliminary aquatic field survey locations and expert knowledge. At each site, eDNA samples were collected and a habitat assessment was completed concurrently using AUSRIVAS. Further details on the eDNA survey are available in Appendix A: Additional Ecological Investigations.

Greater glider surveys (ERM)

Following new habitat assessment methodology published in Eyre et al. (2022), the key guidance on describing greater glider (southern and central) habitat in relation to assessments under the EPBC Act, ERM conducted spotlighting and habitat assessment surveys in areas previously assessed by Ausecology as potential greater glider (southern and central) habitat. Targeted greater glider (southern and central) surveys were completed over a four-day period in December 2023 and spanned 13 sites between Millmerran and Inglewood. The methodology included vegetation assessments to determine if suitable habitat was present and nocturnal spotlighting transects in each site. Detailed methodology of this survey is attached in Appendix A: Additional Ecological Investigations.

Bat surveys (BAAM)

Targeted threatened bat surveys were conducted by BAAM in March-April 2023 to assess the presence of south-eastern long-eared bat and large-eared pied bat. These surveys involved numerous survey methods, including harp trapping, bat call identification, radio-tracking and habitat assessments to inform the impact assessments and habitat mapping within the Project footprint (Williams, 2023).

Koala, reptile and wild dog surveys (UniSQ)

University of Southern Queensland is conducting ongoing koala, reptile and wild dog surveys within a broad area including the Project footprint to assess species movement, habitat utilization, dietary preferences, risks and the impacts on threatened species and mitigation requirements. The primary objectives of these ongoing surveys included assessing koala diet and movement patterns; assessing risks posed by wild dogs; assessing wild dog management strategies, assessing capture success and reptile habitat preferences; assessing the relationship between land use practices and reptile presence/absence; and assessing reptile genomes for associations with artificial habitat designs.

3.3.3 SUMMARY OF SURVEY EFFORT

A summary of the preliminary field survey effort (for the draft EIS released in 2021) and survey effort undertaken by Cardno (2021), Ausecology (2022), Boobook Consulting (2022), Hydrobiology (2023) ERM (2024a), and UniSQ (2024) is presented in Table 3-6. The full survey adequacy assessment for threatened MNES species is provided in Appendix E.

Incidental sightings of threatened fauna were also recorded during all field surveys of the Project footprint. This effort has not been quantified; however, surveys have taken place across multiple years and within all seasons.

TABLE 3-6 SUMMARY OF TARGETED FAUNA SURVEY EFFORT

Survey method	Target species/ fauna group	Preliminary field surveys	Revised draft EIS field surveys	Total survey effort
Call Playback	Birds	-	12 sites x 5 hours x 2 survey periods	120 hours
	Mammals	-	12 sites x 1 hour x 2 survey periods	24 hours
Spotlighting	Mammals	-	37 x 200 m transects	37 x 200 m transects
	Greater glider (southern and central)	-	13 x 200 m transects in previously mapped greater glider habitat	13 x 200 m transects
	Reptiles	-	12 sites x 6 hours x 2 survey periods	144 hours
Stag watching	Mammals	-	212 sites x 80 minutes x 2 survey periods	32 hours

Survey method	Target species/ fauna group	Preliminary field surveys	Revised draft EIS field surveys	Total survey effort
Greater glider (southern and central) habitat assessments	Greater glider (southern and central)	-	30 habitat assessments across 13 sites (~1 assessment per 100 m of previously mapped greater glider (southern and central) habitat)	30 habitat assessments
Koala Rapid Assessment Method	Koala	-	35 sites	-
Dawn survey	Birds and butterflies	-	12 sites x 4 hours x 2 survey periods	96 hours
Dusk survey	Birds and butterflies	-	12 sites x 4 hours x 2 survey periods	96 hours
	Bats (fly out)	-	12 sites x 4 hours x 2 survey periods	96 hours
General bird surveys	Birds	44 sites x 20 minutes	20 sites x 20 minutes	21.2 hours
	Reptiles	44 sites x 20 minutes x 2 people	-	29.3 hours
Area searches (scats, tracks etc.)/ incidental flushing	All fauna groups	-	12 sites x 8 hours x 2 survey periods	96 hours
Active diurnal searches (for individuals and habitat)	Mammals	-	37 x 100 m transects	37 x 100m transects
	Reptiles	-	12 sites x 3 hours x 2 survey periods 10 additional opportunistic sites and transects	72 hours
	Birds	-	12 sites x 4 hours x 2 survey periods	96 hours
	Land snails	-	20 sites x 2 hours	40 hours
Camera traps	All fauna groups	-	12 sites x 20 traps x 4 nights x 2 survey periods	969 trap nights
	Predators	-	100 traps (2 km apart) x 10 months	~ 30,000 trap nights
Hair tube traps	Mammals	-	12 sites x 20 traps x 4 nights x 2 survey periods	1920 trap nights
Pitfall traps	Reptiles	-	12 sites x 6 pitfalls x 4 nights x 2 survey periods	576 trap nights

Survey method	Target species/ fauna group	Preliminary field surveys	Revised draft EIS field surveys	Total survey effort
Elliott traps (Type A)	Mammals	-	12 sites x 20 traps x 4 nights x 2 survey periods	1920 trap nights
Cage traps and Elliott traps (Type B)	Mammals	-	12 sites x 10 traps x 4 nights x 2 survey periods	960 trap nights
Artificial burrows	Condamine earless dragon	-	2 sites x 58 traps x 6 nights	696 trap nights
Bat detectors (unattended)	Microbats	7 trap nights 12 trap nights	12 sites x 1 Anabat / Songmeter x 4 nights x 2 survey periods	115 trap nights
Bat detectors (attended)	Microbats	-	12 sites x 4 hours x 2 survey periods	96 hours
Harp traps	Microbats	-	12 sites x 2 survey periods	96 trap nights
Funnel traps	Reptiles	-	12 sites x 2 traps (one on either end of pitfall drift fence) x 4 nights x 2 survey periods	192 trap nights
eDNA- Hydrobiology	Aquatic MNES	-	3 samples x 10 sites	30 eDNA samples
GPS collaring	Koala	-	43 individuals captured and collared for up to 431 days; 12 retained for continual tracking	25,610 GPS points – monitoring ongoing
	Wild dogs and foxes	-	3 wild dogs and 4 foxes captured and collared for 401 days; 2 dogs and 1 fox retained for continual tracking	3,018 GPS points – monitoring ongoing
Reptile trapping grids	Reptiles	-	20 sites surveyed monthly • 4 sites x 12 survey periods • 4 sites x 11 survey periods • 8 sites x 10 survey periods • 4 sites x 9 survey periods	208 site surveys
Reptile rock piles	Reptiles	-	5 paired sites x 5 survey periods	25 site surveys

3.3.4 WHETSTONE MDC AND BORROW PIT SURVEYS

3.3.4.1 WHETSTONE MATERIAL DISTRIBUTION CENTRE PRELIMINARY ENVIRONMENTAL ASSESSMENT

Umwelt (2022) conducted an ecological assessment within the MDC development footprint comprising 212.62 ha. Investigations focused on MNES and Matters of State Environmental Significance (MSES). Prior to field investigations, Umwelt completed desktop analysis of publicly available environmental databases and historic field surveys. Site-based investigations were undertaken on a single day on 20 September 2022 and included quaternary assessments of vegetation, fauna habitat assessments, active searches, diurnal bird surveys and opportunistic flora and fauna sightings.

Further information is available in Appendix A: Additional Ecological Investigations.

3.3.4.2 BORROW PIT ECOLOGICAL SURVEYS

Field surveys were conducted for seven borrow pits at six sites (inclusive of access tracks) on 5-6 September 2023 (Ausecology, 2024a). These surveys included ground-truthing Regional Ecosystems, BioCondition assessments, targeted flora surveys and incidental fauna surveys. No MNES were recorded and the results are summarised in revised draft EIS Appendix L Terrestrial and Aquatic Ecology Technical Report.

3.4 HABITAT MAPPING

Post-field analysis of ground-truthed data was undertaken to produce detailed habitat mapping within the Project footprint for MNES species identified as known, likely or which have the potential to occur within the Project footprint.

For threatened flora species known to occur within the Project footprint, habitat mapping was developed using records from field surveys and online databases. Where flora species were recorded during field surveys, habitat was mapped using methods outlined in *Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method* (DPIE, 2020) with regard to defining an area of suitable habitat. Individuals identified by point locations were buffered by a 30 m radius, with overlapping boundaries combined to form complete polygons. For all other flora records, habitat was mapped in accordance with the *Method for mapping matters of state environmental significance* (DESI, 2024) where all flora records were compiled, vetted and buffered by a 1 km radius to map areas of suitable habitat.

Habitat definitions were written to support habitat mapping for all other relevant threatened species. Habitat suitability and function was assessed by suitably qualified ecologists in accordance with published information concerning the known supporting habitat characteristics for each species together with relevant approved Conservation Advices, Recovery Plans, SPRAT profiles, DESI species profiles and other literature where available. This analysis identified what functional types of habitats (breeding, foraging, roosting, nesting or denning, dispersal) occur for fauna species (where applicable) and therefore what aspect of the species functional ecology would be impacted by the Project. Habitat definitions were then reviewed by species experts (as detailed in Section 3.4.1) and underwent refinement where advised. These habitat descriptions and mapping rules are presented in Appendix F Species and Community Profiles.

Numerous targeted field surveys (as per Section 3.3) were conducted within the Project footprint and used to identify areas of species habitat. Final habitat definitions were mapped by Ausecology and reviewed by Ausecology, ERM, ARTC and/or species experts until all consultants were satisfied with the final mapping.

3.4.1 EXPERT CONSULTATION

ERM consulted with species experts on habitat definitions, including habitat mapping rules. Based upon feedback received, ERM updated these accordingly. Additionally, these species experts reviewed the survey adequacy table for the species relevant to their expertise. Experts consulted were:

- Bats – Dr Elizabeth Williams, Biodiversity Assessment and Management (BAAM);
- Brigalow woodland snail – Craig Eddie, Boobook Consulting;
- Gliders – Dr Teresa Eyre, Queensland Herbarium and Biodiversity Science, Department of Environment, Science and Innovation;
- Murray cod – Andrew Berghuis, Aquatic Biopassage Services;
- Reptiles – Dr Jon-Paul Emery, University of Southern Queensland;
- Spotted-tailed quoll – Dr Scott Burnett;
- Koala – Dr David Dique, ERM; and
- Squatter pigeon – Ned Bowden, ERM.

Updated habitat definitions were mapped by Ausecology. Mapping rules and mapped habitats were reviewed and adjusted by Ausecology, ERM, ARTC and/or species experts until all consultants were satisfied with the final mapping.

3.5 IMPACT ASSESSMENT METHODOLOGY

3.5.1 NOISE AND VIBRATION IMPACT ASSESSMENT

Assessments were undertaken for construction and operation separately, allowing for the different characteristics of noise and vibration such as duration and frequency, noting short term impacts associated with construction and the limited passes per day during operations, such that even if disturbance occurs highly mobile species can likely move in and out of impacted habitat, or will habituate.

Noise impact assessment methods involved:

- A literature review to understand the likely impacts of noise and vibration based on the current understanding of the different tolerance and behavioural responses of wildlife to noise and vibration impacts.
- Review of modelling contours for construction (LAeq(15min) dB(A) for the modelled construction scenarios) and operations (single maximum event (SEM) levels) to understand the likely extent of noise impacts (i.e. the distance project-related noise travels to the point where it attenuates to levels where only minimal impacts are likely to occur).
- Qualitative assessment of likely impacts based on generalised behavioural responses of wildlife to noise (ie. literature indicates that moderate impacts to habitat use may occur when noise levels are above 60 to 65 dB(A) and fauna are likely to leave the area when

noise levels are around 80 dB(A) or above) and the extent (distance from the source) to which those impacts may occur.

3.5.2 ALTERED HYDROLOGY AND FLOODING IMPACT ASSESSMENT

Impacts on MNES associated with flooding were assessed using the following approach, with each step further detailed in Figure 3-2 and Section 5.2.10:

1. Risk assessment: Risk assessment of listed threatened species known, likely and with the potential to occur and TECs known to occur, to determine those protected matters that are subject to a negligible, low, medium or high risk of changes to hydrology. See Section 5.2.10.1 for details.
2. Habitat mapping: For those protected matters with a low to high rating in the risk assessment, habitat mapping has been prepared outside of the footprint within 5 km of the centre of the rail line. See Section 5.2.10.2 for details.
3. Assessment of susceptibility: The 1% annual exceedance probability (AEP) (1 in 100-year flood) scenario was overlaid on the habitat mapping and used to identify those protected matters that are susceptible to changes in flooding, requiring detailed quantification of impacts. See Section 5.2.10.3 for details.
4. Quantification of flooding impacts: Detailed quantification of changes in inundation area, duration, depth, and velocity as modelled under three scenarios, 20% AEP (1 in 5-year flood), 10% AEP (1 in 10-year flood), and 5% AEP (1 in 20-year flood) for relevant at-risk protected matters (as determined by steps 1 and 3 above). See Section 5.2.10.4 for details.
5. Impact assessment: Impact assessment of the outcomes of the quantification and determination of significant residual impacts. See Section 5.2.10.5 for details.

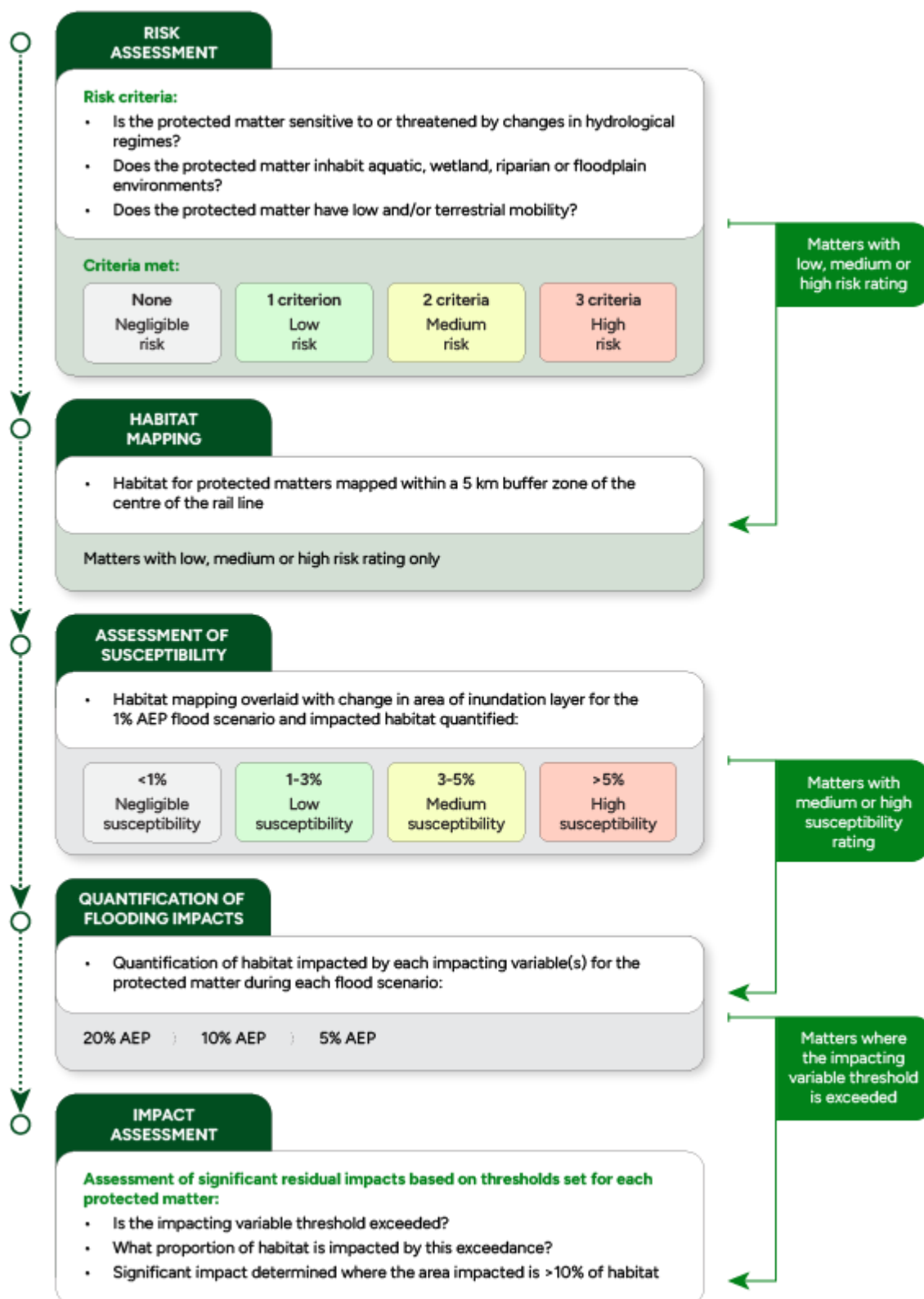


FIGURE 3-2 FLOW CHART OF FLOODING IMPACT ASSESSMENT

3.5.3 SIGNIFICANT IMPACT ASSESSMENT

Significant impact assessments (SIAs) have been undertaken in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Significant Impact Guidelines) (DoE 2013a). Detailed significant impact assessments were undertaken for each MNES against criteria set out in the Significant Impact Guidelines, specific to the matters listing status, i.e. extinct in the wild, critically endangered and endangered, and vulnerable.

National Recovery Plans and approved conservation advice documents, where available, were used to inform the assessment and are identified in the relevant sections. To inform significant impact assessment decisions where species-specific recovery plans, approved conservation advice documents or policy guidelines were not available, species Listing Advice, Species Profile and Threats (SPRAT) database and/or best available literature were used.

In the absence of species-specific policy guidelines or species-specific definitions within current statutory documents for the species, the definitions from the *Significant Impact Guidelines* for 'population of a species', 'important population', and 'habitat critical to the survival of a species or threatened ecological community' were applied. These and other relevant definitions are provided in Table 3-7

TABLE 3-7 SIGNIFICANT IMPACT GUIDELINE DEFINITIONS

Term	Definition
Population of a species	A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to: • A geographically distinct regional population, or collection of local populations, or • A population, or collection of local populations, that occurs within a particular bioregion.
Important population of a species	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range.
Habitat critical to the survival of a species or ecological community	'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary: • For activities such as foraging, breeding, roosting, or dispersal • For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • To maintain genetic diversity and long term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community. Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.
Extent of occurrence	'Extent of occurrence' is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the

Term	Definition
	known, inferred or projected sites of present occurrence of a taxon (excluding cases of vagrancy).
Area of occupancy	'Area of occupancy' is the area within its 'extent of occurrence' which is occupied by a taxon, excluding cases of vagrancy.

The assessment of significant impacts associated with the Project is based on:

- Ground-truthed extent and condition threshold assessments of the TECs (Appendix A: Additional Ecological Investigations);
- Ground-truthed extent of suitable habitat for TECs and threatened species (Appendix F Species and Community Profiles and Sections 4.2 (threatened communities), 4.3 (threatened flora) and 4.4 (threatened fauna));
- Potential habitat mapping outside of the Project footprint for produced for assessment of impacts relating to changes in hydrology and flooding (Section 5.2.10 and Appendix F Species and Community Profiles);
- The revised reference design and incorporated mitigation measures (Sections 6.2);
- Information on potential impacts of Project during construction and operation (Section 5.2); and
- Proposed post-approval mitigation measures (Section 6.3).

Only relevant information from these sections is reiterated in the SIA tables to support conclusions made.

In accordance with Section 158A of the EPBC Act, MNES are assessed using the Significant Impact Guidelines in accordance with their EPBC Act status at the time of the controlled action decision (i.e., 9 April 2018) however, information in contemporary approved conservation advices and any other data more recent than the controlled action decision date, were considered in the assessment.

Assessment of MNES against the relevant criteria in the Significant Impact Guidelines is presented in the following sections:

- TECs – Section 7.1.
- Threatened flora species – Section 7.2.
- Threatened fauna species – Section 7.3.

3.5.4 CUMULATIVE IMPACT ASSESSMENT

When multiple projects occur in a region they may result in cumulative impact, which differ from those of an individual project when considered in isolation. Cumulative impacts may be positive or negative, and their severity and duration will depend on the Project size and timing overlap.

The following sections outline the selected projects and the method applied in the Cumulative Impact Assessment (CIA).

3.5.4.1 APPROACH

The approach used to identify and assess potential cumulative impacts of this Project was:

- A review of the potential impacts identified within this assessment. The environment at the time of the ToR is the baseline, prior impacts from past land use have not been considered;
- A preliminary list of projects for consideration in the CIA was collated with estimated timelines to demonstrate the temporal relationship between projects. The assessable projects are relevant at the time of receiving the request for additional information from the Coordinator-General. These comprise projects that meet either one or more of the selection criteria summarised in Section 3.5.4.2;
- Identification and mapping of the assessable projects and area of influence (AOI) of each specific matter being considered to determine the spatial overlaps. Predictive habitat mapping was used to estimate habitat within the AOI; and
- Where there is a potential overlap in impacts (either spatially or temporally), a CIA has been undertaken to determine the nature of the cumulative impact. This includes:
 - Where possible, the assessment method has been quantitative in nature; however, qualitative assessment has also been undertaken for some specific matters;
 - The probability, duration and magnitude/intensity of the impacts have been considered, as well as the sensitivity of the receiving environmental conditions.
- An assessment matrix method (See Section 3.5.4.3) has been used to determine the significance of cumulative impacts with respect to beneficial or detrimental effects; and
- Where cumulative impacts were deemed to be of 'medium' or 'high' significance, additional mitigation measures were proposed, beyond those already proposed.

3.5.4.2 PROJECT SELECTION CRITERIA

Projects identified as assessable, and therefore included in the CIA, meet either one or more of the following criteria:

- 'State significant' or 'strategic' projects (i.e. coordinated projects under the *State Development and Public Works Organisation Act 1971* (QLD) (SDPWO Act) that are in the public domain as being planned, constructed or operated at the time of the assessment.
- Additional projects that have been deemed to be of local significance, as occurring through consultation with community groups and stakeholders including:
 - Projects subject to approval under the *Planning Act 2016* (QLD) and listed in the GRC and TRC development application databases;
 - Economic Development Queensland (EDQ) development projects, including development within Priority Development Areas (PDA) and State Development Areas (SDA);
 - Infrastructure designation;
 - Projects within the public register of environmental authorities;
 - Department of Transport and Main Roads (DTMR) infrastructure projects;
 - Private infrastructure facilities; and
 - Development in accordance with the *Regional Planning Interests Act 2014* (QLD);
- Other Inland Rail projects adjacent to the Project.

This assessment focuses on the cumulative impacts to MNES. Assessment of cumulative impacts for MSES is provided in revised draft EIS Appendix L: Terrestrial and Aquatic Ecology Technical Report.

3.5.4.3 ASSESSMENT MATRIX

Following the identification of each potential cumulative impact, relevance factor scores of Low, Medium, and High have been determined in consideration of the impacts, in accordance with the assessment matrix in Table 3-8.

The significance of the impact has been determined by using professional judgement to select the most appropriate relevance factor for each aspect in Table 3-8 and summing the relevance factors. The sum of the relevance factors determines the impact significance and consequence which are summarised in Table 3-9. For example, if a Project impact on an ecological value such as changed flood regimes was considered to have a probability of impact of 2, duration of impact of 3, magnitude /intensity of impact of 1 and a sensitivity of receiving environment of 1 the significance of impact would be $(2+3+1+1 = 7) = \text{Medium}$.

TABLE 3-8 ASSESSMENT MATRIX

Aspect	Relevance factor		
	Low	Medium	High
Probability of impact	1	2	3
Duration of impact	1	2	3
Magnitude/intensity of impact	1	2	3
Sensitivity of receiving environment	1	2	3

TABLE 3-9 IMPACT SIGNIFICANCE

Impact significance	Sum of relevant factors	Consequence
Low	1 to 6	Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.
Medium	7 to 9	Mitigation measures likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
High	10 to 12	Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

4. RESULTS

This section contains the results of the desktop assessments and field surveys conducted within the Project footprint. Results from the significant impact assessment are discussed in Section 7.

4.1 HABITAT TYPES

A total of eight broad habitat types have been identified within the Project footprint, noting that groundwater dependent ecosystems (GDEs) are only minor occurrences within other habitat types. The broad habitat types were delineated by grouping vegetation communities according to their vegetation structure, composition, and geomorphological characteristics. The extent of ground-truthed habitat types within the Project footprint is provided in Table 4-1. As a result of the dry conditions during the survey period the extent of GDEs and watercourses was unable to be ground-truthed and are included as components of the broad habitat types.

TABLE 4-1 GROUND-TRUTHED HABITAT TYPES WITHIN THE PROJECT FOOTPRINT

Broad habitat type	Extent within the Project footprint	
	Area (ha)	Percentage (%)
Non-remnant disturbed pasture, cropping areas and other land uses	2,516.87	74.42
Remnant dry sclerophyll eucalypt woodlands	430.65	12.73
Regrowth eucalypt communities	190.07	5.62
<i>Acacia harpophylla</i> - <i>Casuarina cristata</i> open forest	151.19	4.47
Natural grasslands	77.73	2.30
Freshwater wetlands	15.67	0.46
Total	3,382.17	100.00

4.1.1 NON-REMNANT DISTURBED PASTURE, CROPPING AREAS AND OTHER LAND USES

This habitat type includes cultivated land, non-native grasslands, non-native vegetation and areas of other land use, and is the dominant habitat type within the Project footprint. Cultivated land is extensive in the Project footprint and includes irrigated and dryland crops, stubble fields and fallow fields. Common crops include winter cereals and irrigated cotton.

Disturbed areas and non-native grasslands are dominated by exotic pasture grasses and are represented by areas of non-remnant vegetation (excluding cultivated land, previously cleared of native vegetation for agriculture. Dominant pasture grasses include *Chloris gayana* (Rhodes grass), *Megathyrsus maximus* (green panic) and *Sorghum halepense* (Johnson grass). However, native grass species also occur including *Dichanthium sericeum* (Queensland bluegrass), *Digitaria* spp., *Panicum* spp. and *Bothriochloa* spp.

Non-remnant and cultivated areas are known to provide habitat for MNES species such as the squatter pigeon (southern) (*Geophaps scripta scripta*), Condamine earless dragon (*Tympanocryptis condaminensis*), and Belson's panic (*Homopholis belsonii*). These areas are devoid of canopy cover, but isolated paddock trees can provide dispersal habitat for fauna species including the MNES species painted honeyeater (*Grantiella picta*) and the koala (*Phascolarctos cinereus*).

4.1.2 REMNANT DRY SCLEROPHYLL EUCALYPT WOODLANDS

Dry sclerophyll eucalypt woodlands are present on a variety of substrates, including sedimentary and igneous rocks, duricrusts, sand plains, alluvial plains and in riparian areas alongside channels (Plate 4.1 and Plate 4.2). The mature woodland, open forest or forest canopies are dominated by a variety of eucalypt species including mountain grey gum (*Eucalyptus orgadophila*), narrow-leaved ironbark (*E. crebra*), Queensland blue gum (*E. tereticornis*), river red gum (*E. camaldulensis*), broad-leaved red ironbark (*E. fibrosa* subsp. *nubilis*), poplar box (*E. populnea*) and yellow box (*E. melliodora*). Dry sclerophyll eucalypt woodlands in the west of the Project footprint regularly had a subdominant tree layer of Acacia and/or Casuarina/Allocasuarina species and an abundance of mistletoe, both of which provide good foraging habitat for various bird species and roosting habitat for various Microchiroptera bat species. Overall, this habitat type was found to contain a low to medium abundance of small to medium sized tree hollows, however it supported a shallow layer of leaf litter and a moderate abundance of woody debris that can provide important refuge and foraging opportunities for a range of reptiles, amphibians, and small mammal taxa.

Areas of mature eucalypt open forest and woodland on sedimentary and igneous rock within the Project footprint may provide suitable habitat for MNES fauna species including the south-eastern long-eared bat (*Nyctophilus corbeni*), squatter pigeon (southern) (*Geophaps scripta scripta*), koala (*Phascolarctos cinereus*) and grey-headed flying-fox (*Pteropus poliocephalus*). Eucalypt forests and woodlands on sand plains and on duricrusts may provide habitat for south-eastern long-eared bat.

Structurally complex habitat present in riparian and alluvial open forest and woodland habitat may be suitable for the MNES fauna species, painted honeyeater (*Grantiella picta*), greater glider (southern and central) (*Petauroides volans*), yakka skink (*Egernia rugosa*) and koala. During the wet season, riparian and alluvial areas may temporarily flood, effectively becoming a wetland habitat (riverine wetland) that may be suitable for the Australian painted snipe (*Rostratula australis*).



PLATE 4.1 MATURE EUCALYPT WOODLAND ON SEDIMENTARY ROCK, LOCATED WITHIN THE INGLEWOOD REGION (2018)



PLATE 4.2 ALLUVIAL POPLAR BOX WOODLAND NEAR MILLMERRAN (2018)

4.1.3 REGROWTH EUCALYPT COMMUNITIES

Areas of regrowth vegetation are present throughout the Project footprint and are generally in poor condition, with extensive weed invasion and disturbance from cattle grazing practices (Plate 4.3). Areas of regrowth habitat may provide foraging and roosting habitat for transitional bird species and suitable microhabitats, including cracking clay soils for reptile species.



PLATE 4.3 REGROWTH COMMUNITY DOMINATED BY EUCALYPTUS AND ACACIA SPECIES, LOCATED WITHIN THE INGLEWOOD REGION (2018)

4.1.4 ACACIA HARPOPHYLLA-CASUARINA CRISTATA OPEN FOREST

Acacia harpophylla-*Casuarina cristata* open forest habitat is present within the Project footprint on sedimentary rocks and clay plains (Plate 4.4 and Plate 4.5).

This habitat type typically occurs on cracking clays that are usually black or grey to brown or reddish-brown in colour, often self-mulching and sometimes with gilgai microrelief in flatter areas. This open forest habitat lacked an abundance of medium or large sized tree hollows, however the ground layer can be dense, with coarse woody debris and leaf litter providing important habitat for reptiles. Deep cracking clay soils also provide important habitat for a range of amphibians, particularly during the wet season when the gulgais are inundated. Some

open forest habitat areas also contained an abundance of mistletoe, providing important habitat for birds.

This habitat type is suitable for MNES species including Dunmall's snake (*Furina dunmalli*) and south-eastern long-eared bat (*Nyctophilus corbeni*) where shelter-sites such as logs, rocks, tree hollows, decorticated bark and root cavities are available. The Brigalow woodland snail (*Adclarkia cameroni*) is associated with this habitat type and suitable habitat for painted honeyeater (*Grantiella picta*) is present in areas with abundant mistletoe (*Amyema* spp.).



PLATE 4.4 BRIGALOW/BELAH OPEN FOREST ON SEDIMENTARY ROCK LOCATED TO SOUTH OF MILLMERRAN (2018)



PLATE 4.5 BRIGALOW/BELAH OPEN FOREST ON CLAY PLAINS LOCATED WITHIN ROAD RESERVES SOUTH OF YELARBON (2018)

4.1.5 NATURAL GRASSLANDS

Natural grassland habitats within the Project footprint include remnant native grasslands and derived native grasslands. Small remnants of native grassland include *Dichanthium sericeum* grassland on Cainozoic igneous rocks, *Themeda avenacea* grassland on alluvial plains, and *Triodia scariosa* grassland.

Derived native grasslands are dominated by native grass species and are represented by areas of non-remnant vegetation (excluding cultivated land), previously cleared of woody species (i.e. trees and shrubs) for agriculture. Dominant grass species include *Panicum queenslandicum* (Queensland panic), *Dichanthium sericeum* (Queensland bluegrass), *Digitaria* spp., *Themeda* spp., and *Bothriochloa* spp. However, exotic pasture grasses sometimes occur, such as *Chloris gayana* (Rhodes grass).

Native and derived grasslands are considered as one fauna habitat type due to similarities in structure and floristics. Natural grassland habitat is extensive within the Project footprint and is typically located on alluvial floodplains and creek flats. Grasslands in road reserves provide the least impacted representation of this habitat (Plate 4.6 and Plate 4.7).

Scattered paddock trees occur across many grassland habitats, acting as 'stepping stones' between patches of native vegetation and aid in connectivity in otherwise cleared and fragmented landscapes.

In general, the grasslands that dominate the Project footprint provide limited habitat value for MNES fauna species due to widespread agricultural impacts (grazing, proximity to cropping and weed invasion), although grasslands may provide temporary habitat for wetland bird species when flooded. MNES fauna species that may utilise grassland habitat within the Project footprint include squatter pigeon (southern) (*Geophaps scripta scripta*) and natural grassland habitats with microhabitat features such as cracking clay soils, may support reptile species such as the Condamine earless dragon (*Tympanocryptis condaminensis*) and five-clawed worm-skink (*Anomalopus mackayi*). Grasslands may also provide suitable habitat for MNES flora species such as Belson's panic (*Homopholis belsonii*), king bluegrass (*Dichanthium queenslandicum*) and toadflax (*Thesium australe*).



PLATE 4.6 EXAMPLE OF NATIVE GRASSLAND IN ROAD RESERVE LOCATED SOUTH OF MILLMERRAN (2018)



PLATE 4.7 GRASSLAND COMPOSED OF NATIVE AND NON-NATIVE SPECIES WITHIN ROAD RESERVE SOUTH OF TOOWOOMBA (2018)

4.1.6 FRESHWATER WETLANDS

Wetland habitats within the Study area include dams and reservoirs (lacustrine), wetlands associated with the floodplains of major watercourses (riverine), and vegetated swamps (palustrine). Artificially created wetlands (i.e., farm dams), which are abundant across agricultural landscapes, are included as they potentially provide suitable wetland alternatives for fauna. Artificial wetlands include typically small farm dams and much larger turkey-nest dams associated with irrigated cropping, as well as drinking water supply reservoirs. Riverine wetlands associated with floodplains are ephemeral and typically vegetated by a mixture of native and non-native grasses and grass-like plants.

Wetland habitats within the region are highly ephemeral, particularly in the southern and drier sections of the Project footprint (Plate 4.8). Wetland habitats within the Project footprint are considered to provide suitable habitat for a variety of amphibian, reptile, and bird species. Larger palustrine-wetlands potentially provide important refuge habitat for many bird species and may act as stepping stones during periods of travel.



PLATE 4.8 EPHEMERAL WETLAND AREAS LOCATED AT YELARBON, ASSOCIATED WITH THE YELARBON SCALD (2018)

Wetland habitats within the Project footprint may provide suitable habitat for a variety of fish, amphibian, reptile (including turtles) and bird species. Larger palustrine-wetlands potentially provide important refuge habitat for many bird species. MNES fauna species that may utilise wetland habitats within the Project footprint include the Australasian bittern (*Botaurus poiciloptilus*) and Australian painted snipe (*Rostratula australis*), although both of these species are reliant on the presence of dense vegetation, either aquatic (for the Australian bittern) or as nearby cover (for Australian painted snipe). Farm dams are less likely to provide these habitat elements and floodplain wetlands are highly ephemeral.

Wetland areas associated with the Yelarbon scald (Plate 4.8) provide habitat for MNES flora species such as winged peppergrass (*Lepidium monophloides*) and *Xerothamnella herbacea*.

4.1.7 WATERCOURSES

Watercourse areas within the Study area include permanent and ephemeral rivers, creeks and tributaries. Rivers intersecting the Project footprint include the Condamine River and the Macintyre River and their tributaries. Creeks intersecting the Project footprint include Dry Creek, Umbiram Creek, Grasstree Creek, Back Creek, Nicol Creek, Bringalily Creek, Native Dog Creek, Cattle Creek, Pariagara Creek, and their tributaries. Additionally, gullies intersected by the Project Area include Four Mile Gully, One Mile Gully and Half Mile Gully.

Targeted aquatic ecology assessments were carried out by Eco Logical Australia (2020) and Hydrobiology (2023) across several waterways intersected by the Project footprint. Aquatic ecology and surface water values were variable across the Project footprint. Ephemeral watercourses, which have been subject to previous disturbance from agricultural development and public infrastructure such as road crossings are dominant. Many of the waterways surveyed were dry at the time of the assessments and were not deemed to provide suitable habitat for threatened aquatic species. However, those that contain permanent waterbodies may provide suitable habitat for Murray cod (*Maccullochella peelii*) (such as Macintyre Brook, Condamine River, Back Creek, Bringalily Creek, and Cabbage Creek).

MNES aquatic species, Murray cod (*Maccullochella peelii*), has been recorded in the Macintyre River and in the Macintyre Brook. Key sites in Bringalily Creek, Pariagara Creek, Nicol Creek, Native Dog Creek, Back Creek and Grasstree Creek have also been identified as potential habitat for this species (Aquatic Biopassage Services, 2024). Murray cod is known from the

Condamine River system and may utilise channels within the Study area and the broader river system during prolonged wet periods.

Water flow and occurrence is variable and dependent on seasons. Sites on the Condamine River floodplain were generally dry with very little water in the channel (water generally present in small pools with infrequent deeper pools) (Plate 4.9 and Plate 4.10) during the Ecological Australia inspection (2020). However, the area of Condamine River inspected during the Hydrobiology survey (2023) was observed to be flowing.



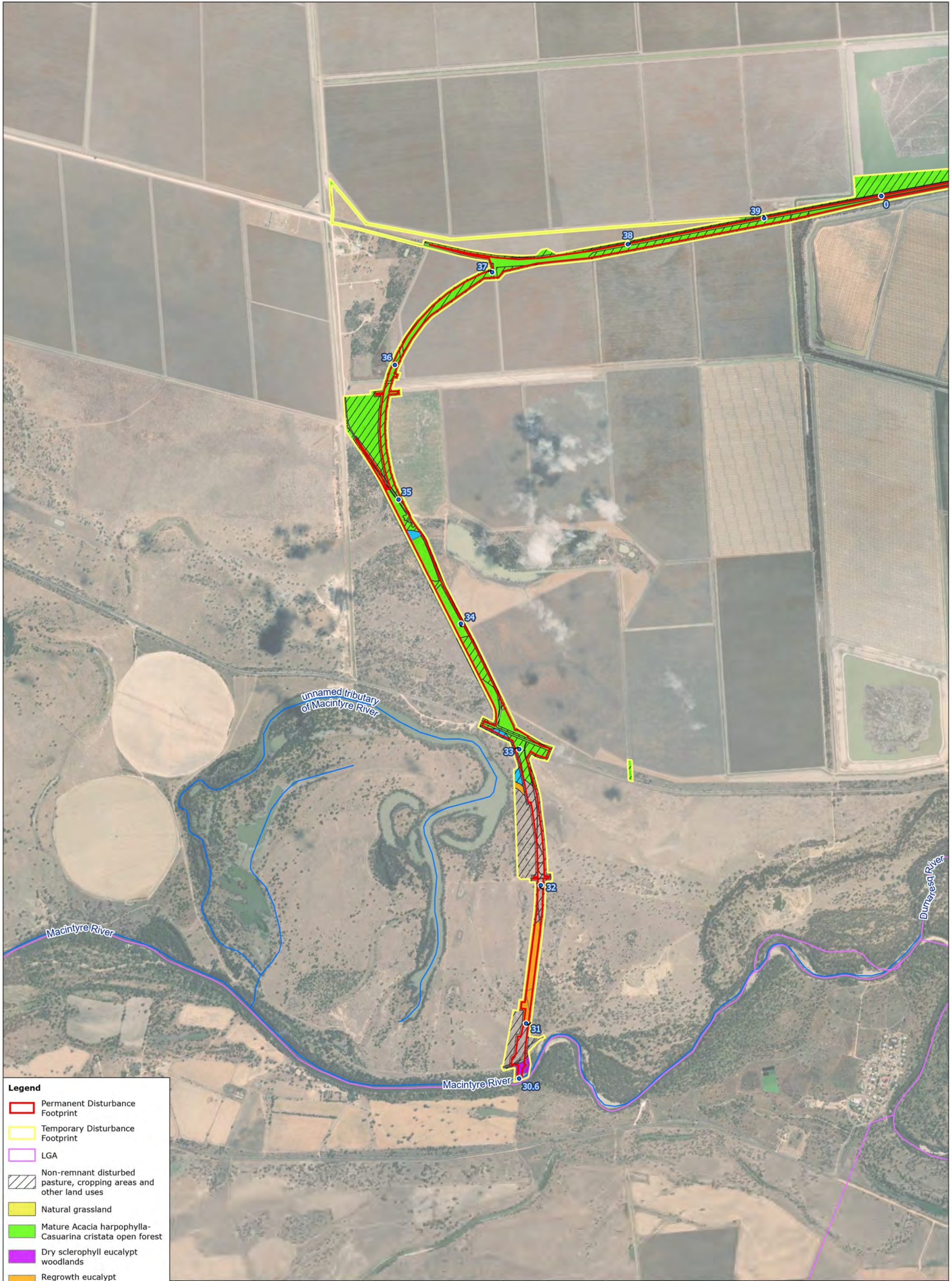
PLATE 4.9 GRASSTREE CREEK - SOUTHERN
CONDAMINE RIVER FLOODPLAIN AREA



PLATE 4.10 CONDAMINE RIVER (NORTH
BRANCH)

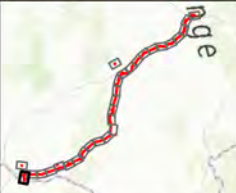
4.1.8 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater plays an important role in sustaining MNES species utilising aquatic and terrestrial ecosystems, such as springs, wetlands and rivers. DES groundwater dependent ecosystem mapping (GDE Atlas) shows terrestrial groundwater dependent ecosystems mapped within the Project footprint. Shallow (alluvial) groundwater may sustain associated riparian canopy vegetation during dry conditions including river red gum (*E. camaldulensis*) which is utilised by species such as koala (*Phascolarctos cinereus*) and greater glider (southern and central) (*Petauroides volans*). Groundwater dependent ecosystems are minor occurrences within other habitat types.



Legend

- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- LGA
- Non-remnant disturbed pasture, cropping areas and other land uses
- Natural grassland
- Mature *Acacia harpophylla*-*Casuarina cristata* open forest
- Dry sclerophyll eucalypt woodlands
- Regrowth eucalypt communities
- Wetlands
- Watercourse
- State Forests
- Chainage (km)



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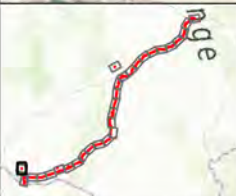
F4.1(1)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



Coordinate System:
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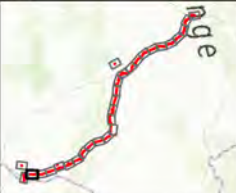
F4.1(2)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



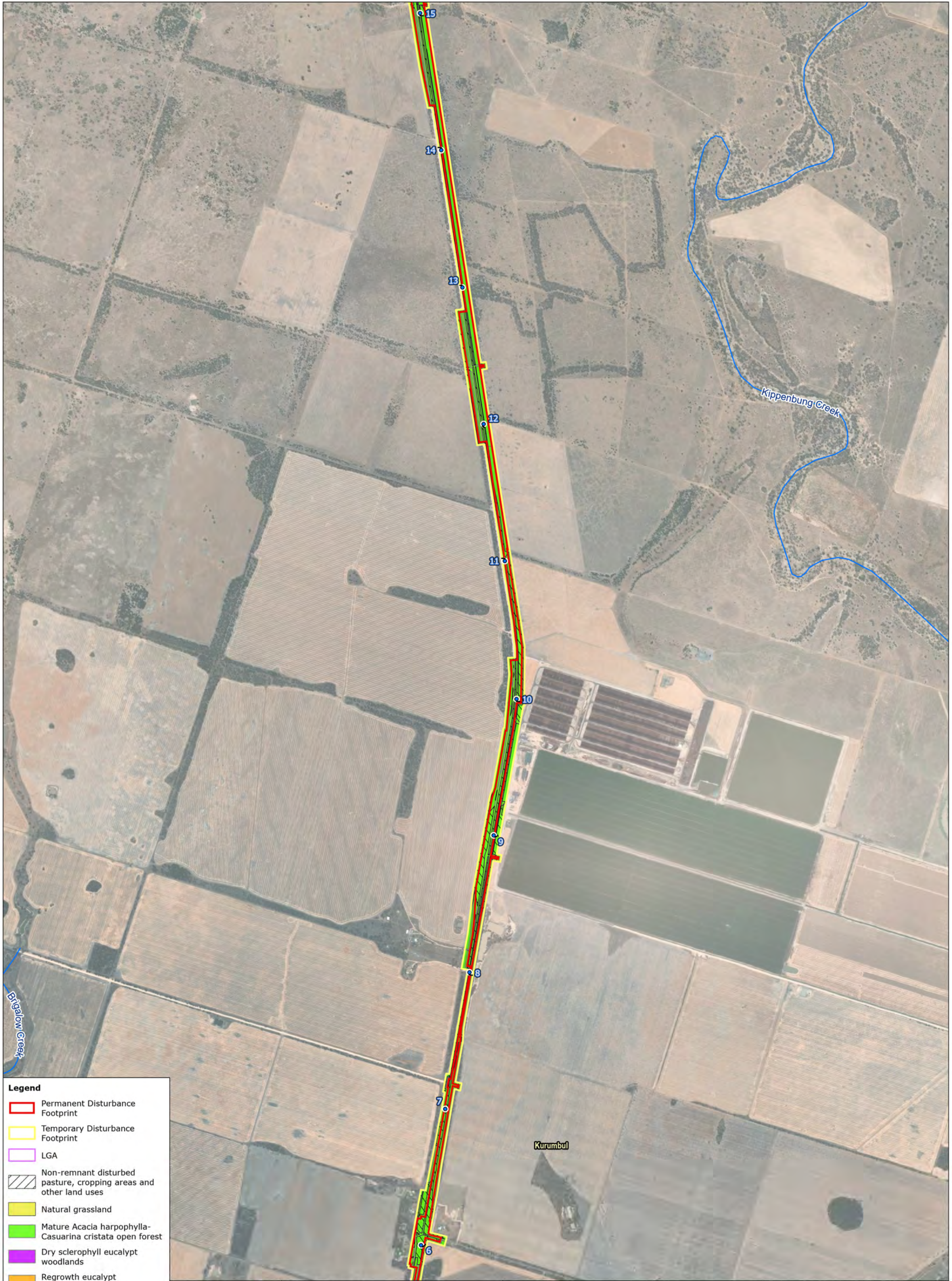
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F4.1(3)- Location of Habitat Types Within the Project footprint

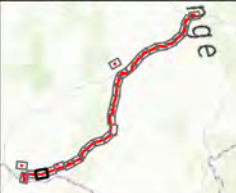
Appendix O - Matters of National Environmental Significance Report
ARTC





Legend

- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- LGA
- Non-remnant disturbed pasture, cropping areas and other land uses
- Natural grassland
- Mature Acacia harpophylla-Casuarina cristata open forest
- Dry sclerophyll eucalypt woodlands
- Regrowth eucalypt communities
- Wetlands
- Watercourse
- State Forests
- Chainage (km)



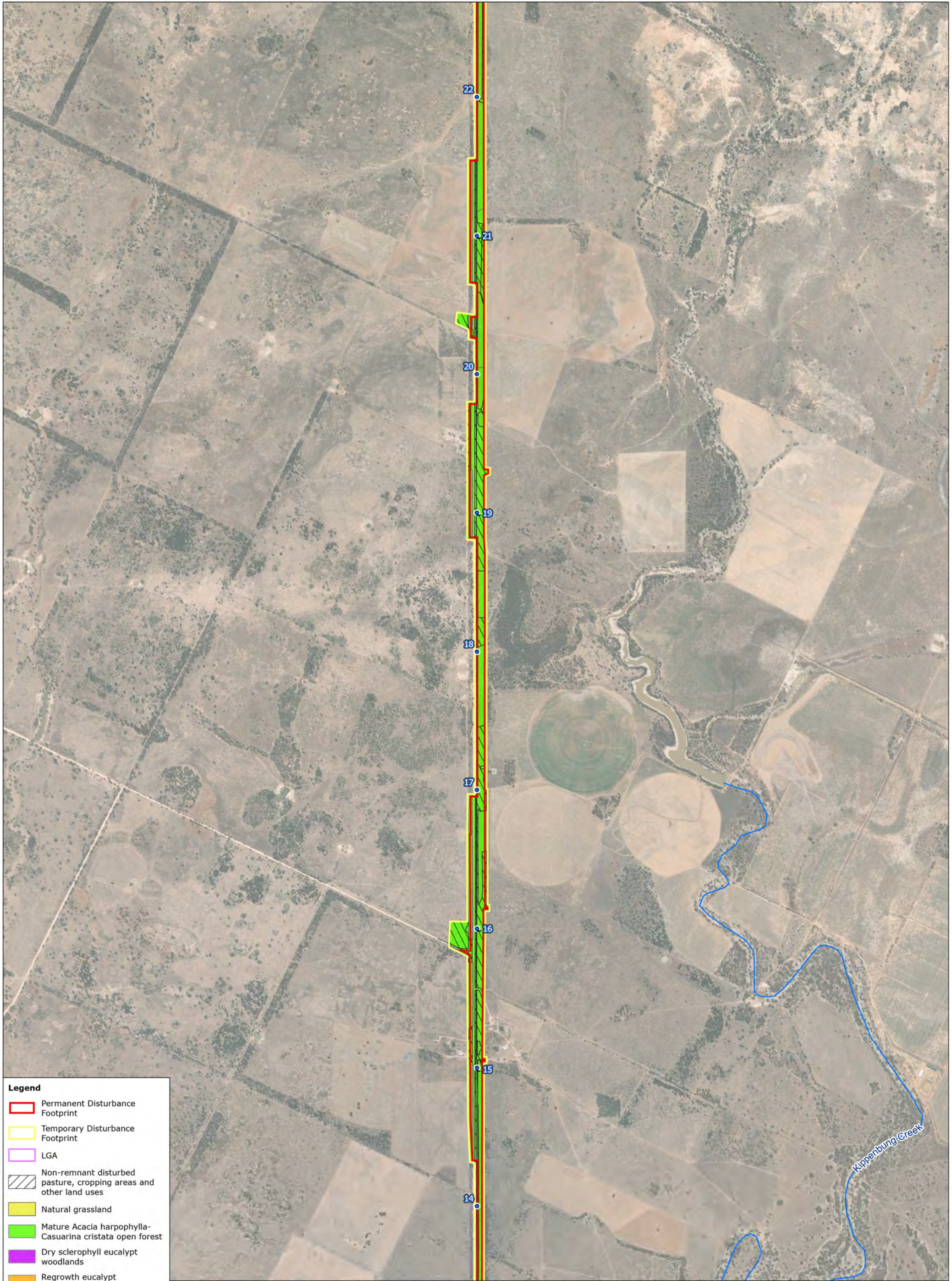
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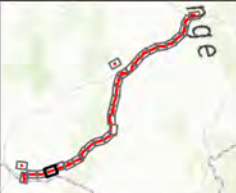
F4.1(4)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



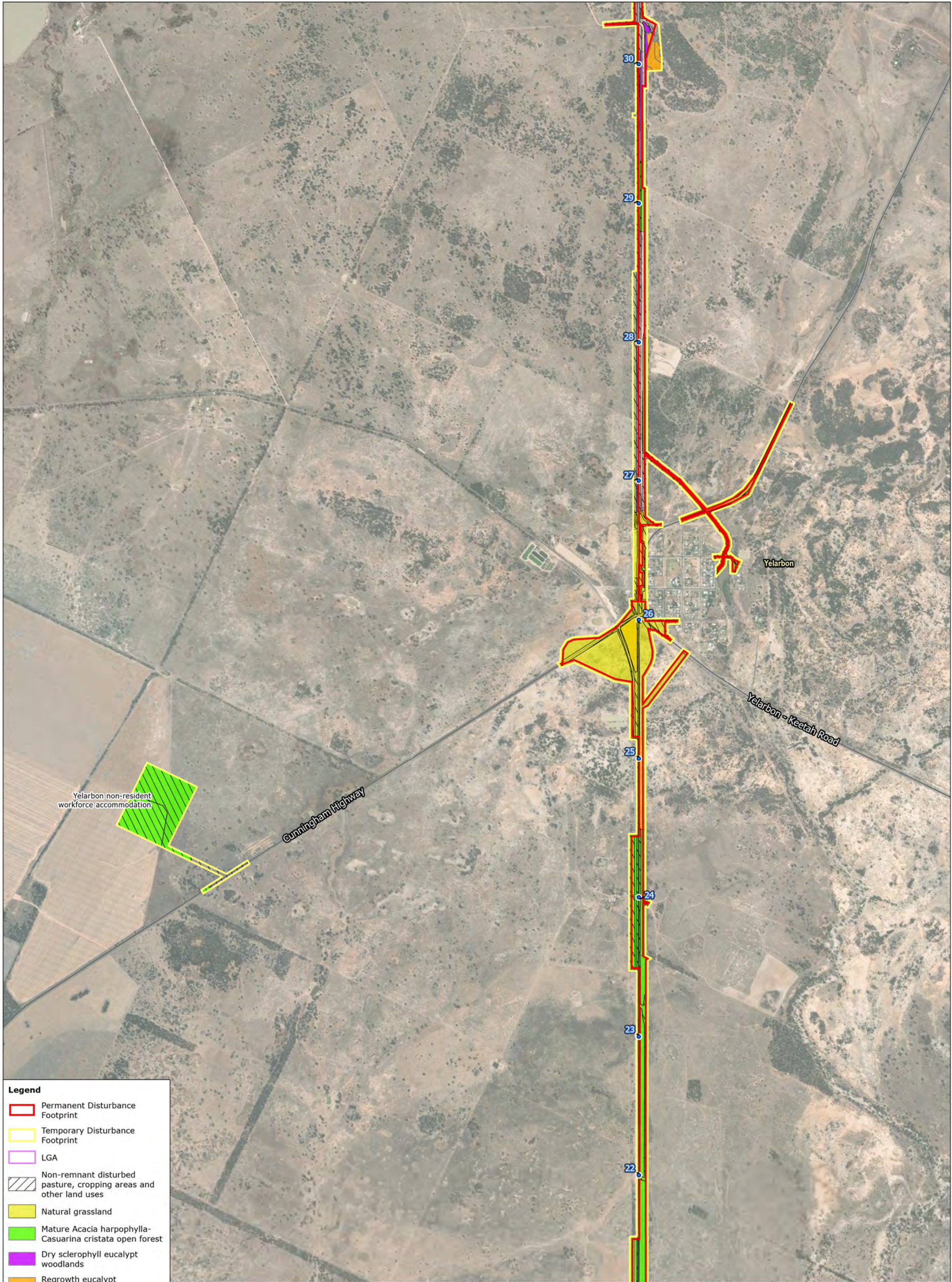
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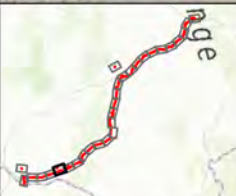
F4.1(5)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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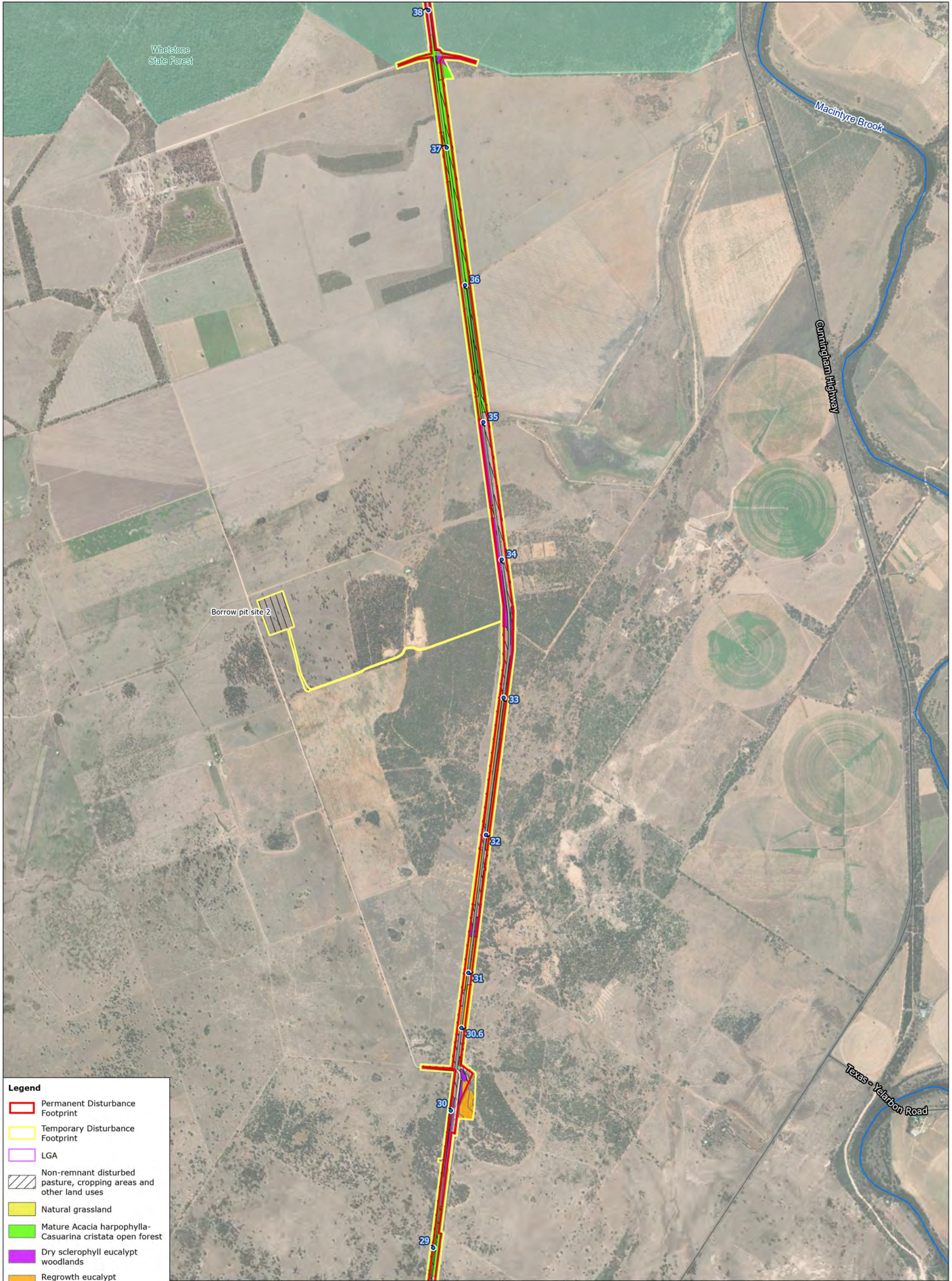


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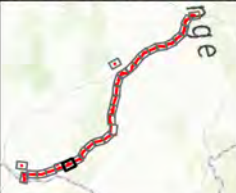
F4.1(6)- Location of Habitat Types Within the Project footprint

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ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



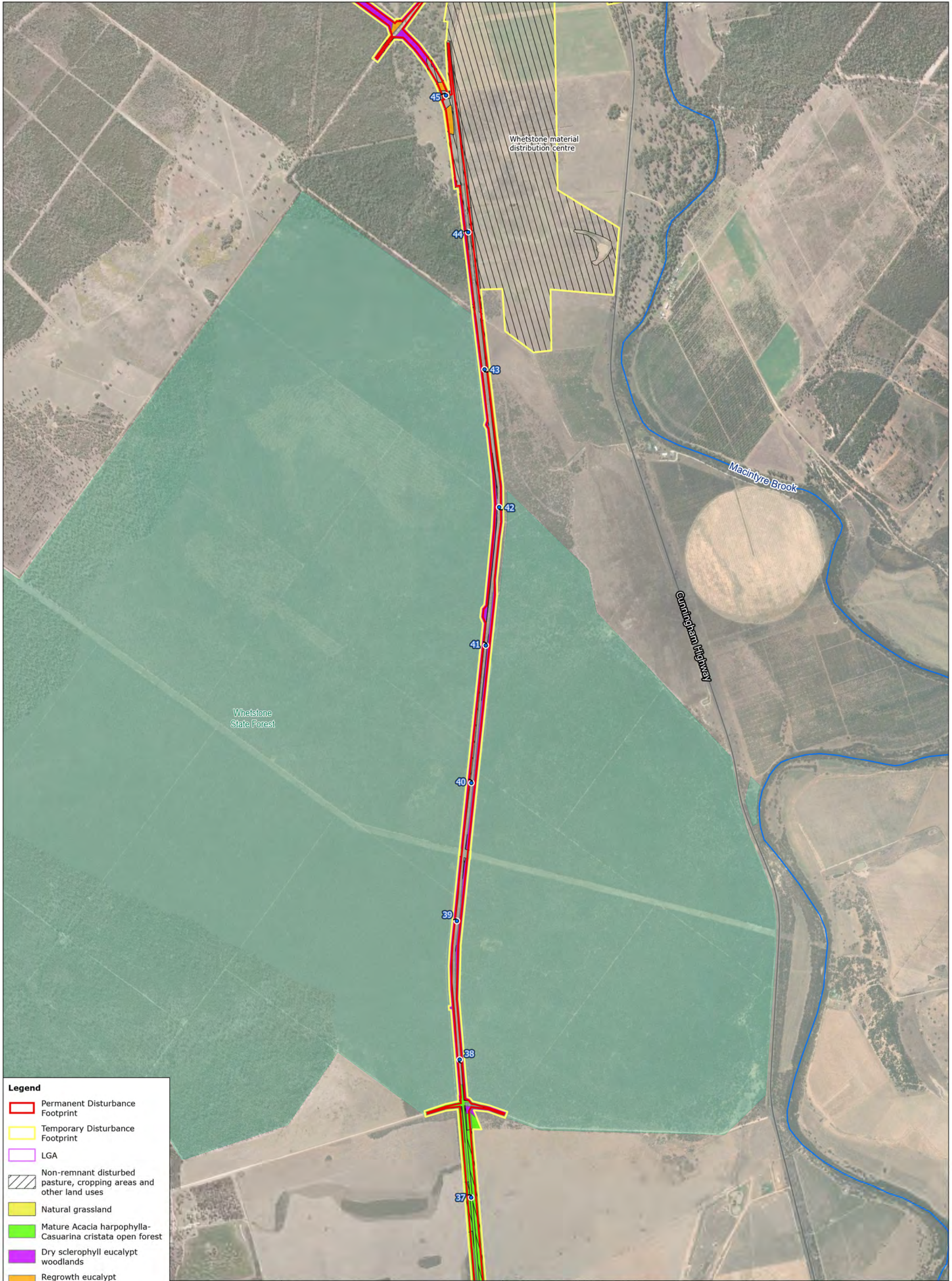
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
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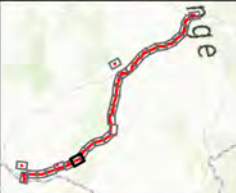
F4.1(7)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



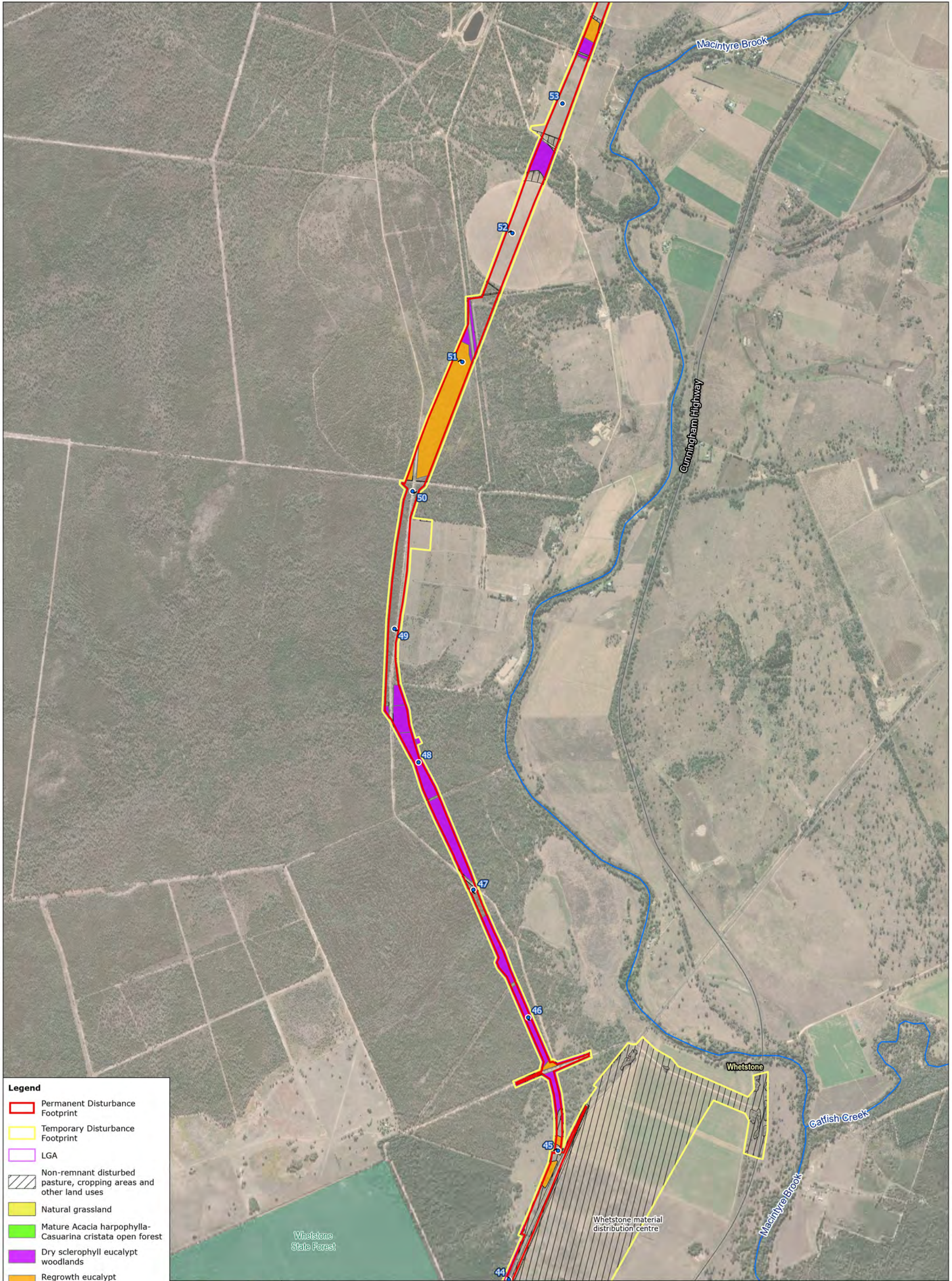
Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
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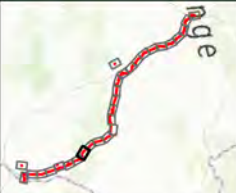
F4.1(8)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



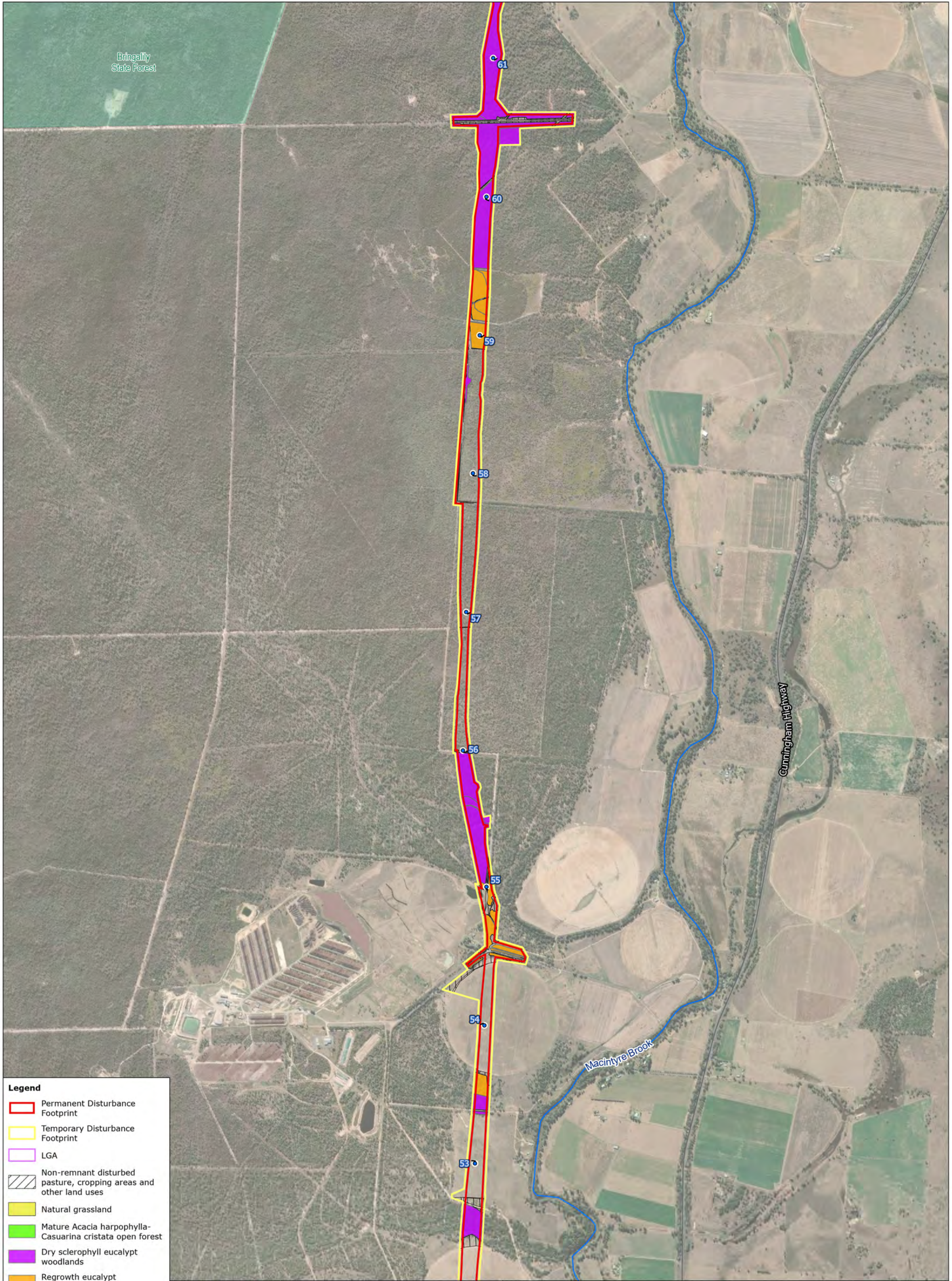
Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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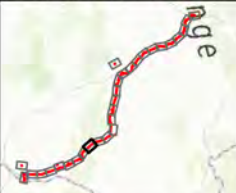
F4.1(9)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



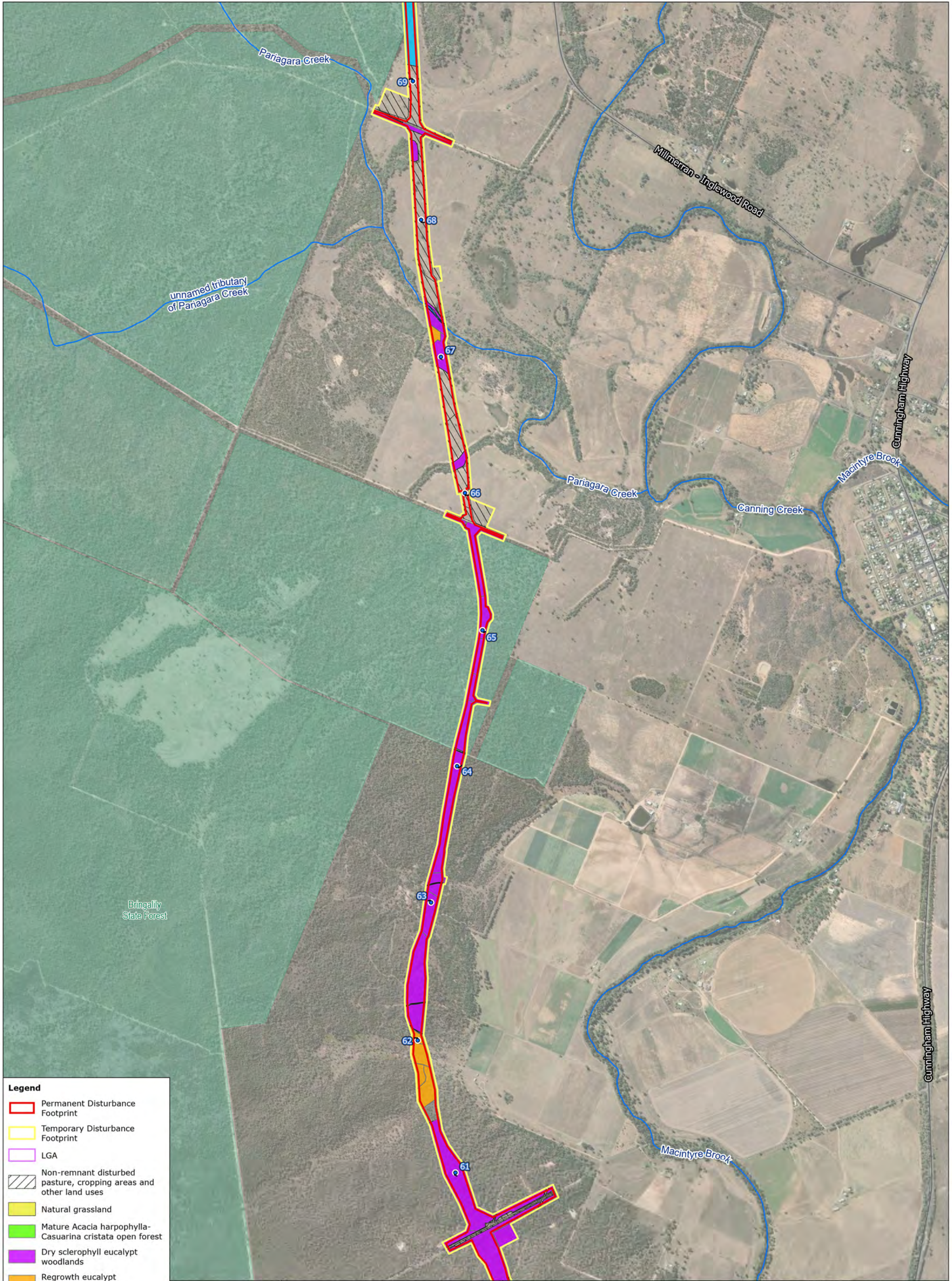
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GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(10)- Location of Habitat Types Within the Project footprint

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ARTC





Legend

Permanent Disturbance Footprint

Temporary Disturbance Footprint

LGA

Non-remnant disturbed pasture, cropping areas and other land uses

Natural grassland

Mature Acacia harpophylla-Casuarina cristata open forest

Dry sclerophyll eucalypt woodlands

Regrowth eucalypt communities

Wetlands

Watercourse

State Forests

Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56

Date:
17/10/2024

Created By:
CB/VN

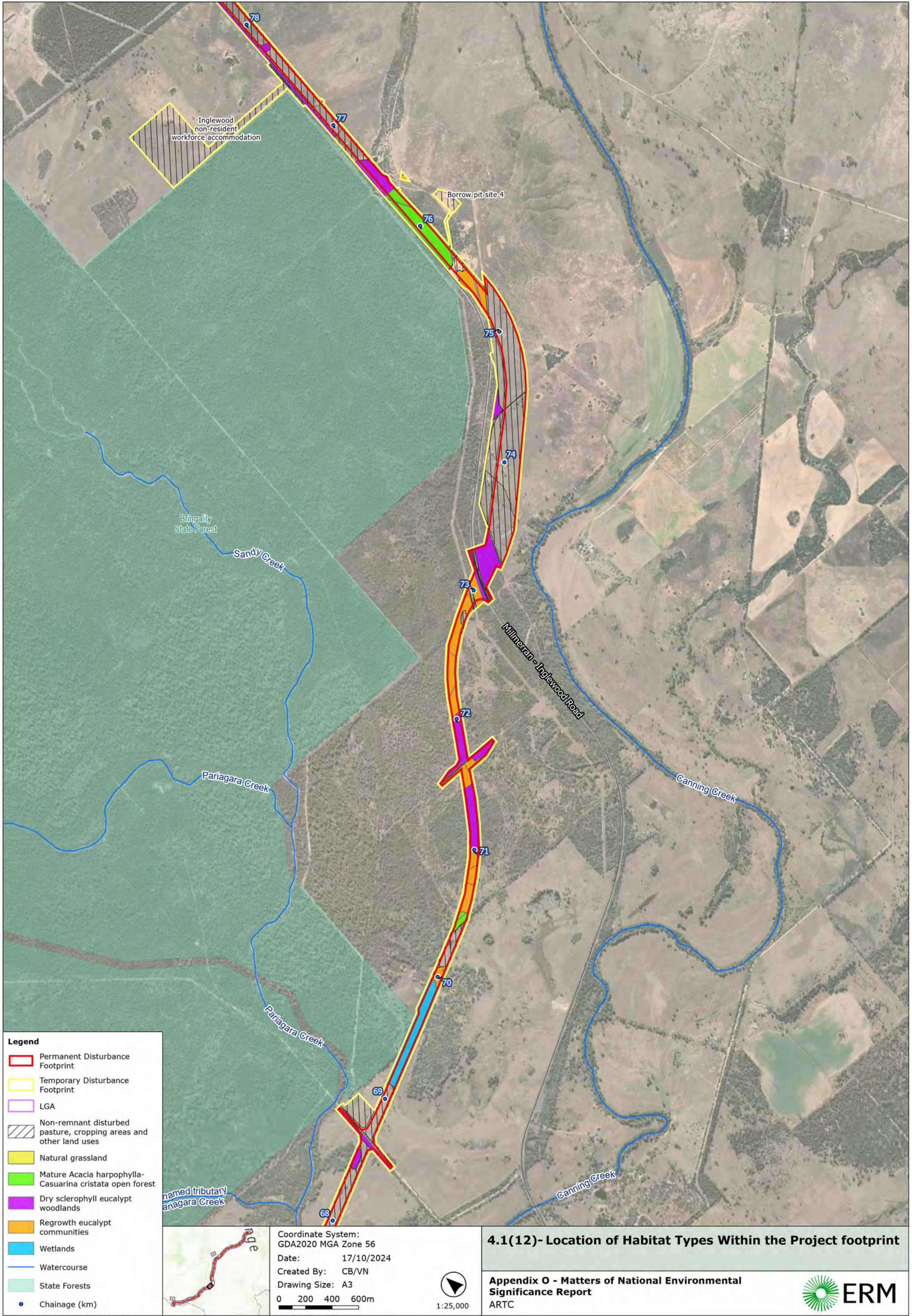
Drawing Size:
A3

0 200 400 600m

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4.1(11)- Location of Habitat Types Within the Project footprint





Legend

- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- LGA
- Non-remnant disturbed pasture, cropping areas and other land uses
- Natural grassland
- Mature Acacia harpophylla-Casuarina cristata open forest
- Dry sclerophyll eucalypt woodlands
- Regrowth eucalypt communities
- Wetlands
- Watercourse
- State Forests
- Chainage (km)



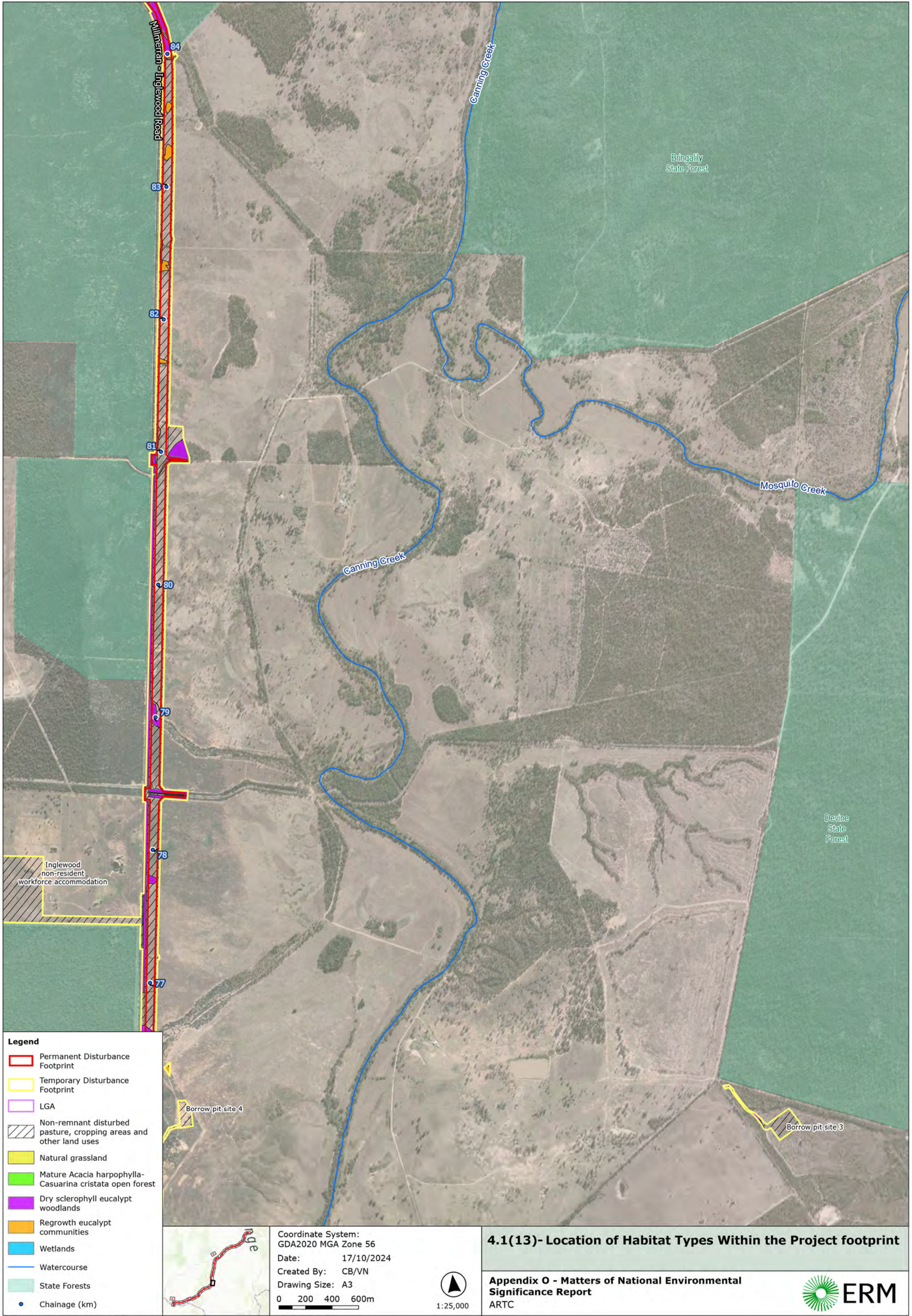
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(12)- Location of Habitat Types Within the Project footprint

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ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



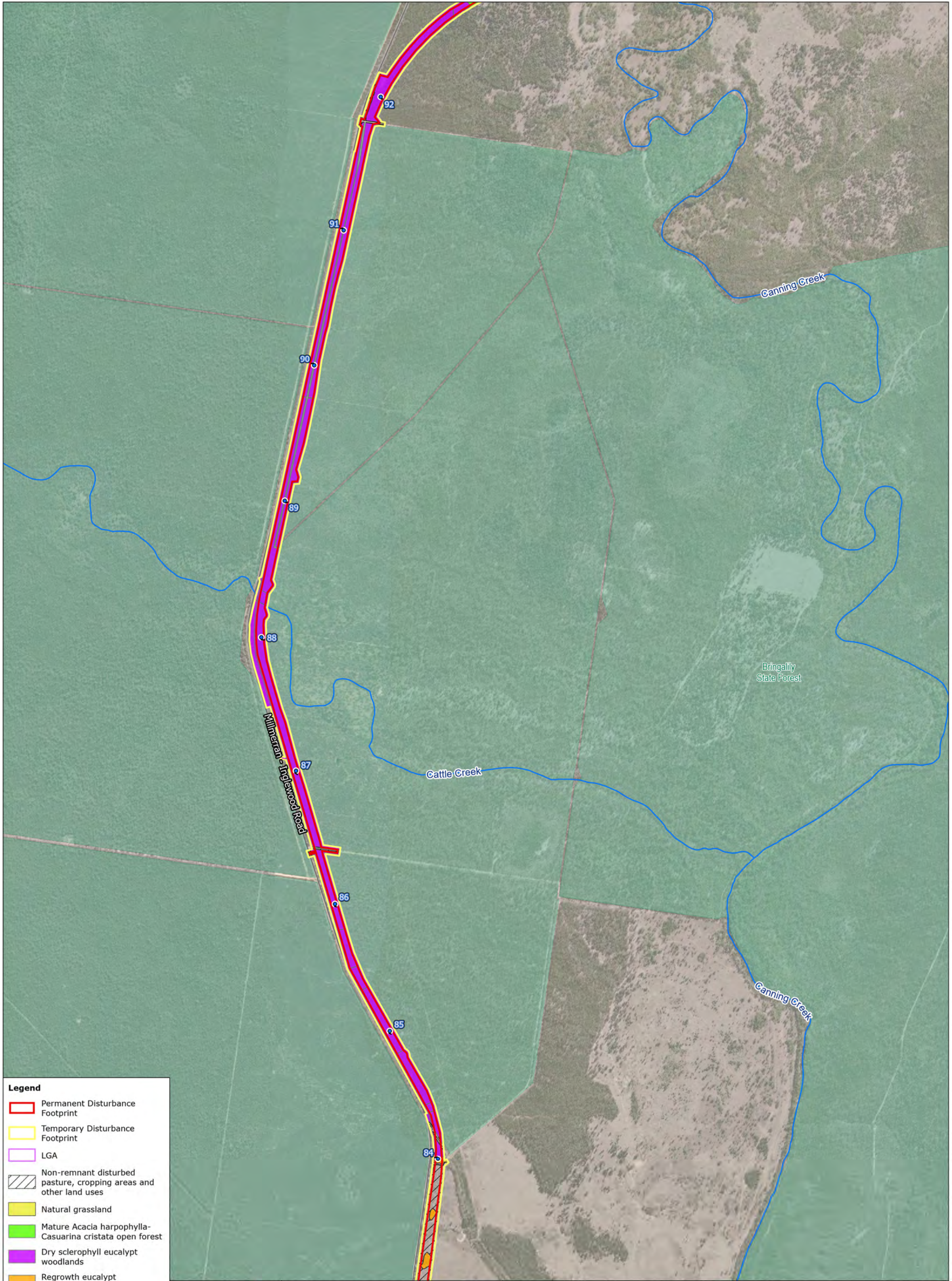
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(13)- Location of Habitat Types Within the Project footprint

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ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



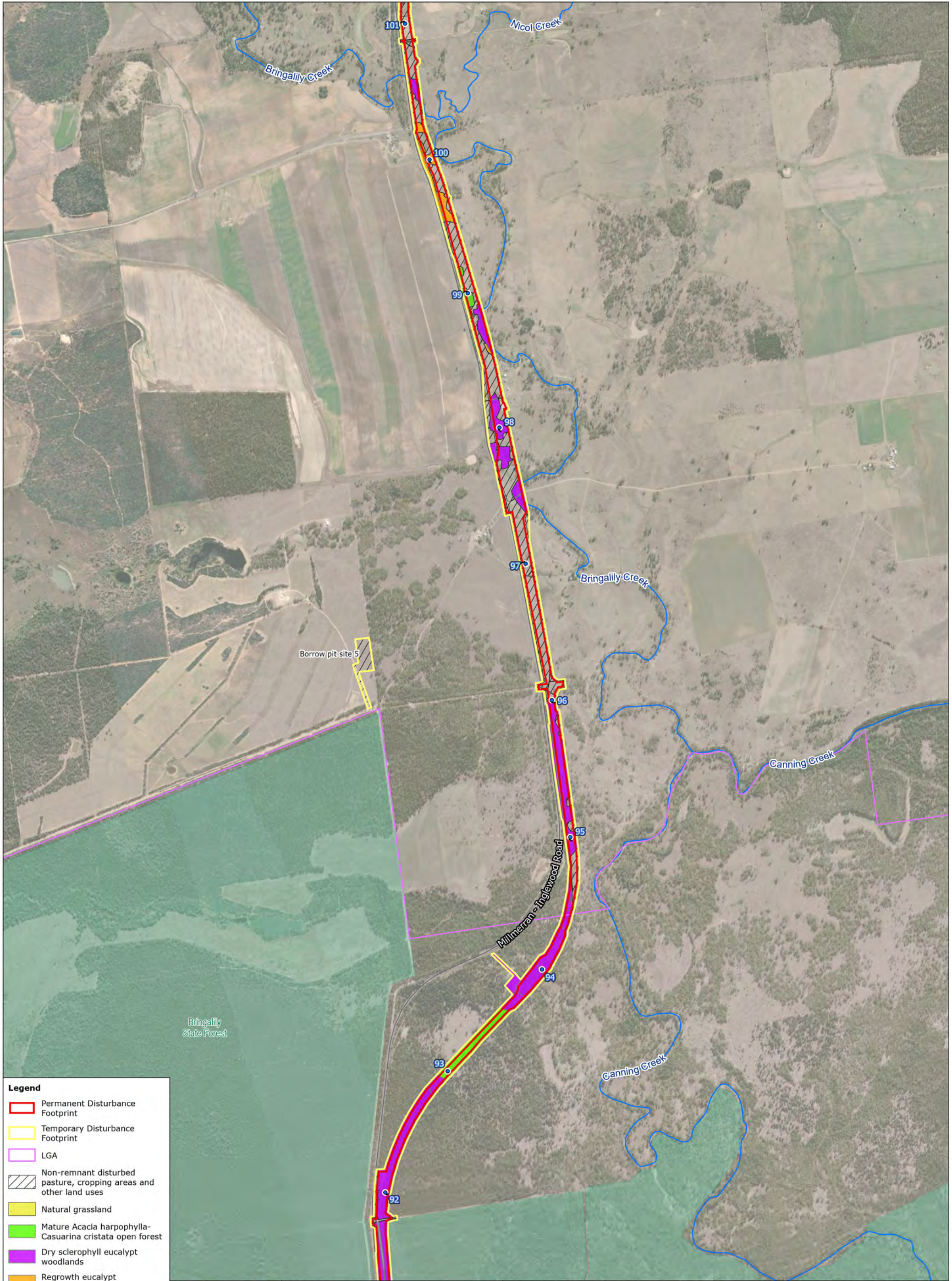
Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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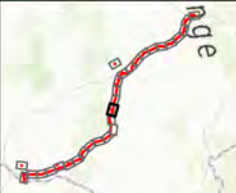
4.1(14)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



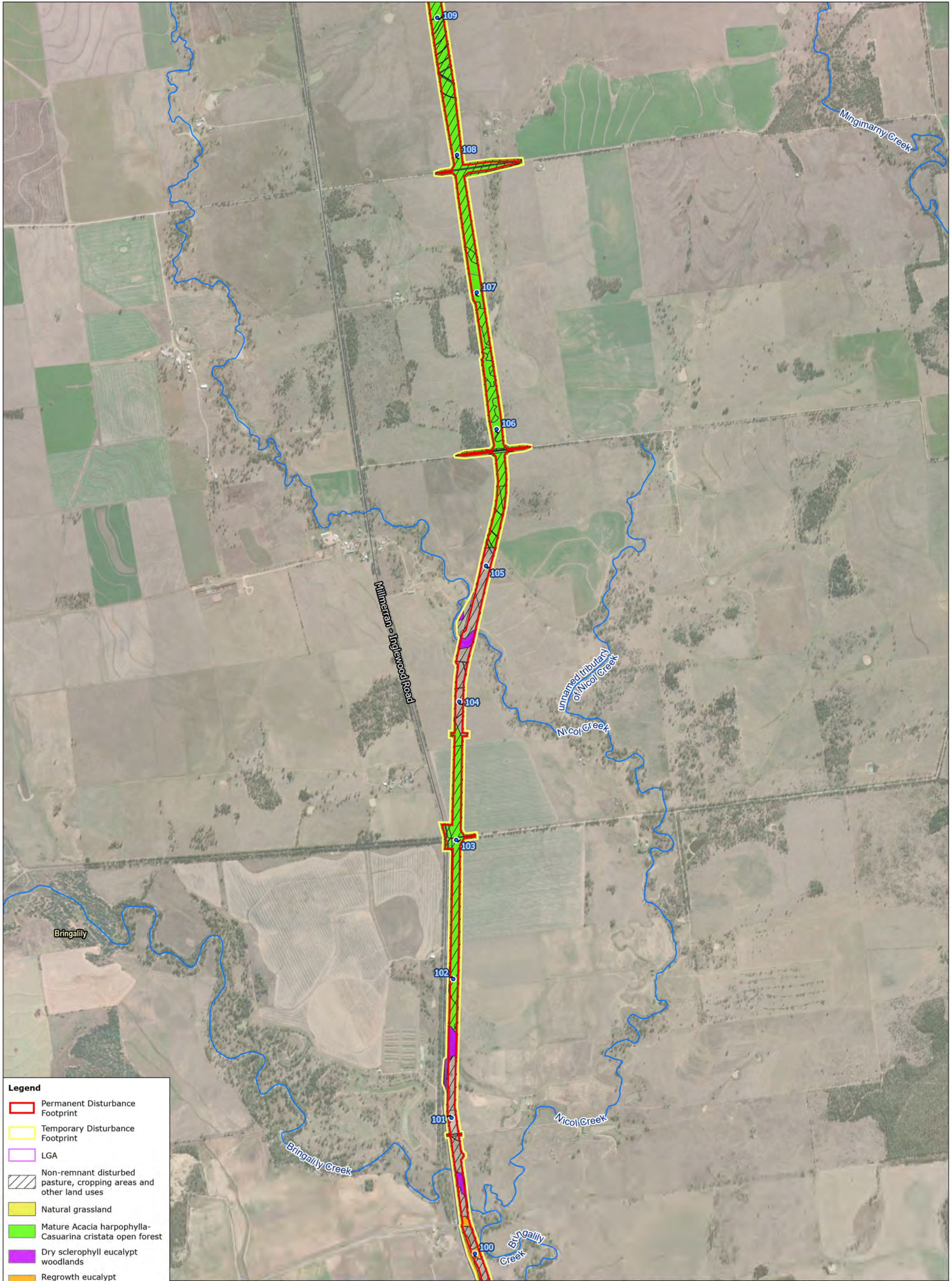
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(15)- Location of Habitat Types Within the Project footprint

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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



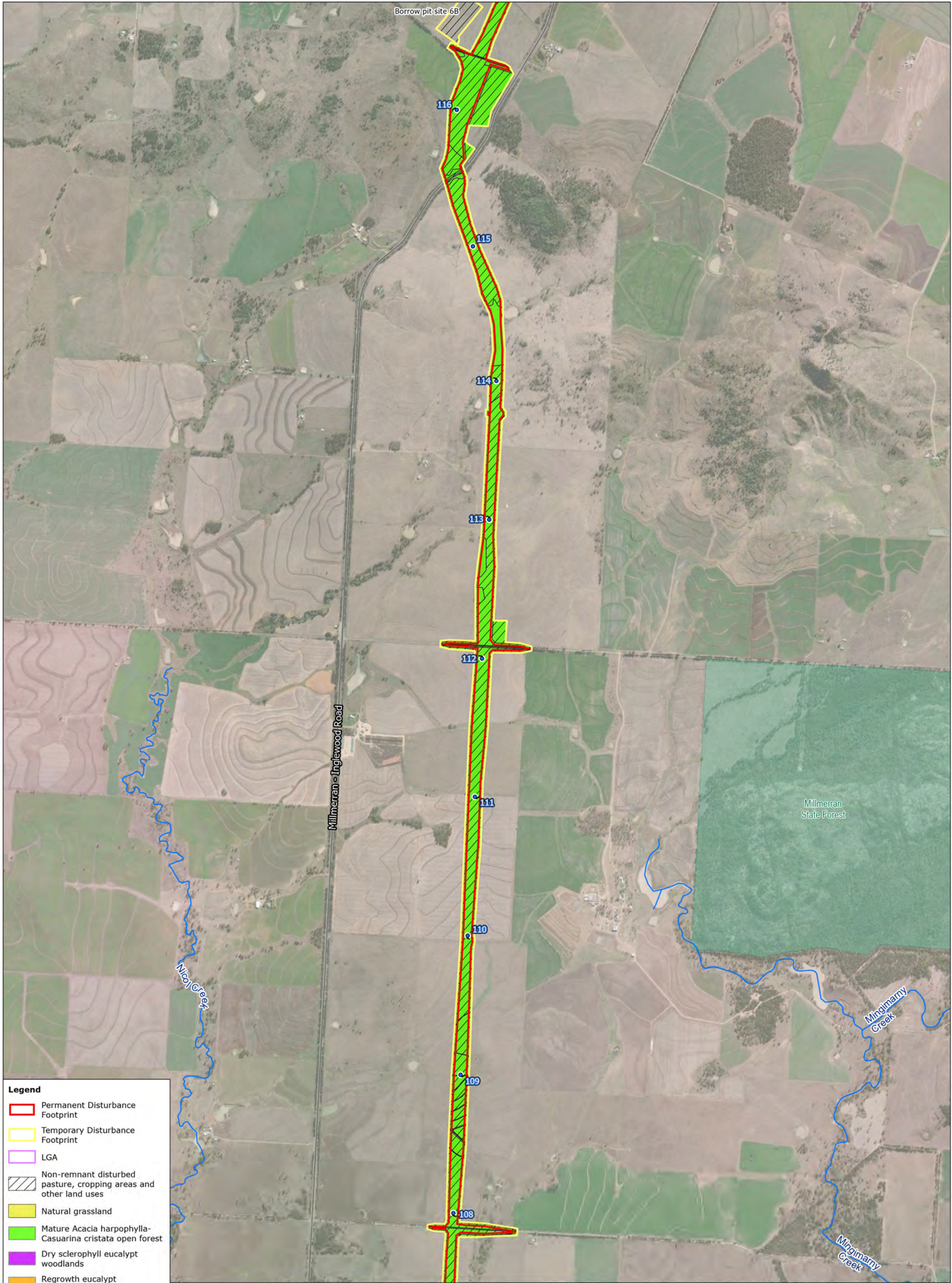
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(16)- Location of Habitat Types Within the Project footprint

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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



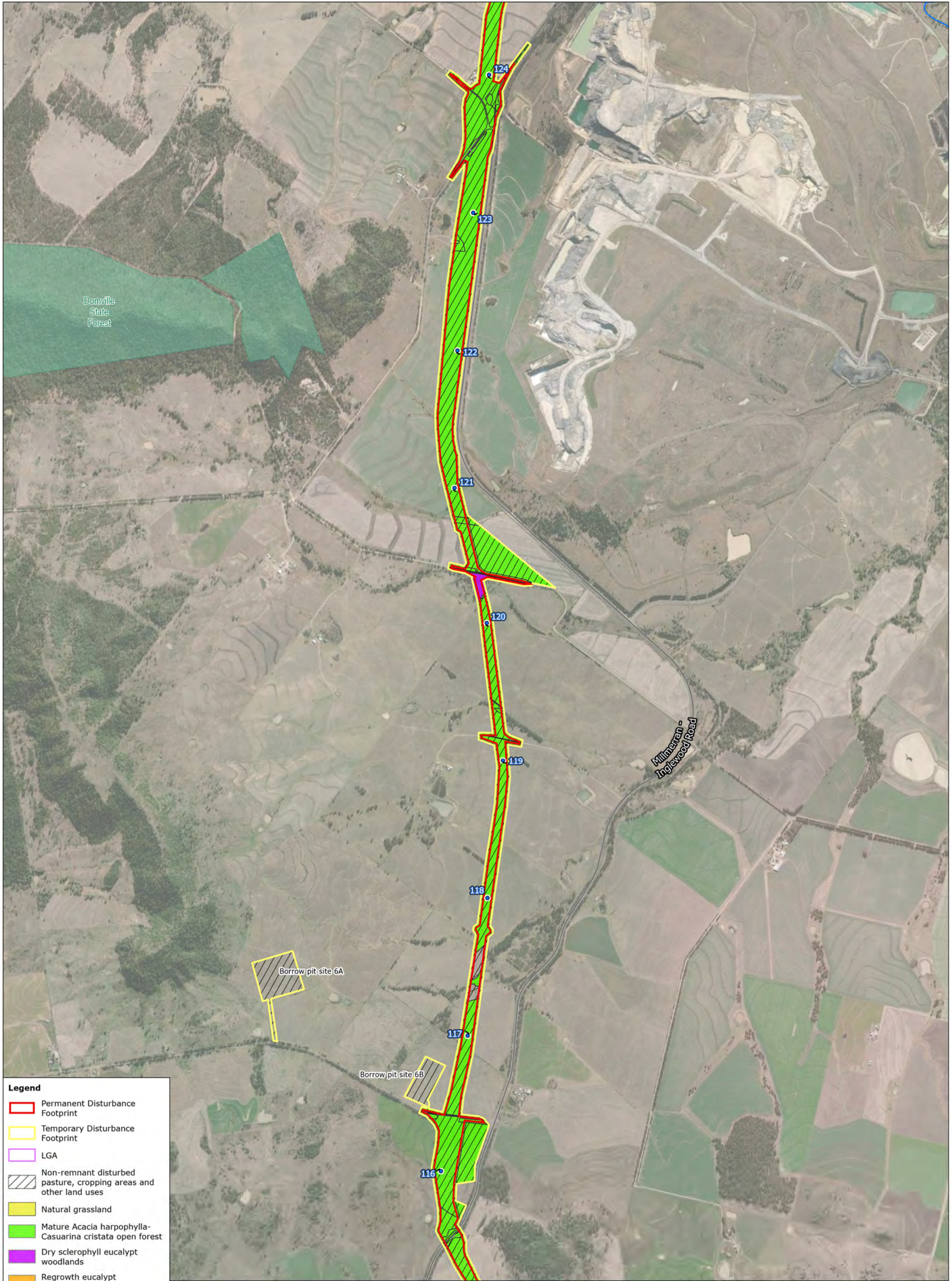
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(17)- Location of Habitat Types Within the Project footprint

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ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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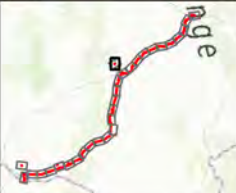
4.1(18)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



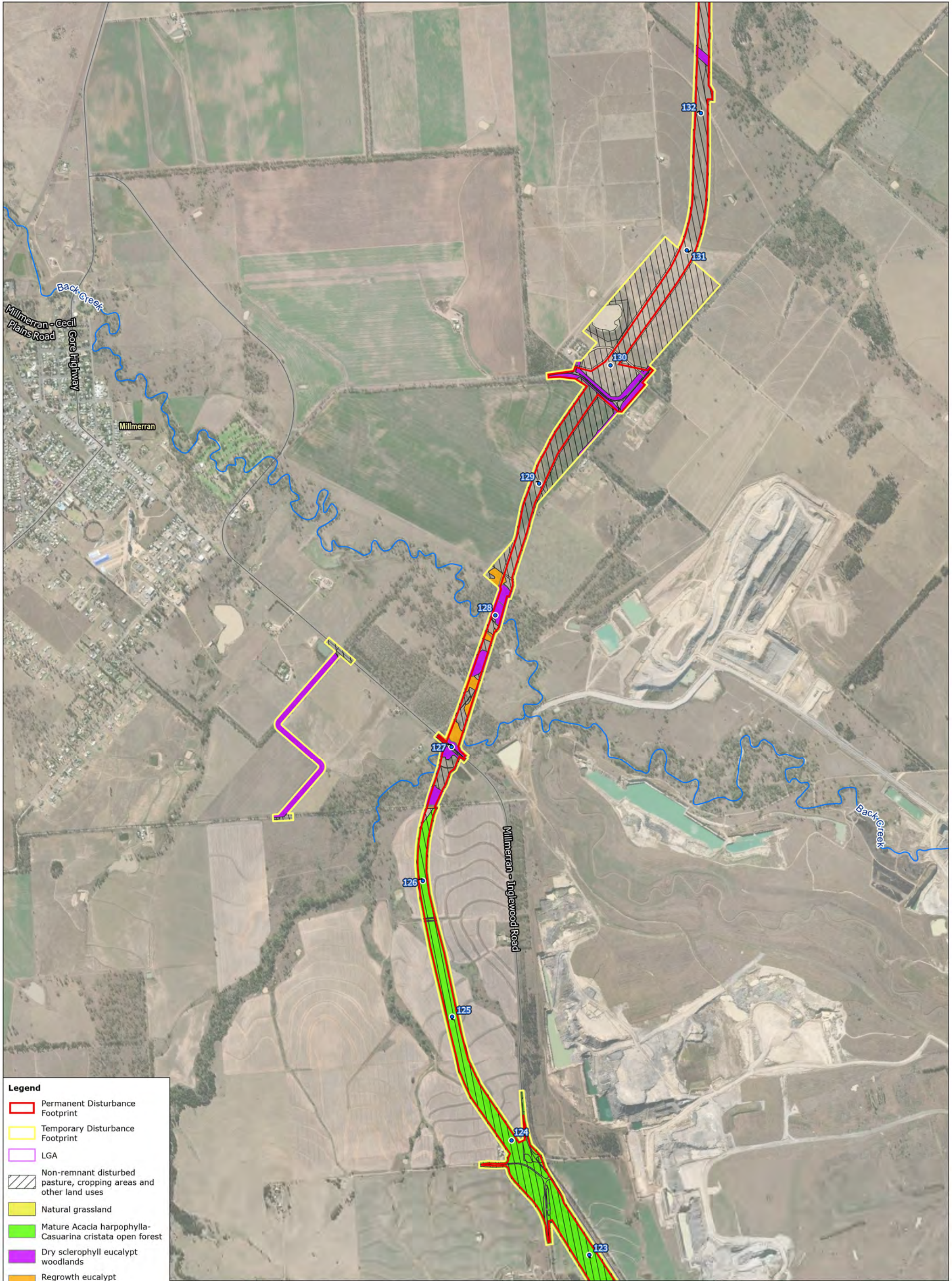
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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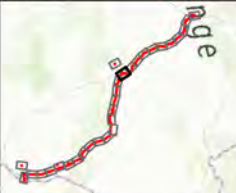
4.1(19)- Location of Habitat Types Within the Project footprint

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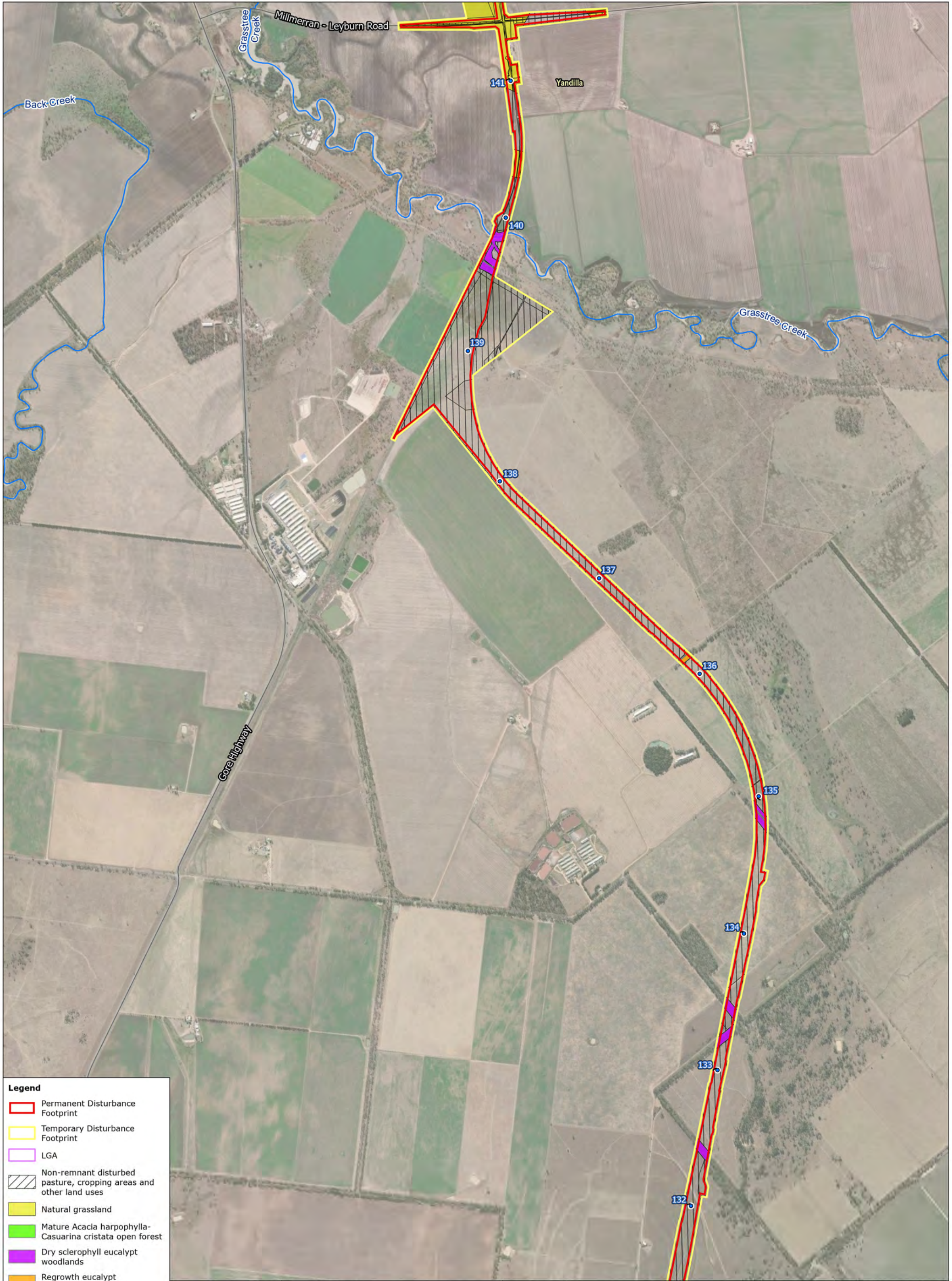


- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature *Acacia harpophylla*-*Casuarina cristata* open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)

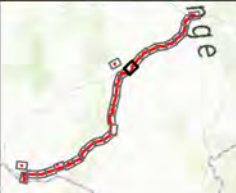


Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



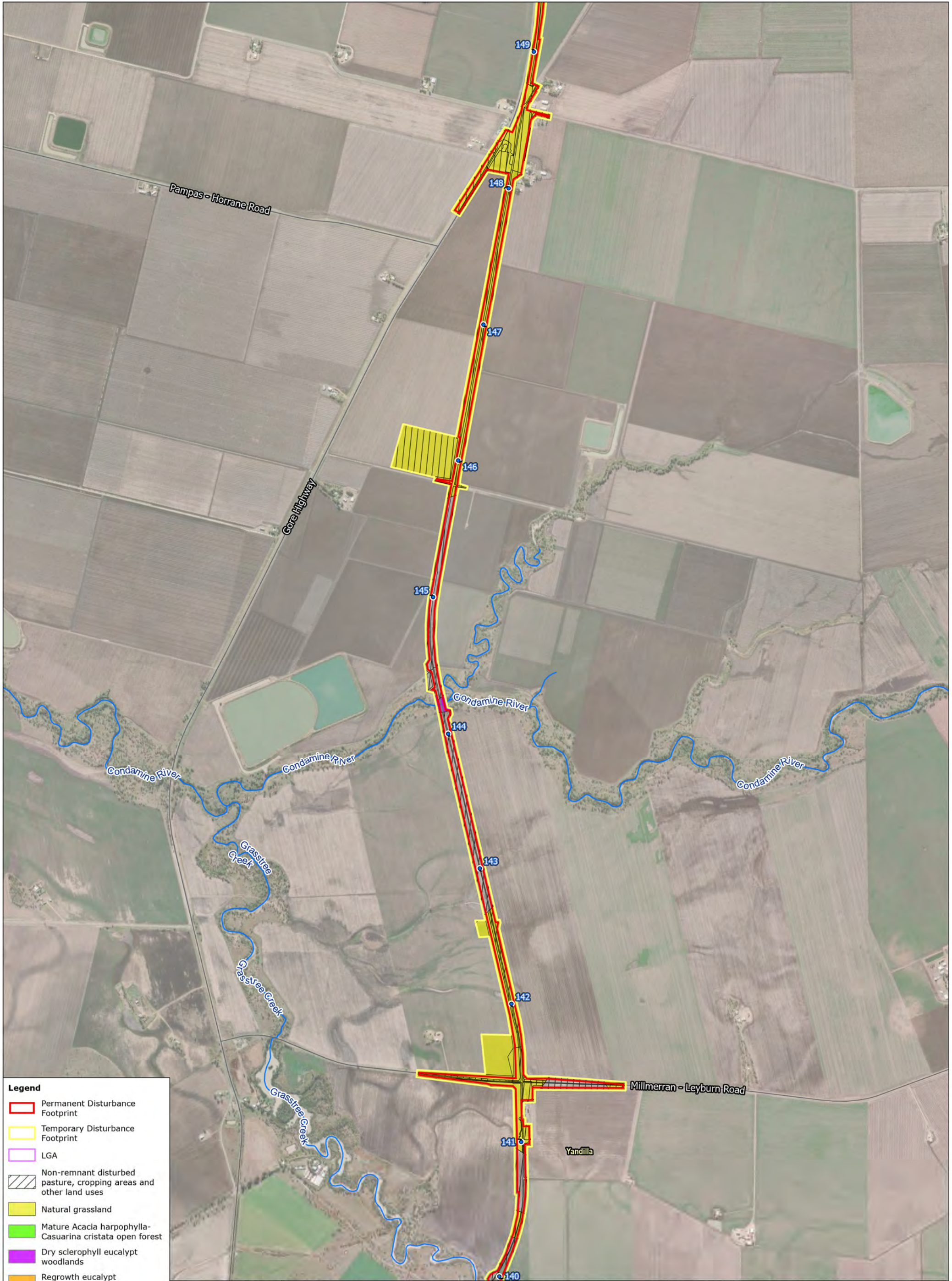
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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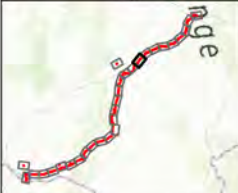
4.1(21)- Location of Habitat Types Within the Project footprint

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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



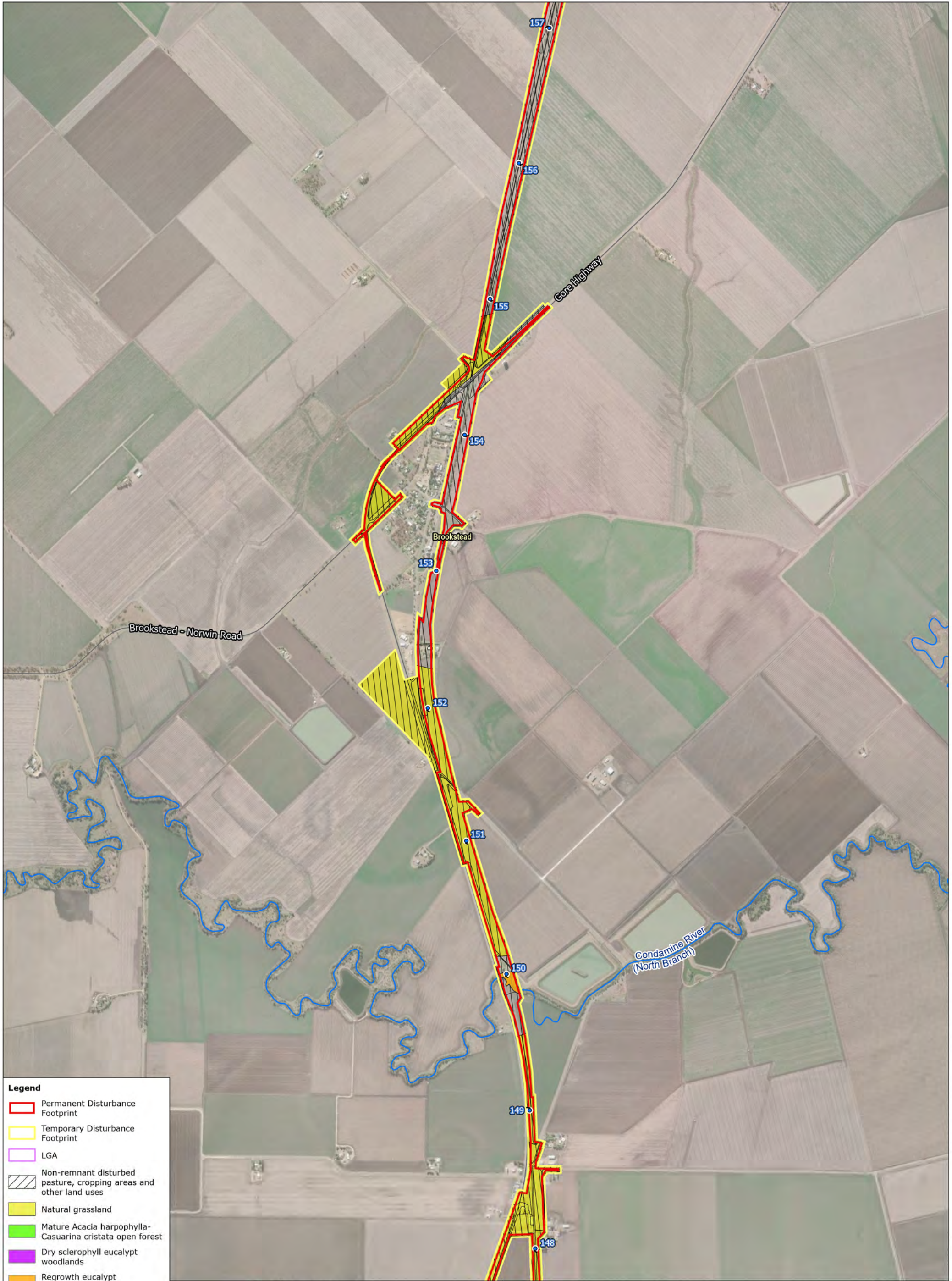
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GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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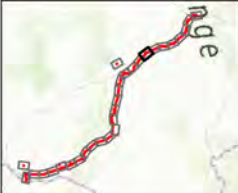
4.1(22)- Location of Habitat Types Within the Project footprint

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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature *Acacia harpophylla*-*Casuarina cristata* open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



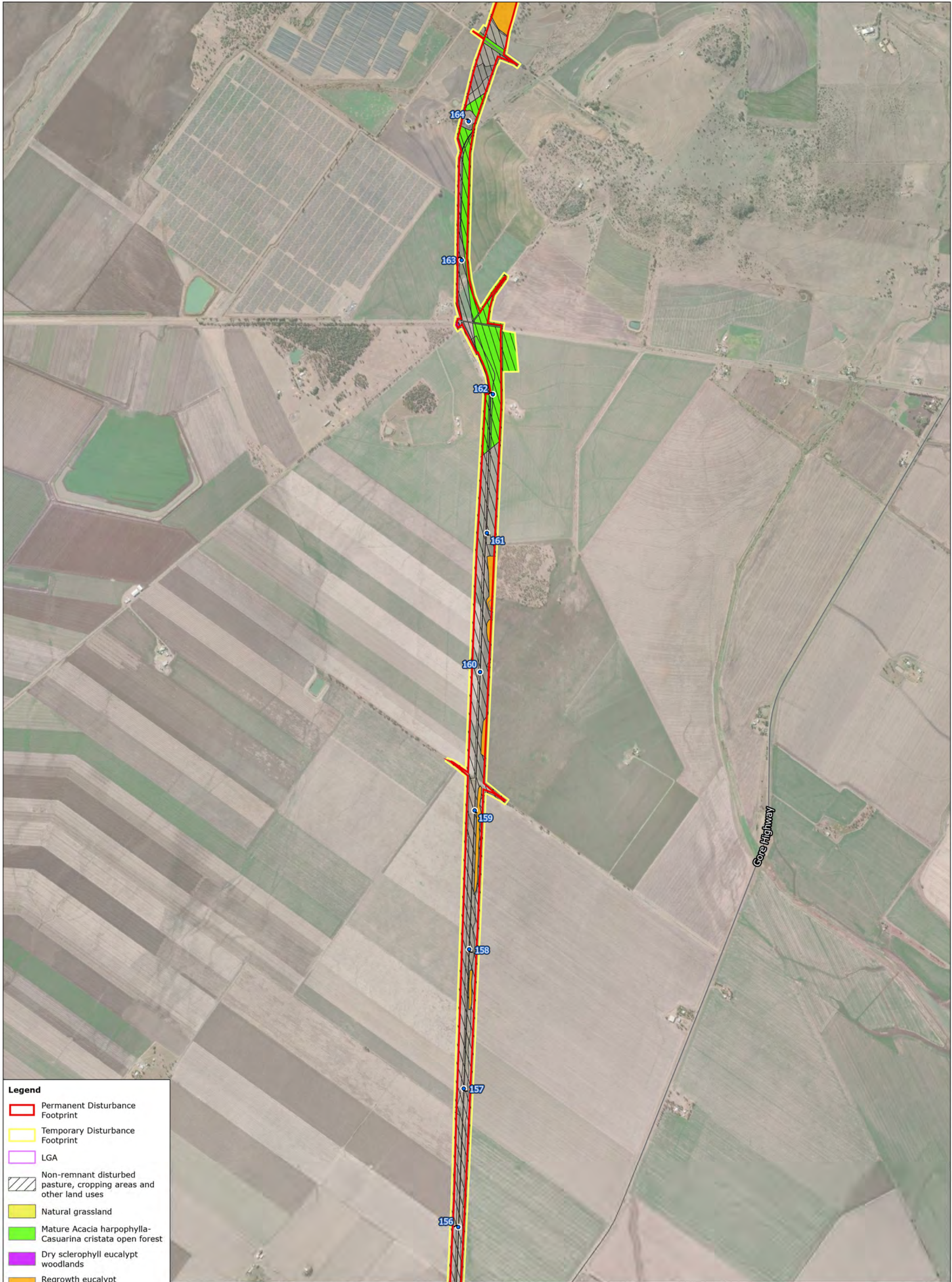
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(23)- Location of Habitat Types Within the Project footprint

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ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



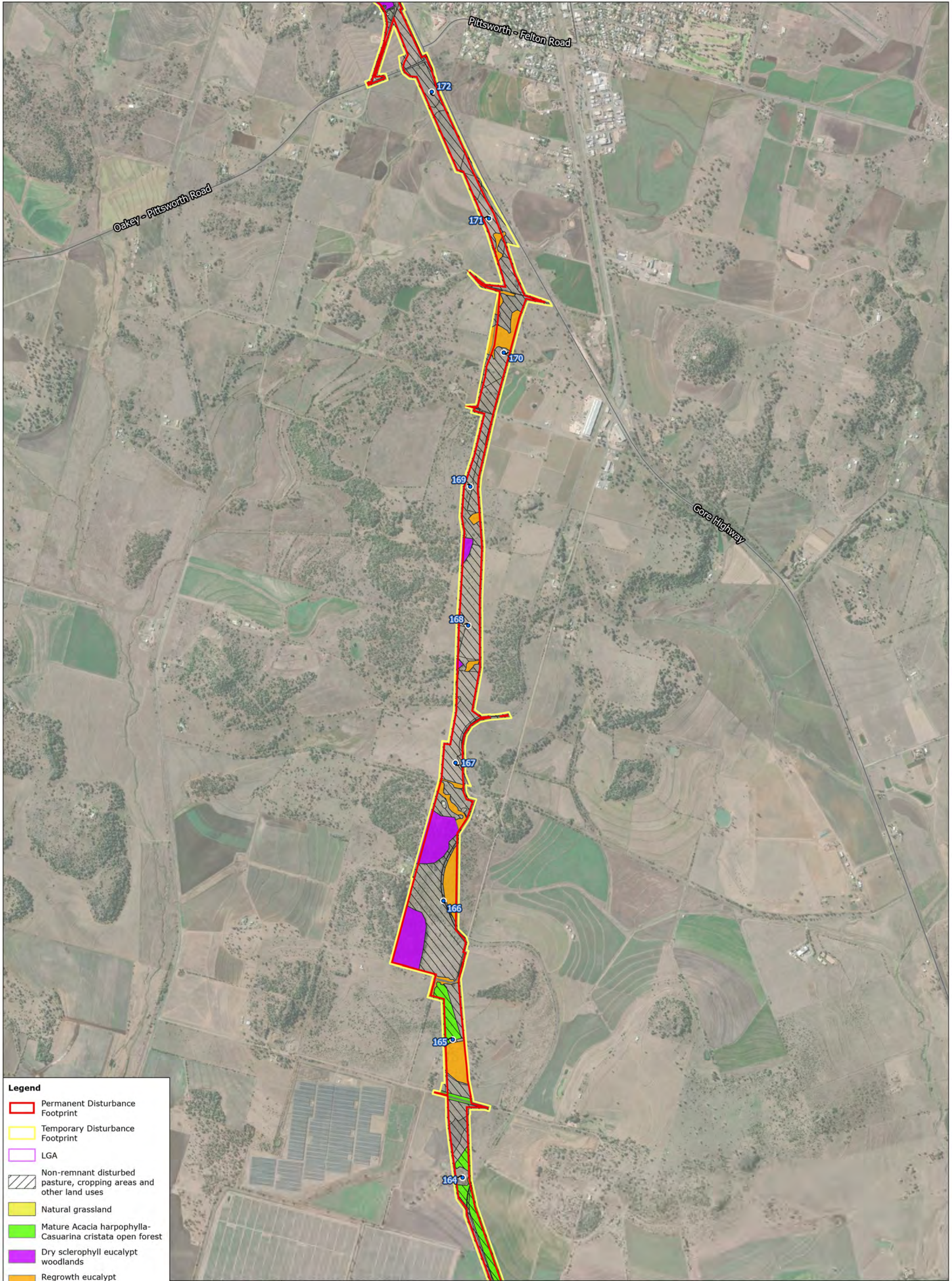
Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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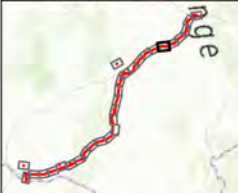
4.1(24)- Location of Habitat Types Within the Project footprint

Appendix O - Matters of National Environmental Significance Report
ARTC





- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)

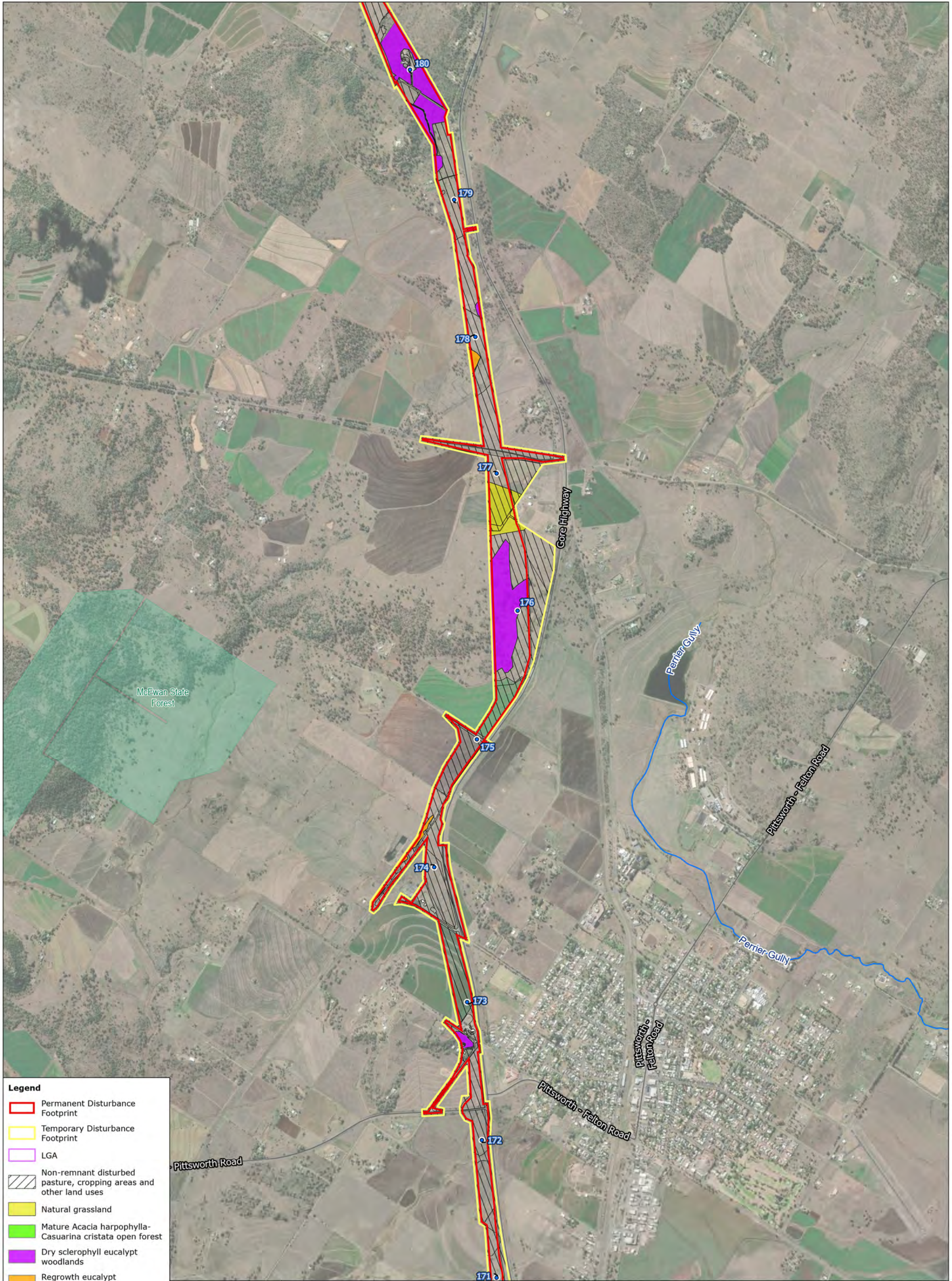


Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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4.1(25)- Location of Habitat Types Within the Project footprint

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ARTC





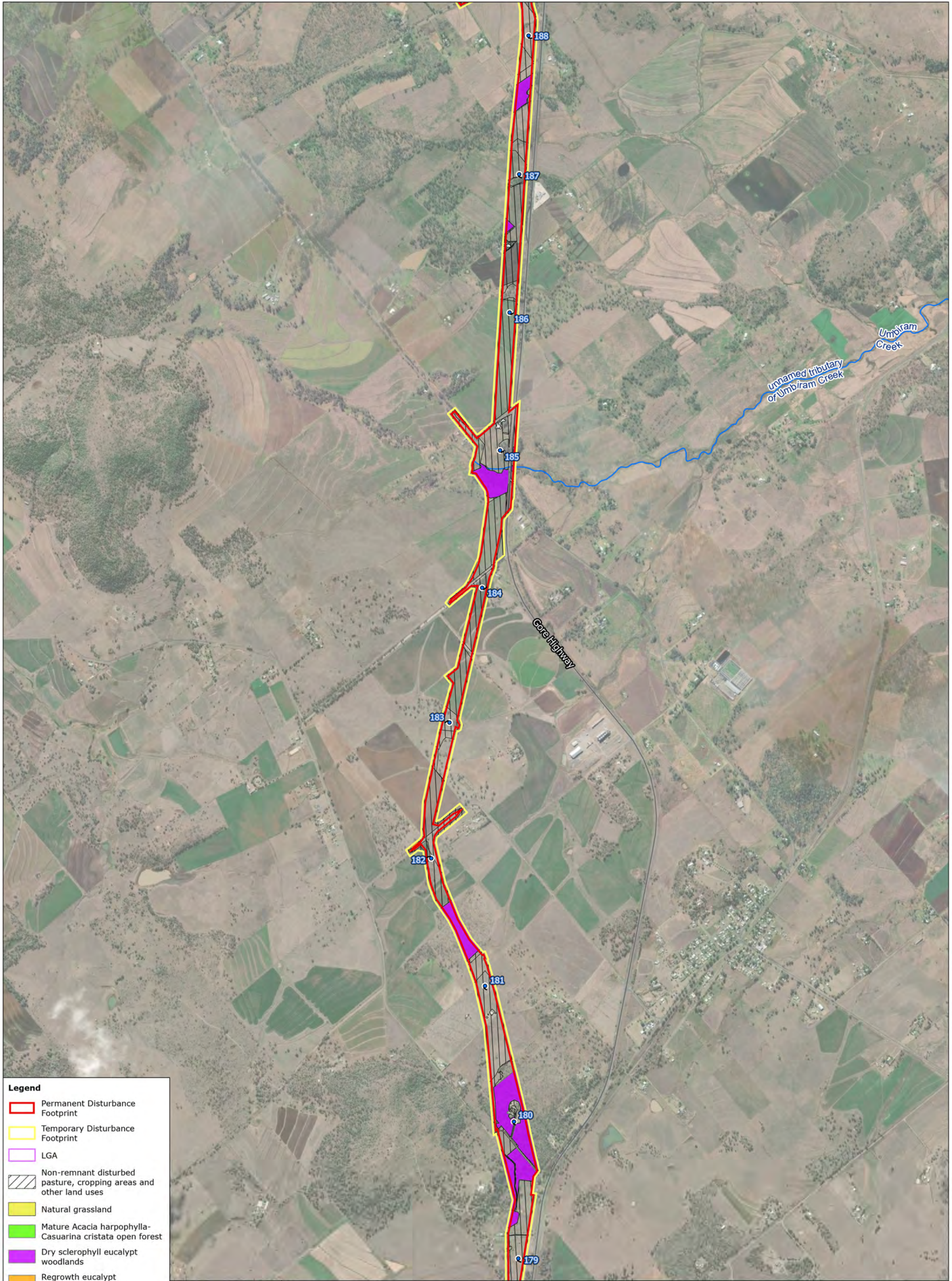
- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature *Acacia harpophylla*-*Casuarina cristata* open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)

Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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1:25,000

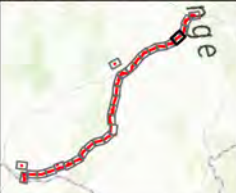
4.1(26)- Location of Habitat Types Within the Project footprint

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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature *Acacia harpophylla*-*Casuarina cristata* open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



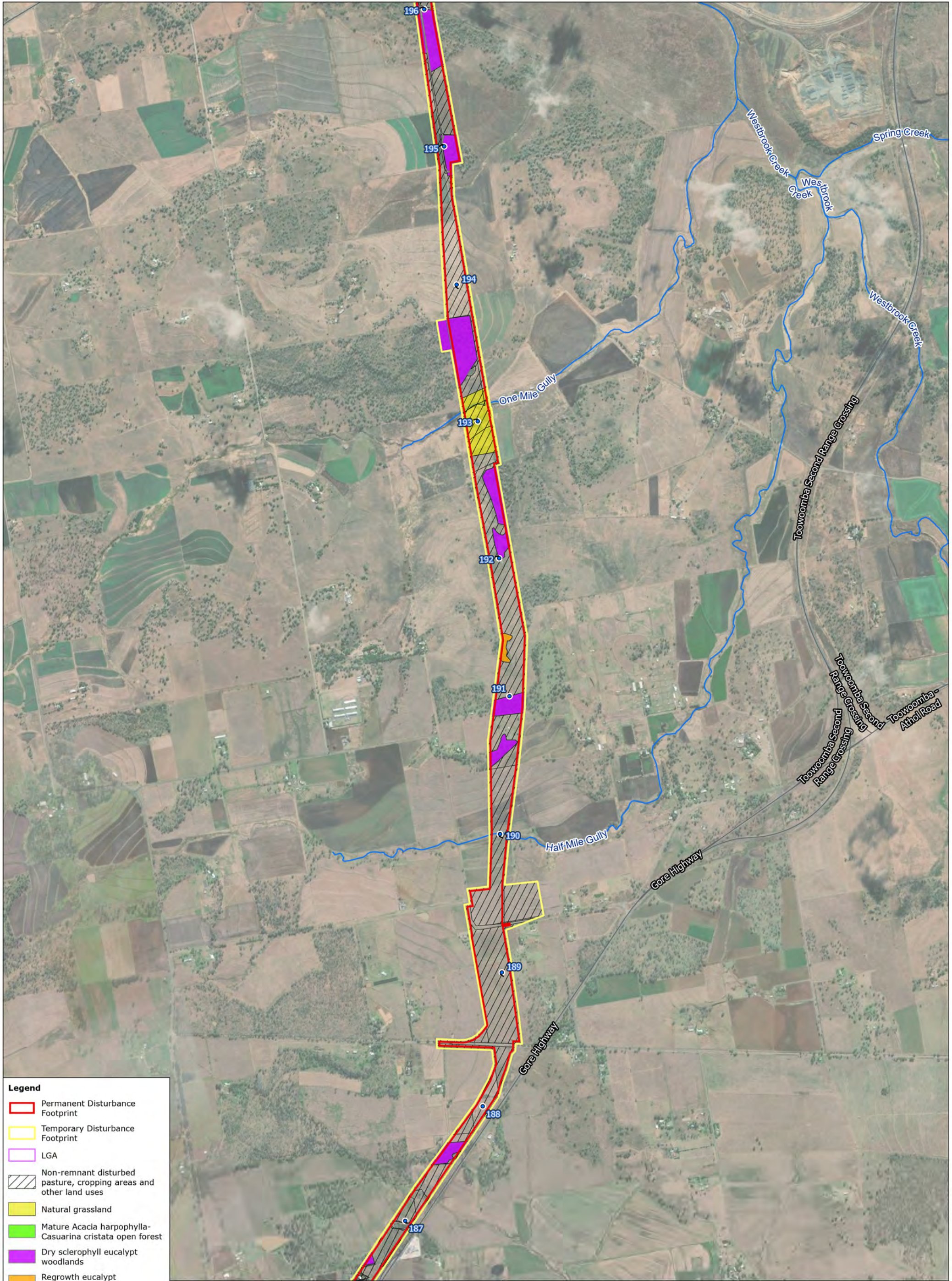
Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(27)- Location of Habitat Types Within the Project footprint

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Legend

Permanent Disturbance Footprint

Temporary Disturbance Footprint

LGA

Non-remnant disturbed pasture, cropping areas and other land uses

Natural grassland

Mature Acacia harpophylla-Casuarina cristata open forest

Dry sclerophyll eucalypt woodlands

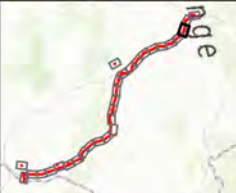
Regrowth eucalypt communities

Wetlands

Watercourse

State Forests

Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56

Date:
17/10/2024

Created By:
CB/VN

Drawing Size:
A3

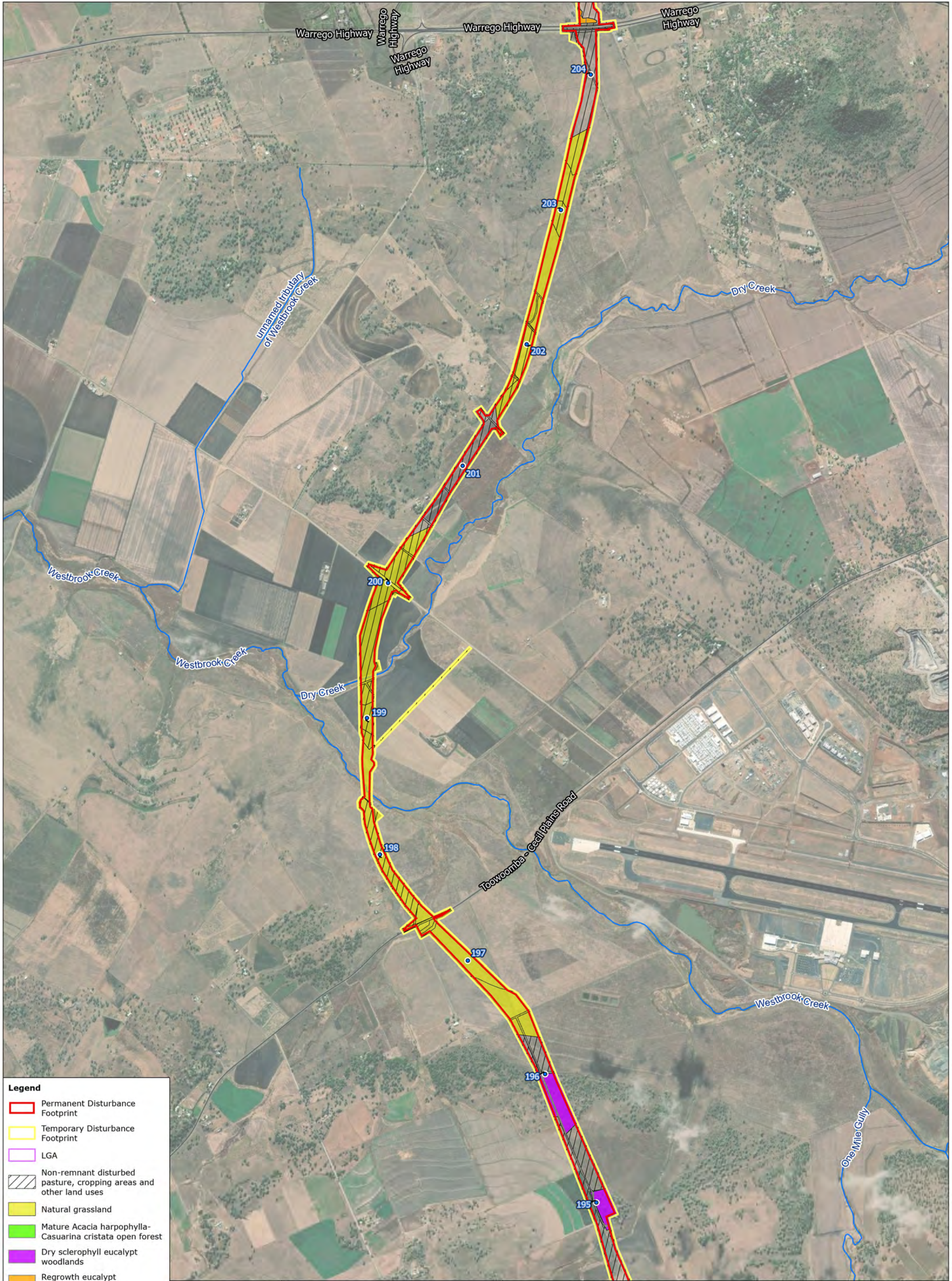
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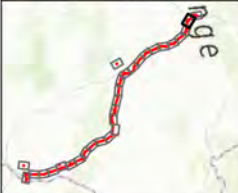
4.1(28)- Location of Habitat Types Within the Project footprint

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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



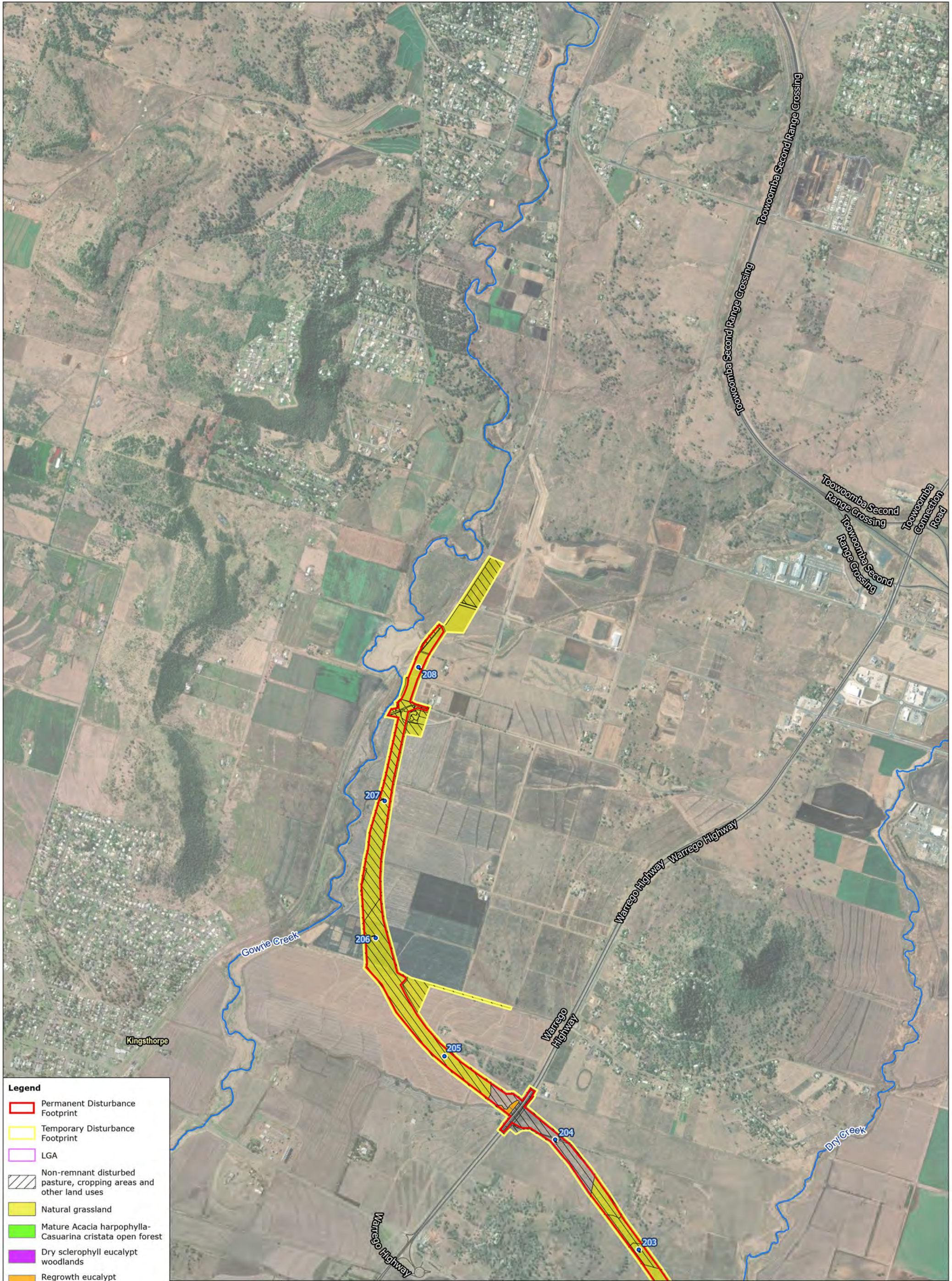
Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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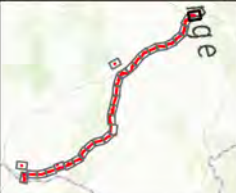
4.1(29)- Location of Habitat Types Within the Project footprint

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- Legend**
- Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - LGA
 - Non-remnant disturbed pasture, cropping areas and other land uses
 - Natural grassland
 - Mature Acacia harpophylla-Casuarina cristata open forest
 - Dry sclerophyll eucalypt woodlands
 - Regrowth eucalypt communities
 - Wetlands
 - Watercourse
 - State Forests
 - Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



4.1(30)- Location of Habitat Types Within the Project footprint

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ARTC



4.2 THREATENED ECOLOGICAL COMMUNITIES

4.2.1 DESKTOP ASSESSMENT RESULTS

The desktop assessment identified eight TECs with potential to occur within the Project footprint, namely:

- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Coolibah – black box woodlands of the Darling Riverine Plains and the Brigalow Belt South bioregions;
- Lowland rainforest of subtropical Australia;
- Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland;
- Poplar box grassy woodland on alluvial plains;
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions;
- Weeping Myall Woodlands; and
- White box-yellow box-Blakely's red gum grassy woodland and derived native grassland.

As the poplar box TEC was listed as endangered under the EPBC Act on 4 July 2019, after the controlled action decision date (9 April 2018), it will not be considered in this assessment. The other seven match those listed in the ToR for the Project.

4.2.2 FIELD SURVEY RESULTS

Four TECs were identified within the Study area during field surveys, of which three occur within the Project footprint (Table 4-2).

TABLE 4-2 LIKELIHOOD OF OCCURRENCE ASSESSMENT – THREATENED ECOLOGICAL COMMUNITIES

TEC	EPBC Act status	Desktop likelihood of occurrence	Field-verified likelihood of occurrence	Comments
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) ecological community	E	Potential	Known	103.69 ha identified within the Project footprint
Coolibah – black box woodlands of the Darling Riverine Plains and the Brigalow Belt South bioregions	E	Potential	Unlikely	No analogous REs were recorded within the Project footprint
Lowland rainforest of subtropical Australia	CE	Potential	Unlikely	No analogous REs were recorded within the Project footprint
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	CE	Potential	Known	66.07 ha identified within the Project footprint

TEC	EPBC Act status	Desktop likelihood of occurrence	Field-verified likelihood of occurrence	Comments
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions	E	Potential	Unlikely	No analogous REs were recorded within the Project footprint however 0.08 ha identified within the Study area
Weeping myall woodlands	E	Potential	Unlikely	11.3.2 was the only analogous RE recorded within the Project footprint. All areas of RE 11.3.2 were assessed.
White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands	CE	Potential	Known	2.54 ha identified within the Project footprint

Table notes:

CE = Critically endangered; E = Endangered

The nature and extent of the three TECs that were ground-truthed within the Project footprint are:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) (brigalow TEC) (Figure F2-1) – This TEC met the diagnostic criteria in patches of the following four REs, namely RE 11.3.1, RE 11.4.3, RE 11.4.10 and RE 11.9.5; where brigalow patches were >0.5 ha in size, and total vegetation cover consisting of <50% exotic perennial plants. Brigalow TEC within the Project footprint totals an area of 103.69 ha;
- Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland (natural grassland TEC) (Figure F2-2) – Within the Project footprint this TEC met the diagnostic criteria within two REs, namely RE 11.3.21 and RE 11.8.11, where patches aligned with the good quality and best quality criteria, totalling an area of 66.07 ha;
- White box-yellow box-Blakely's red gum grassy woodland and derived native grassland (box-gum grassy woodland TEC) (Figure F2-4) – Within the Project footprint this TEC met the diagnostic criteria within a patch of RE 11.9.9a, totaling an area of 2.54 ha.

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC) was identified within the Study area (Figure F2.3). Originally located within the Project footprint, this TEC met the diagnostic criteria within RE 11.8.3, totaling an area of 0.08 ha (It should be noted that the area of this TEC has been reduced by landholder clearing since the Cardno surveys in 2021 and Ausecology surveys in 2022 (stated as ~0.2 ha in Cardno, 2021 and 0.16 ha in Ausecology, 2022) as subsequent assessments surveyed the patch in more detail to assess its size and location more accurately in relation to the Project footprint and also as a result of clearing by the landholder). The Project footprint has since been adjusted to avoid SEVT TEC however it has been included for consideration in the significant impact assessment (Section 7.1.4).

The location and extent of TECs within the Project footprint is presented in Appendix F: Species and Community Profiles. Detailed information on the location and condition of TECs within the Project footprint is provided in the Ausecology (2022) and ERM (2024a) reports in Appendix A.

Extent and condition of the relevant TECs beyond the Project footprint were also subject to detailed field surveys to facilitate assessment of indirect impacts associated with the Project. Profiles related to each of the TECs, mapping produced by DCCEEW, approved conservation advice, relevant threat abatement/recovery plans and threatening processes are provided in Appendix F Species and Community Profiles.

4.3 FLORA

4.3.1 DESKTOP ASSESSMENT RESULTS

The desktop assessment identified a total of twenty-two EPBC Act listed threatened flora species with the potential to occur within the Project footprint (Appendix G). These species are listed in Table 4-3. Additionally, the ToR lists additional species, some of which have been assessed in the LoO as unlikely to occur, and therefore, are not considered in the impact assessment (refer to Appendix D). No threatened flora species were recorded during preliminary field surveys within the Study area.

TABLE 4-3 SUMMARY OF EPBC ACT THREATENED FLORA WITH THE POTENTIAL TO OCCUR IN THE PROJECT FOOTPRINT FROM DESKTOP ASSESSMENT

Scientific name	Common name	EPBC status	Desktop likelihood of occurrence
<i>Acacia lauta</i>	Tara wattle	V	Potential
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	Potential
<i>Bertya opposens</i>	Coolabah bertya	V	Potential
<i>Cadellia pentastylis</i>	Ooline	V	Potential
<i>Clematis fawcettii</i>	Stream clematis	V	Potential
<i>Dichanthium queenslandicum</i>	King bluegrass	E	Likely
<i>Dichanthium setosum</i>	Bluegrass	V	Potential
<i>Eucalyptus virens</i>	Shiny-leaved ironbark	V	Potential
<i>Homopholis belsonii</i>	Belson's panic	V	Known
<i>Lepidium monoplacoides</i>	Winged peppercress	E	Likely
<i>Lepidium peregrinum</i>	Wandering peppercress	E	Potential
<i>Macrozamia conferta</i>	-	V	Potential
<i>Macrozamia machinii</i>	Machin's macrozamia	V	Potential
<i>Picris evae</i>	Hawkweed	V	Known
<i>Rhaponticum australe</i>	Austral cornflower	V ⁱ	Likely
<i>Sophora fraseri</i>	Brush sophora	V	Potential

Scientific name	Common name	EPBC status	Desktop likelihood of occurrence
<i>Styphelia</i> sp. Coolmunda (D.Halford Q1635)	-	E	Potential
<i>Swainsona murrayana</i>	Slender Darling-pea	V	Potential
<i>Thesium australe</i>	Austral toadflax	V	Likely
<i>Vincetoxicum forsteri</i> (formerly known as <i>Tylophora linearis</i>)	-	E	Potential
<i>Westringia parvifolia</i>	Small-flowered westringia	V	Likely
<i>Xerothamnella herbacea</i>	-	E	Known

Table notes:

CE – Critically Endangered; E – Endangered; V – Vulnerable; NT – Near Threatened; SLC – Special Least Concern.

Controlled action date: 09.04.2018

¹ listed as *Leuzea australis*

4.3.2 FIELD SURVEY RESULTS

4.3.2.1 THREATENED FLORA

A total of seven threatened flora species listed under the EPBC Act were identified within the Project footprint during field surveys and one species (king bluegrass (*Dichanthium queenslandicum*)) was recorded adjacent to the Project footprint (0.8 m from the edge of the Project footprint).

Table 4-4 summarises the likelihood of occurrence assessments following desktop assessments and targeted field surveys and habitat assessments. Eight MNES species are known to occur, and a further four species were assessed as potentially occurring within the Project footprint. The remaining nine species identified in the desktop likelihood of occurrence (Table 4-3) were considered unlikely to occur within the Project footprint based on the field assessment results. Targeted surveys for *Westringia parvifolia*, *Xerothamnella herbacea*, *Lepidium monoplacoides*, *Thesium australe*, *Acacia lauta*, and *Eucalyptus virens* were conducted in the Project footprint and the surrounding landscape where historical records occur to better understand the population sizes and locations of these species. Preliminary results support the likelihood of occurrence outcome for *Acacia lauta* as potential and *Eucalyptus virens* as unlikely.

Further detailed results and discussion of the likelihood of occurrence of threatened species is provided in Appendix D: Likelihood of occurrence.

TABLE 4-4 EPBC ACT THREATENED SPECIES FIELD VERIFIED LIKELIHOOD OF OCCURENCE

Scientific name	Common name	EPBC Act status	Desktop likelihood of occurrence	Field-verified likelihood of occurrence
<i>Acacia lauta</i>	Tara wattle	V	Potential	Potential
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	Potential	Potential
<i>Clematis fawcettii</i>	Stream clematis	V	Potential	Potential

Scientific name	Common name	EPBC Act status	Desktop likelihood of occurrence	Field-verified likelihood of occurrence
<i>Dichanthium queenslandicum</i>	King bluegrass	E	Likely	Known
<i>Dichanthium setosum</i>	Bluegrass	V	Potential	Potential
<i>Homopholis belsonii</i>	Belson's panic	V	Known	Known
<i>Lepidium monoplacoides</i>	Winged peppergrass	E	Likely	Known
<i>Picris evae</i>	Hawkweed	V	Known	Known
<i>Rhaponticum australe</i> ¹	Austral cornflower	V	Likely	Known
<i>Thesium australe</i>	Toadflax	V	Likely	Known
<i>Westringia parvifolia</i>	Small-flowered westringia	V	Likely	Known
<i>Xerothamnella herbacea</i>	-	E	Known	Known

Table notes:

E = Endangered; V = Vulnerable

Note: NC Act listed species are considered and assessed in accordance with their listing status at the time the latest survey efforts were undertaken, 17 March 2022.

¹ listed as *Leuzea australis*

Species locations and population counts within the Project footprint is detailed in Appendix A: Additional Ecological Investigations. Information related to the ecology, biology, distribution and habitat mapping within the Project footprint for threatened flora species known, likely or with the potential to occur within the Project footprint is provided in Appendix F: Species and Community Profiles.

4.3.2.2 RESTRICTED MATTERS

A total of 121 introduced flora species were identified during the Project field investigations (Appendix H). Weeds were prevalent across the Project footprint; however, highest densities were recorded in areas subject to anthropogenic disturbance such as roadsides, areas subject to cattle grazing and along fence lines.

Eight Category 3 restricted matter flora species (under the Biosecurity Act (QLD)) were identified within the Project footprint (Table 4-5). Of these species, six species are also listed as Weeds of National Significance (WoNS).

TABLE 4-5 RESTRICTED MATTERS IDENTIFIED WITHIN THE PROJECT FOOTPRINT

Species name	Common name	WoNS	Schedule 2 of the Biosecurity Act*
<i>Bryophyllum delagoense</i>	Mother-of-millions	Yes	Category 3
<i>Eichhornia crassipes</i>	Water hyacinth	Yes	Category 3
<i>Harrisia martinii</i>	Harrisia cactus	No	Category 3

Species name	Common name	WoNS	Schedule 2 of the Biosecurity Act*
<i>Lantana camara</i>	Lantana	Yes	Category 3
<i>Lantana montevidensis</i>	Creeping lantana	No	Category 3
<i>Opuntia aurantiaca</i>	Tiger pear	Yes	Category 3
<i>Opuntia stricta</i>	Prickly pear	Yes	Category 3
<i>Opuntia tomentosa</i>	Velvety tree pear	Yes	Category 3

Table notes:

* Category 3 = includes noxious fish, weeds, and pest animals.

4.4 FAUNA

4.4.1 DESKTOP ASSESSMENT RESULTS

The desktop assessment identified a total of twenty-three threatened fauna species with the potential to occur within the Project footprint (Appendix G). These species are:

- Regent honeyeater (*Anthochaera Phrygia*) listed as Critically Endangered;
- Australasian bittern (*Botaurus poiciloptilus*) listed as Endangered;
- Curlew sandpiper (*Calidris ferruginea*) listed as Critically Endangered;
- Squatter pigeon (southern) (*Geophaps scripta scripta*) listed as Vulnerable;
- Painted honeyeater (*Grantiella picta*) listed as Vulnerable;
- Swift parrot (*Lathamus discolor*) listed as Critically Endangered;
- Australian painted snipe (*Rostratula australis*) listed as Endangered;
- Black-breasted button-quail (*Turnix melanogaster*) listed as Vulnerable;
- Large-eared pied bat (*Chalinolobus dwyeri*) listed as Vulnerable (uplisted to Endangered effective 15/11/2023);
- Spotted-tailed quoll (southeastern mainland population) (*Dasyurus maculatus maculatus*) listed as Endangered;
- South-eastern long-eared bat (*Nyctophilus corbeni*) listed as Vulnerable;
- Greater glider (southern and central) (*Petauroides volans*) listed as Vulnerable (uplisted to Endangered effective 05/07/2022);
- Brush-tailed rock-wallaby (*Petrogale penicillate*) listed as Vulnerable;
- Koala (*Phascolarctos cinereus*) listed as Vulnerable (uplisted to Endangered effective 12/02/2022);
- Grey-headed flying-fox (*Pteropus poliocephalus*) listed as Vulnerable;
- Five-clawed worm-skink (*Anomalopus mackayi*) listed as Vulnerable;
- Collared delma (*Delma torquata*) listed as Vulnerable;
- Yakka skink (*Egernia rugosa*) listed as Vulnerable;
- Dunmall's snake (*Furina dunmalli*) listed as Vulnerable;
- Condamine earless dragon (*Tympanocryptis condaminensis*) listed as Endangered;
- Murray cod (*Maccullochella peelii*) listed as Vulnerable;

- Brigalow woodland snail (*Adclarkia cameroni*) listed as Endangered; and
- Dulacca woodland snail (*Adclarkia dulacca*) listed as Endangered.

The following species were recorded during preliminary field surveys within the Project footprint:

- Grey-headed flying-fox (*Pteropus poliocephalus*) was observed at a camp located on Macintyre Brook next to the township of Inglewood. This is a known flying-fox camp and approximately 200 to 300 individuals were present at the time;
- Condamine earless dragon (*Tympanocryptis condaminensis*) was identified in an existing rail reserve located between Millmerran and Brookstead. Potential grassland on cracking clay habitat suitable for the species was identified throughout the area; and
- Murray cod (*Maccullochella peelii*) was recorded in the Macintyre River and Macintyre Brook during targeted surveys in 2019 and Canning Creek in 2023. Suitable habitat for the species was identified as present on the waterways intersected by the Project within the Condamine River floodplain.

4.4.2 FIELD SURVEY RESULTS

4.4.2.1 THREATENED FAUNA

A total of seven threatened fauna species were identified within the Project footprint during field surveys and an additional six threatened fauna species are considered likely to occur within the Project footprint (Table 4-6). Ten species are considered either potential or likely to occur within the Project footprint based on the results of targeted field surveys and RE/habitat mapping within the Project footprint (Table 4-6). Additionally, 11 species were considered unlikely to occur within the Project footprint based on the desktop assessment and reconfirmed by the field assessment results (Appendix A and Appendix D). These species have not been assessed further.

The greater glider (southern and central) was initially considered to be likely to occur, however following a targeted survey in December 2023 by ERM (2024a) they have been identified as being potentially occurring. Most sites that were previously considered to be greater glider (southern and central) habitat by Ausecology (2022) were identified as unsuitable habitat under new guidelines (Eyre et al., 2022). Three sites were identified as suitable habitat; however, it is likely that these sites are not accessible by individuals due to low connectivity. Further detailed results from this survey can be found in Appendix A: Additional Ecological Investigations.

Supplementary surveys around the Project footprint and on potential offset properties have been conducted (with some ongoing). Capture, tracking, incidental and other observations of threatened fauna species have been recorded during these surveys. These records have been added into the likelihood of occurrence and species profiles for the relevant species and in some instances changed the determination for the species. The majority of these observations were outside of the Project footprint. Species recorded incidentally or during these surveys but not during other ecological survey included:

- Squatter pigeon (southern) on the Canning Creek potential offset property;
- Australian painted snipe on the Glenlovely potential offset property;
- Spotted-tailed quoll in Bringalily State Forest (~4.5 km from the Project footprint); and
- Dunmall's snake in Bringalily State Forest (within the Project footprint).

Seven potential borrow pit sites at six locations were surveyed for the presence of MNES; however, no MNES were recorded. These surveys were inclusive of access track disturbance areas.

Further detailed results and discussion of the likelihood of occurrence of threatened species is provided in Appendix D. Information related to the ecology, biology, and distribution for threatened fauna species known, likely or with the potential to occur within the Project footprint is provided in Appendix F Species and Community Profiles.

TABLE 4-6 LIKELIHOOD OF OCCURRENCE ASSESSMENT FOLLOWING FIELD SURVEYS - THREATENED FAUNA SPECIES

Scientific name	Common name	EPBC Act status	Desktop likelihood of occurrence	Field verified likelihood of occurrence
Birds				
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	Potential	Potential
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	Likely	Likely
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	Potential	Potential
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	Likely	Likely
<i>Grantiella picta</i>	Painted honeyeater	V	Likely	Known
<i>Lathamus discolor</i>	Swift parrot	CE	Potential	Potential
<i>Rostratula australis</i>	Australian painted snipe	E	Potential	Likely
<i>Turnix melanogaster</i>	Black-breasted button quail	V	Potential	Unlikely
Mammals				
<i>Chalinolobus dwyeri</i>	Large-eared pied bat	V ³	Potential	Unlikely
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll	E	Likely	Likely
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	Likely	Known
<i>Petauroides volans</i>	Greater glider (southern and central)	V ²	Likely	Potential
<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	V	Potential	Unlikely
<i>Phascolarctos cinereus</i>	Koala	V ¹	Likely	Known
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V	Likely	Known
Reptiles				
<i>Anomalopus mackayi</i>	Five clawed worm-skink	V	Likely	Likely
<i>Delma torquata</i>	Collared delma	V	Potential	Potential
<i>Egernia rugosa</i>	Yakka skink	V	Potential	Potential
<i>Furina dunmalli</i>	Dunmall's snake	V	Likely	Known
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	Likely	Known

Scientific name	Common name	EPBC Act status	Desktop likelihood of occurrence	Field verified likelihood of occurrence
Fish				
<i>Maccullochella peelii</i>	Murray cod	V	Likely	Known
Invertebrates				
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	Potential	Known
<i>Adclarkia dulacca</i>	Dulacca woodland snail	E	Potential	Unlikely

Table notes:

CE = Critically endangered; E = Endangered; V = Vulnerable

Note: NC Act listed species are considered and assessed in accordance with their listing status at the time the latest survey efforts were undertaken, 17 March 2022.

¹ Koala uplisted to Endangered effective 12 February 2022, after controlled action date.

² Greater glider (southern and central) uplisted to Endangered effective 5 February 2022, after controlled action date.

³ Large-eared pied bat uplisted to Endangered effective 15 November 2023, after controlled action date.

Suitable habitat for these species has been ground-truthed for the Project footprint and habitat mapping within the Project footprint is presented in Appendix F: Species and Community Profiles. Additionally, all records of species locations and population counts within the Project footprint is detailed in Appendix A: Additional Ecological Investigations.

4.4.2.2 BREEDING HABITAT

The presence of potential animal breeding habitat is widespread throughout the Project footprint and include microhabitat features that have potential to provide breeding places for a diversity of native fauna species. Microhabitat features ranged from observed nests, fallen woody debris, hollows, cracks and crevices in trees, burrows, termite mounds, dense wetland vegetation, and rocky outcrops/piles.

Hollows were observed to be the most abundant habitat feature, ranging from small (2 cm) to large (>20 cm) sized hollows. Smaller hollows have potential to provide habitat for hollow-breeding microbats, birds, and reptiles. The larger hollows have potential to be utilised by threatened fauna species including greater glider (southern and central) (*Petauroides volans*) and south-eastern long-eared bat (*Nyctophilus corbeni*).

Other microhabitat features such as fallen bark, leaf litter and soil cracks could not be quantified, however, provide potential habitat for EPBC Act listed reptiles.

4.4.2.3 RESTRICTED MATTERS

Nine non-native fauna species declared as restricted matters (invasive animals) under the Biosecurity Act (QLD), were identified within the Project footprint during field investigations (Appendix A and Appendix H). These species were widespread across the entire Study area (Table 4-7).

The Project intersects the Darling Downs Moreton Rabbit Board (DDMRB) rabbit-proof fence at approximate Ch 120.2 km, when traversing through the locality of Clontarf.

TABLE 4-7 RESTRICTED MATTER FAUNA SPECIES IDENTIFIED WITHIN THE PROJECT FOOTPRINT

Species name	Common name
<i>Canis lupus dingo</i>	Dingo
<i>Canis lupus familiaris</i>	Dog
<i>Cyprinus carpio</i>	European carp
<i>Felis catus</i>	Cat
<i>Gambusia holbrooki</i>	Mosquitofish
<i>Lepus europaeus</i>	Hare
<i>Oryctolagus cuniculus</i>	Rabbit
<i>Sus scrofa</i>	Feral pig
<i>Vulpes vulpes</i>	European fox

4.5 HABITAT FOR MNES WITHIN THE PROJECT FOOTPRINT

Habitat for three TECs, 12 threatened flora species and 19 threatened fauna species considered known, likely or with potential to occur has been ground-truthed, mapped and quantified within the Project footprint (Table 4-8 and Table 4-9). Habitat definitions and habitat mapping for MNES known, likely or with potential to occur within the Project footprint is provided in Appendix F Species and Community Profiles.

TABLE 4-8 GROUND-TRUTHED THREATENED ECOLOGICAL COMMUNITIES WITHIN THE PROJECT FOOTPRINT

TEC	EPBC Act status	Total area (ha)
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	E	103.69
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	CE	66.07
White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands	CE	2.54

Table notes:

CE = Critically endangered; E = Endangered

TABLE 4-9 GROUND-TRUTHED HABITAT FOR THREATENED FLORA AND FAUNA SPECIES WITHIN THE PROJECT FOOTPRINT

Species name	Common name	EPBC Act status	Ground-truthed habitat within the Project footprint (ha)
Threatened flora species			
<i>Acacia lauta</i>	Tara wattle	V	410.00

Species name	Common name	EPBC Act status	Ground-truthed habitat within the Project footprint (ha)
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	13.13
<i>Clematis fawcettii</i>	Stream clematis	V	2.27
<i>Dichanthium queenslandicum</i>	King bluegrass	E	50.31 (on edge of footprint)
<i>Dichanthium setosum</i>	Bluegrass	V	260.52
<i>Homopholis belsonii</i>	Belson's panic	V	242.25 (~100 individuals)
<i>Lepidium monolocoides</i>	Winged peppergrass	E	79.86 (~180 individuals)
<i>Picris evae</i>	Hawkweed	V	110.67 (~448,842 individuals)
<i>Rhaponticum australe</i>	Austral cornflower	V	83.49 (~164 individuals)
<i>Thesium australe</i>	Austral toadflax	V	46.44 (~474 individuals)
<i>Westringia parvifolia</i>	Small-flowered westringia	V	27.19 (~214 individuals)
<i>Xerothamnella herbacea</i>	-	E	11.99 (~70 individuals)
Threatened fauna species			
Birds			
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	285.01
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	7.91
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	Not mapped ¹
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	- Breeding habitat – 166.89 - Foraging habitat – 254.53 Total habitat – 421.42
<i>Grantiella picta</i>	Painted honeyeater	V	330.66
<i>Lathamus discolor</i>	Swift parrot	CE	Foraging habitat only – 614.93
<i>Rostratula australis</i>	Australian painted snipe	E	7.91
Mammals			
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (SE mainland population)	E	- High quality – 259.93 - Low quality – 127.55 Total habitat – 387.48
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	- Roosting habitat – 301.28 - Foraging habitat – 394.97 Total habitat – 696.25

Species name	Common name	EPBC Act status	Ground-truthed habitat within the Project footprint (ha)
<i>Petauroides volans</i>	Greater glider (southern and central)	V	- Breeding/denning habitat – 1.60 - Foraging habitat – 14.37 Total habitat – 15.97
<i>Phascolarctos cinereus</i>	Koala	V	- Breeding and foraging habitat – 769.40 - Dispersal habitat – 593.13 Total habitat – 1,362.53
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V	Foraging habitat only – 788.39
Reptiles			
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	V	241.61
<i>Delma torquata</i>	Collared delma	V	36.83
<i>Egernia rugosa</i>	Yakka skink	V	241.13
<i>Furina dunmalli</i>	Dunmall's snake	V	262.69
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	51.20
Fish			
<i>Maccullochella peelii</i>	Murray cod	V	60.50
Invertebrates			
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	146.72

Table notes:

CE = Critically endangered; E = Endangered; V = Vulnerable

1. Habitat for the curlew sandpiper was not ground-truthed as it is a migratory species that could potentially utilise large areas during flood events, but would be unlikely to use the small permanent wetland areas present the Project footprint due to their size.

5. POTENTIAL IMPACTS

This section discusses the Project activities, by phase, that have potential to result in impacts to MNES. Descriptions of specific direct and indirect impacts that may occur are also provided.

Potential impacts to MNES may occur during all applicable Project stages subject to determination under the EPBC Act including pre-construction and early works, construction, and commissioning and operations. The potential impacts and affected MNES are summarised in Table 5-1. This section outlines unmitigated potential impacts to MNES associated with the Project. Whether each pathway is a direct or indirect impact may be unclear at times, however the purpose of this table is to recognise all potential impact pathways.

TABLE 5-1 SUMMARY OF UNMITIGATED IMPACTS AND AFFECTED MNES MATTERS

Potential impact pathways	Impact type	MNES		
		TECs	Flora	Fauna
Habitat loss from vegetation clearing/removal	Direct and indirect	Yes	Yes	Yes
Fauna species injury or mortality	Direct	No	No	Yes
Reduction in biological viability of soil to support plant growth	Direct	Yes	Yes	No
Invasion of weeds, pathogens and pest species	Indirect	Yes	Yes	Yes
Habitat fragmentation	Indirect	Yes	Yes	Yes
Reduction in the connectivity of biodiversity corridors	Indirect	No	Yes	Yes
Barrier effects	Indirect	No	Yes	Yes
Edge effects	Indirect	Yes	Yes	Yes
Traffic and transport	Direct and indirect	No	No	Yes
Noise and vibration	Indirect	No	No	Yes
Dust	Indirect	Yes	Yes	Yes
Lighting	Indirect	No	No	Yes
Contamination	Indirect	Yes	Yes	Yes
Changes to groundwater resources	Indirect	Yes	Yes	No
Waste management	Indirect	No	No	Yes
Aquatic habitat degradation	Indirect	No	No	Yes
Erosion and sedimentation	Indirect	Yes	Yes	Yes
Flooding	Indirect	Yes	Yes	Yes

5.1 PROJECT ACTIVITIES

Activities proposed as part of the Project that may impact on MNES have been categorised into two phases: pre-construction and construction, and commissioning and operation.

The Project encompasses intricate construction elements such as large bridges, highway upgrades, road crossings, and brownfield Queensland Rail works, necessitating detailed construction and logistics management. While the overall construction program spans four years, the staging and sequencing of these major elements will result in varying degrees of site disturbance on a discipline and section-specific basis, with durations varying accordingly (refer to Table 5-2). This variability arises from multiple concurrent work fronts involving earthwork and structural crews mobilizing across different segments of the Project footprint, incorporating considerations like mass-haul logistics, concrete production, interfaces, long lead items, and staging logistics.

Adjustments to construction sequences will be explored during the detailed design stage to optimise program efficiency, ensure design constructability, manage resource availability, respond to local conditions (including weather and industry factors), and coordinate with adjacent Inland Rail projects.

A summary of Project related activities for each Project phase is provided in Table 5-2. The durations listed for each disturbance activity have been classified as per the *Queensland EIS Guideline* (DSDI, 2024), as no such schedule is listed in the Commonwealth documentation.

TABLE 5-2 SUMMARY OF PROJECT RELATED ACTIVITIES ASSOCIATED WITH CONSTRUCTION, COMMISSIONING AND OPERATION

Phase	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
Pre-construction and construction	Site preparation (relating to all work sites)	Vegetation clearing	Permanent
		Topsoil stripping	Medium term
		Construction of temporary site compounds including fencing	Medium term
		Construction of rail access roads	Permanent
		Installation of boreholes and construction water storage	Medium term
		Installation of offices, hardstands, etc.	Medium term
		Stockpiling	Medium term
		Establishment of initial laydown areas	Medium term
		Establishment of temporary drainage infrastructure (e.g., sediment ponds)	Medium term
		Borrow pit establishment and excavation of fill	Medium term
	Additional surveys	Potential further geotechnical investigations	Short term
	Traffic and transport	Delivery of materials to the Project footprint	Medium term
		Movement of workforce	Medium term

Phase	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
		Transportation/collection of plant, equipment and other machinery	Medium term
		Delivery of non-resident workforce accommodation cabins to site	Medium term
		Rail-to-road diversions due to track closures	Medium term
	Fencing	Modification of biosecurity fencing	Long term
		Installation of boundary fencing	Short term
	Relocation of QR assets and utilities / services	Moving / protection of QR assets	Medium term
		Establishing utilities and services	Medium term
	Accommodation	Establishment of non-resident workforce accommodation	Medium term
	Utility diversions	Excavation	Short term
		Trenching	Short term
		Modification, diversion and realignment of utilities and associated infrastructure	Short term/medium term
	Drainage	Installation of drainage infrastructure (culverts, longitudinal drainage, scour).	Permanent
	Structures	Construction of waterway crossings (bridges and piers)	Permanent
		Road/rail bridge construction	Permanent
	Civil works	Earthworks and embankment construction involving excavation for cuts, cut to fill, importation of fill from quarries and other external sources where required and bank stabilisation.	Medium term
		Construction of temporary haul roads	Medium term
	Road works	Road realignment	Permanent
		Construction of permanent rail maintenance access roads	Permanent
	Rail logistics	Sleeper stockpiling	Medium term
		Rail stockpiling	Medium term
	Rail construction	Drilling	Short term

Phase	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
		Ballast installation	Short term
		Sleeper placement	Long term
		Rail placement	Permanent
		Installation of train signals and communications infrastructure	Long term
		Demobilising site compounds	Short term
	Signals and communications installation	Installation of telecommunications and signalling infrastructure.	Short term
	Demobilisation	Temporary site offices, accommodation facilities, laydowns, fencing, stockpile areas, temporary drainage, concrete batch plants, and associated facilities removed. Construction sites, borrow pits, compounds, and access routes will be reinstated or rehabilitated progressively once available.	Short term
		Removal of temporary waterway crossings as soon as they are no longer needed to support construction works.	Short term
		Decommissioning and decontamination of any impact areas (e.g. around fuel transfer locations)	Short term
		Stabilisation of landforms	Permanent
		Progressive establishment of permanent fencing	Short term
		Decommissioning of access roads no longer required	Short term
Commissioning and operation	Testing and commissioning	Testing and checking of the rail line and communication / signalling systems	Short term
	Training	Driver training and test trains	Short term
	Train operations	Train movement along railway	Permanent
	Operational maintenance works	Ongoing vehicle movement within railway corridor	Long term
		Minor maintenance works: - Bridge inspections - Culvert cleanout - Sleeper replacement - Rail welding and grinding - Ballast profile management	Short term

Phase	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
		- Track tamping - Vegetation management – slashing/clearing	
		Major periodic maintenance: - Ballast cleaning - Formation work - Reconditioning of track - Adjustment - Turnout replacement - Correction of track level and line - Maintenance of structures including waterproofing, jointing.	Short term

Table note:

*Duration of disturbance timeframes (DSDI, 2024):

- Short term – up to 12 months
- Medium term – from 1 to 3 years
- Long term – from 3 to 100 years
- Permanent.

5.2 POTENTIAL IMPACTS TO TERRESTRIAL ECOLOGICAL VALUES

5.2.1 HABITAT LOSS THROUGH CLEARING

Vegetation clearing will occur during the pre-construction and construction phases and will result in the loss of available habitat for MNES within the Project footprint. The impact may be direct in the form of vegetation and habitat removal, or indirect as fauna and flora diversity may decline due to shortages in available habitat resources. Small-scale clearing within largely intact patches of vegetation can cause localised depletion of some species (Kutt et al., 2012) and is particularly relevant to species with small home ranges or limited ability to disperse (e.g. five-clawed worm-skink).

The Project footprint encompasses a total of 3,382.17 ha, with 2,544.86 ha being within the permanent footprint and 837.31 ha being temporarily disturbed. Ground-truthed vegetation mapping indicates that the Project footprint comprises 570.75 ha of remnant vegetation, 16.48 ha of mature regrowth vegetation, 270.92 ha of immature regrowth vegetation and 2,524.02 ha of non-remnant areas.

An assessment of the significance of impacts associated with vegetation clearing on each of the relevant MNES is provided in Section 7.

5.2.2 FAUNA SPECIES INJURY OR MORTALITY

Physical trauma to MNES fauna species causing injury or mortality may occur through:

- Vegetation clearing;
- Vehicle strike related to construction or maintenance traffic (both onsite and offsite);
- Fauna being trapped in trenches or other excavations;
- Barbed wire entanglement;
- Construction within waterways that may impact on aquatic fauna; and

- Train strike during the operational phase.

Physical trauma has the potential to reduce local population size and create "source/sink" dynamics (i.e. increase or decrease in population size due to birth, immigration, death and emigration rates), but this may not necessarily alter population size (Furrer and Pasinelli, 2016). However, changes in mortality rate can affect population viability and may be a critical factor in a fragmented landscape where population sizes are small and/or poorly connected. The impact of mortality on population viability is particularly pronounced for longer-lived, slow breeding species, such as the koala (*Phascolarctos cinereus*) (i.e. K-selected species) and is less pronounced in those species with high fecundity and generally shorter lifespans, such as spotted-tailed quoll (*Dasyurus maculatus maculatus*) (i.e. R-selected species) (Oli, 2004).

The revised reference design has considered fauna movement pathways with the aim of minimising the amount of fauna injury/mortality that will occur as a result of the Project. However, physical trauma has the potential to occur during all phases of the Project, in following sections.

5.2.2.1 VEGETATION CLEARING, EARTHWORKS AND TRENCHING

The highest potential likelihood of physical trauma to fauna is during construction activities within the Project footprint, that involve vegetation clearing, earthworks and trenching. The potential impact will be proportionate to the extent of vegetation and habitat potential for fauna that is removed.

Some diurnal (active during the day) and mobile species, such as birds, may move away from areas being disturbed and may not be adversely affected unless they are nesting. However, less mobile species (i.e. ground-dwelling reptile and mammal species), species restricted to constrained habitats (i.e. aquatic species), or those that are nocturnal and nest or roost in trees or tree hollows during the day (i.e. arboreal mammals such as listed gliders and koala), may find it difficult to move away from roosts or active breeding places.

Entrapment of fauna in trenches or other excavations may also cause physical trauma to fauna. Open trenches for underground utilities, or other pits are known to be effective at trapping a wide variety of wildlife and often result in mortality (Ayers and Wallace, 1997; Doody et al., 2003; Woinarski et al., 2006). Species most susceptible are ground dwelling species that can move across modified areas, e.g. Condamine earless dragon (*Tympanocryptis condaminensis*) and arboreal species which descend to the ground to disperse such as koala (*Phascolarctos cinereus*).

5.2.2.2 VEHICLE STRIKE

Vehicle collision is a direct impact that reduces local fauna population numbers and is a common occurrence in Australia (Coffin, 2007; Rowden et al., 2008; DMTR, 2024). The construction of tracks, the general use of access tracks and roads within the Project footprint and increase in traffic across the broader region because of the Project construction, will result in increased potential for vehicle strike (Rhodes et al., 2014; Found and Boyce, 2011). There may be increased risk around concentrated areas such as laydown areas and camps. In addition, once operational, train strike may also occur.

Mammals, reptiles, amphibians, and birds are all at risk of vehicle strike and/or those species that can utilise roads for movement pathways, basking, or as foraging habitat. Species such as the greater glider (southern and central) (*Petauroides volans*) may be struck by trains during

periods of dispersal and movement (e.g. whist gliding over the alignment). This would only be the case where the Project intersects with the glide or fly path of species in predicted habitat (i.e. not in locations of high embankments, bridges, or cuttings).

The impact of vehicle strike is the most apparent during breeding season (Yokochi and Bencini, 2015; Blackwell et al., 2016), particularly for species with low or patchy population densities (e.g. spotted-tailed quoll (*Dasyurus maculatus maculatus*)). As a result of low population densities, individuals are required to travel further to find suitable mates, potentially intersecting with more roads and increasing the risk of vehicle strike (Farmer and Brooks, 2012). However, vehicle strike is a significant risk to MNES throughout the construction phase of the Project due to increased traffic.

Within the Condamine floodplain region of the Project footprint, while there is limited corridor fencing proposed due to flooding constraints, the drainage design in this area includes oversize culverts and bridges very closely spaced throughout the floodplain due to the need to cater for the large amounts of overland flow. This series of continuous drainage infrastructure will facilitate safe passage of fauna across the floodplain, as well as some species being able to freely traverse the floodplain without the need to access specific crossing infrastructure.

5.2.2.3 FENCE ENTANGLEMENT

The use of fauna fencing is one mechanism that would be implemented for the Project to reduce the likelihood of interaction between vehicles (including trains) and fauna species. By reducing the likelihood of interaction between fauna and vehicles, impacts to individual fauna (and population numbers) can be minimised. However, fauna entanglement within pest exclusion fencing or barbed wire fences is a known hazard for a large range of wildlife, in particular flying-foxes, gliders, macropods, waterbirds, and nocturnal birds. Wildlife flies, hops, glides or walk into barbed wire fences, becoming entangled and succumbing to exposure or predation. Several species were recorded deceased on barbed wire fences during surveys including little red flying-foxes, black flying-foxes and white-faced heron. Entanglements are possible on all barbed wire fences, regardless of surrounding water or vegetation, with deceased flying-foxes located on fences intersecting cleared paddocks.

Due to the length to be constructed, fauna exclusion fencing associated with the Project has the potential to cause widespread mortality and injury to a large variety of species. As the Project comprises substantial greenfield works in rural agricultural and grazing areas, standard rural fencing will typically be provided according to ARTC fencing procedure, Boundary Fencing ETM-17-02 (available on the ARTC Extranet: extranet.artc.com.au).

Where ARTC propose to construct within the QR corridor for all returned works (South Western Line and Millmerran Branch Line), ARTC will comply with QR standards; this includes new and replacement fencing.

All existing fencing is proposed to be removed and replaced. Where ARTC are proposing to construct new railway corridor that coincides with road manager or landowner fencing, this will be replaced typically with reference to the ARTC fencing procedure, Boundary Fencing ETM-17-02. Where superior fencing is required, for example where tracks are in close proximity to roads and/or communities, or where trespass is anticipated to occur, a 1.8 m chain link boundary fence may be provided.

Feedback from adjacent landowners indicates that fencing on the Condamine River floodplain:

- Increases the risk of debris being trapped on the fence and causing blockage, potentially exacerbating the risk of flooding impacts and resulting in ongoing maintenance issues; and
- Can be washed away in flood events, causing issues to downstream properties and infrastructure and subsequently requires re-instatement.

Based on this consultation feedback, fencing of the rail corridor has not been included in the revised reference design across floodplain areas. Instead, guideposts or other alternative means of rail corridor boundary protection will be installed in order to demarcate the rail corridor and deter access to the rail corridor. The track elevation through these areas will also act as a deterrent to trespass or livestock access to the railway, where this may otherwise occur.

Gates will be provided at suitable corridor entry/exit locations to allow convenient access to infrastructure for maintenance purposes. This extends to private level crossings and stock crossings. Fencing returns will be installed at bridge abutments and drainage or fauna crossing culverts. Fencing across small waterways will be designed to avoid storm damage and to retain effective stock control.

The existing wild dog check fence (WDCF) will be reinstated at the three locations of impact on a like-for-like basis in consultation and agreement with the with relevant stakeholders, notably DES, impacted landholders and lessees, DAF, and GRC. DAF consultation is required before any amendments to the wild dog check fence under Section S91(3) of the *Biosecurity Act 2014* (Qld).

5.2.3 REDUCTION IN BIOLOGICAL VIABILITY OF SOIL

Project activities can lead to soil compaction which may result in a reduction in biological viability of soils to support plant growth. Compaction of soil and loss of topsoil may result in direct impacts to soil consistency (i.e. the strength and coherence of a soil) and soil structure (i.e. the arrangement of soil particles). The most direct effect of soil compaction is restriction of plant root growth and function. Due to the increase in bulk density, large pores essential for water and air movement in soil are primarily affected. As a result, the effects of soil compaction may negatively impact TECs and threatened flora species. However, soil compaction will be limited to the Project footprint and will not impact uncleared areas outside the Project footprint.

The loss of nutrient rich topsoil as a result of Project activities may also impact the ability of the soil to support flora. Reduction in soil viability and nutrient loss associated with erosion, especially topsoil, may negatively impact TECs and threatened flora species. Impacts to soil may also have flow on effects to MNES fauna through degradation of their associated habitat. This impact may extend outside the Project footprint if erosion is unmitigated.

5.2.4 INTRODUCTION AND SPREAD OF WEEDS, PATHOGENS AND PEST SPECIES

Weeds, pathogens and pest species have the potential to impact terrestrial and aquatic biodiversity through health impacts, predation and competition. Pest species can also damage native vegetation by grazing and trampling (Adair and Groves, 1998; Clarke et al., 2000; Thorp and Lynch, 2011). Accordingly, it is possible that proliferation of weed, pathogen and pest species may reduce the extent of available habitat and hence population size for specific threatened flora and fauna species. This may have the effect of increasing mortality and reducing the size and viability of population sizes through resource limitation and associated stresses. Pathogens have the potential to impact on flora directly (i.e. Myrtle rust or

Phytophthora), fauna directly (i.e. beak and feather disease) and/or the quality of habitat for flora and fauna species. This may have the effect of increasing mortality and reducing the size and viability of populations through resource limitation and associated stresses.

Proliferation of weed and pest species has the potential to occur during all phases of the Project. However, colonization potential is increased during vegetation clearing and soil disturbance activities during the construction phase, as well as rehabilitation activities of the temporary disturbance footprint.

It should be noted that weed and pest species are already present and often widespread within the Study area. Twenty-one Category 3 restricted matter flora species (under the Biosecurity Act) are known to occur within the Study area with 13 species of these also listed as WoNS (Table 4-5). Additionally, nine non-native fauna species, all declared as restricted matters (invasive animals) under the *Biosecurity Act 2014*, were identified within Study area during field investigations (Appendix A and Appendix I). These species were widespread within the Study area. Activities associated with all phases of the Project also have the potential to increase the spread of pathogens including myrtle rust. Myrtle rust is caused by the fungus *Austropuccinia psidii* and threatens the tree and shrub species of the Myrtaceae family, including *Melaleuca spp.*, *Eucalyptus spp.*, *Angophora spp.*, and *Corymbia spp.* Myrtle rust spreads and reproduces via spores carried on: clothing; infected plants and plant material; equipment, machinery and vehicles; and insects and animals (DCCEEW, 2024a).

Without appropriate management strategies, Project activities have the potential to disperse weeds into areas of remnant vegetation where weed species are currently in low densities. In areas that provided highly specific habitat for MNES (e.g. Five-clawed worm skink (*Anomalopus mackayi*)) weed/pest infestations are likely to have the most significant impact and will contribute towards threatening processes. However, pest and weed invasion may benefit some native species and MNES by supplying an abundant food source which would otherwise be unavailable e.g. Mosquitofish (*Gambusia holbrooki*) or carp (*Cyprinus carpio*) as a food source for juvenile Murray cod and non-native seeds as a food source for the squatter pigeon (*Geophaps scripta scripta*).

Project activities also have the potential to introduce new weed species into the Study area. The most likely causes of weed dispersal and introduction associated with the Project include earthworks, movement and disturbance of soil, and the movement of seed (and other propagules) by vehicles and machinery during all phases. Weed dispersal by vehicles along access tracks and roads is a key source of weed invasion (Birdsall et al., 2012).

Soil disturbance during construction may increase the risk of invasion from weed and/or pest species, which can further reduce habitat quality and compromise the integrity of adjacent areas such as the brigalow TEC, and the natural grassland TEC.

Large areas of the Study area have significant weed growth, particularly non-native grasses, which have been introduced as part of historic agricultural land use of the area. Therefore, the potential for habitat modification from weed invasion resulting from the Project is highest where Project activities take place in relatively intact areas, such as those identified as containing intact remnant vegetation that currently has low weed diversity and abundance.

Unmitigated Project activities have the potential to disperse pest (animal) species from the impact assessment area into the surrounding landscape, due to habitat removal, noise disturbance, and human presence during the construction and operation phases of the Project.

Construction of access tracks and the rail infrastructure through large patches of intact vegetation may result in the establishment of pest species (particularly predators such as foxes and cats) into areas where they are currently absent or in low numbers. Therefore, unmitigated potential impacts of the displacement of native species through the invasion of non-native fauna may be temporary or irreversible.

5.2.5 HABITAT FRAGMENTATION

Habitat fragmentation relates to the physical separation of a continuous habitat into disjointed smaller fragments (Fahrig, 2002). The habitat fragments tend to be separated from each other by a matrix of less suitable habitat. The new habitat type situated fragments is often artificial (e.g. a railway or road) and less suitable to the species remaining within the newly created fragments (Bennett, 1990) or is generally only used by adaptive and aggressive generalist species (i.e. noisy miners) (Loyn et al., 1983) which further decreases population levels of other species remaining in the fragments. Fragmentation reduces patch size, thereby increases edge effects within a patch and reduces the area of undisturbed 'core' habitat for the fauna species present in an area.

The landscape in which the Project is situated is generally highly fragmented with most vegetation occurring as small fragments due to agricultural practices such as pasture, cropping and horticulture. The Project activities will contribute to further fragmentation along with the associated edge effects and reduction in habitat. This effect will largely impact habitat associated with the large tracts of extant vegetation within the State forests north of Inglewood.

Habitat fragmentation has been identified as an important threatening process to MNES such as greater glider (southern and central) (*Petauroides volans*), and koala (*Phascolarctos cinereus*) (Appendix F Species and Community Profiles). This is due to the importance of connectivity, dispersal opportunities and habitat quality for species at a local scale and the cumulative impacts at a regional scale. In some instances, the Project may not result in significant fragmentation of populations identified as relevant to the area given the capacity of some species to disperse widely across the landscape (e.g. migratory birds).

The Project will result in some small-scale localised fragmentation which has the potential to be detrimental to the dispersal of relatively sedentary species, such as small mammals, frogs, and reptiles which can lead to crowding effects and increased competition within habitat patches. Mobile species such as larger mammals, birds, and bats may not be affected by this small-scale fragmentation, as the landscape in which they currently exist is fragmented and the predicted level of fragmentation would not be enough to restrict their dispersal between habitat patches.

Potential habitat fragmentation (and associated edge/barrier effects) have been reduced as much as possible through the revised reference design as described in Section 5.3.8.

5.2.5.1 LOSS OF CONNECTIVITY IN BIODIVERSITY CORRIDORS

Biodiversity corridors (including those associated with waterways) can be defined as systems of linear habitat which enhance the connectivity of wildlife populations and may help to overcome the main consequences of habitat fragmentation (Wilson and Lindenmayer, 1995). While not every species utilises them, corridors can assist ecological functioning at a variety of spatial and temporal scales from daily foraging movements of individuals to broad-scale

genetic gradients across biogeographical regions. Fragmentation of such corridors have been identified as important threatening process to MNES such as greater glider (southern and central) (*Petauroides volans*), and koala (*Phascolarctos cinereus*) (Appendix F Species and Community Profiles).

State-based Biodiversity Planning Assessment (BPA) mapping for the Brigalow belt (Queensland Government, 2016) depicts State corridors within the Study area where the Project footprint intersects vegetation associated with Yelarbon, Whetstone and Bringalily State Forests. The Project footprint also intersects a regional corridor comprising patchy fragmented vegetation to the north of Pittsworth. The corridor mapping shows vegetation that is significant for the spread and movement of flora and fauna, including MNES.

The potential impacts of linear infrastructure traversing these biodiversity corridors include habitat fragmentation, edge effects and barrier effects. These potential impacts are discussed further in the following sections. An additional potential impact upon biodiversity corridors resulting from the Project is the proliferation of weeds and pest species, as mentioned in Section 5.2.4.

The unmitigated potential impacts to biodiversity corridors resulting from the Project are likely to be long term and irreversible.

An assessment of the impacts to connectivity for threatened fauna species was undertaken and is described in EIS Appendix P: Fauna Connectivity Strategy. The assessment identified 13 MNES species whose movements may be impacted by the Project:

- Brigalow woodland snail (*Adclarkia cameroni*);
- Condamine earless dragon (*Tympanocryptis condaminensis*);
- Five-clawed worm-skink (*Anomalopus machayi*);
- Greater glider (southern and central) (*Petauroides volans*);
- Koala (*Phascolarctos cinereus*);
- Murray cod (*Maccullochella peelii*);
- Spotted-tailed quoll (*Dasyurus maculatus maculatus*);
- Regent honeyeater (*Anthochaera phrygia*);
- Squatter pigeon (southern) (*Geophaps scripta scripta*);
- Painted honeyeater (*Grantiella picta*);
- Collared delma (*Delma torquata*);
- Yakka skink (*Egernia rugosa*); and
- Dunmall's snake (*Furina dunmalli*).

Several of these species were grouped into the following guilds for assessment purposes:

- Cracking clay reptiles (five-clawed worm-skink);
- Gliding mammals (greater glider);
- Woodland birds (regent honeyeater, squatter pigeon, painted honeyeater); and
- Woodland reptiles (Dunmall's snake, collared delma, yakka skink).

The importance of different sections of the Project for connectivity for these species and species guilds has been assessed in the EIS Appendix P: Fauna Connectivity Strategy, to identify areas that contribute significantly. A total of 35 priority connectivity zones were

identified along the Project (Figure 5-1). These zones are located where high levels of ecological connectivity currently exists which will be impacted by the Project footprint and mitigation is required to maintain landscape connectivity for both threatened and non-threatened fauna.

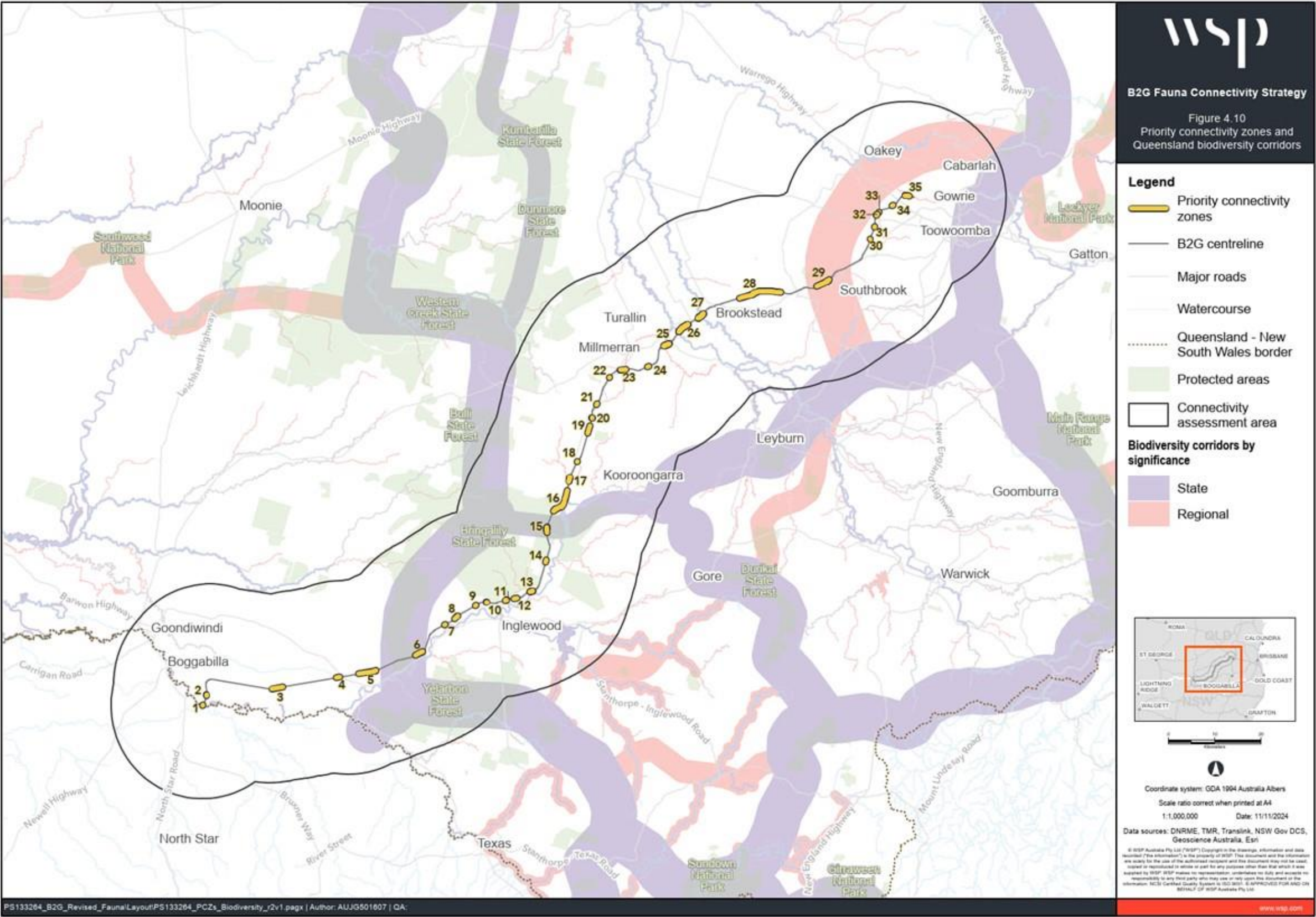


FIGURE 5-1 PRIORITY CONNECTIVITY ZONES

Source: EIS Appendix P: Fauna Connectivity Strategy, Figure 4.10

5.2.5.2 BARRIER EFFECTS

Barrier effects (permanent and/or temporary) occur where species are either unable or unwilling to move between suitable areas of habitat due to the imposition of a barrier. This can include:

- a habitat type that has become unsuitable (e.g. cleared areas devoid of vegetation or structure)
- a physical barrier such as a fence, railway line, road or track, earthworks embankments, cuttings, noise barriers, or alteration to a waterway or a culvert that does not provide movement opportunities to fauna, or,
- a non-physical barrier created by noise or light.

Various Project activities may create temporary and/or permanent barrier effects, particularly those that may create a hard barrier that restricts fauna movement (e.g. fences, noise and light walls, temporary waterway barrier works, retaining walls and sections of cliff or cutting, operational rail corridor, construction laydown areas). This is considered a potential impact in the area north of Inglewood (associated with State forests) due to the highly modified nature of much of the landscape elsewhere in the Project footprint.

Potential barriers to fauna movement were assessed as part of the Appendix P: Fauna Connectivity Strategy. Gliders such as the greater glider (southern and central) (*Petauroides volans*) are susceptible to habitat fragmentation and gaps in vegetation that exceed their glide capability are barriers to movement.

Existing fencing such as the WDCF and the rabbit fence will be reinstated along the Project footprint. New sections of fencing will also be implemented to prevent fauna from crossing the Project footprint to reduce the risk of vehicle strike. Barbed wire and knot mesh fencing will be used minimally, and the majority of the fencing implemented will be plain mesh to reduce risk to fauna. No barbed wire or knot mesh wire will be utilised at designated crossing points with appropriate infrastructure. While the unmitigated implementation of fencing has the potential to create barrier effects that will have long lasting negative impacts to fauna, the implementation of crossing structures such as culverts, glider poles, and bridges will ensure connectivity can be maintained.

Human activity during construction is likely to create a barrier as many species are known to avoid areas of human activity resulting in indirect habitat loss. Human presence may affect species in different ways. Some species display avoidance behaviour while others may habituate and become attracted to areas of human activity. Predators and prey may respond differentially to human activity, causing a disruption of community interaction and potentially disrupting ecological processes (Caro, 2005). Human presence and activity is likely to produce avoidance responses in larger mammalian predators that are sensitive to disturbance (i.e. spotted-tailed quoll), while macropod species (i.e. brush-tailed rock-wallaby) and smaller amphibian and reptile species are more likely to habituate to human presence.

Similarly, barrier effects may be experienced by native animals in the form of increased patrolling and predation by pest animals (e.g. foxes and wild dogs) along barriers, such as a cleared corridor or fencing, as prey becomes more exposed and easier to detect and catch.

The unmitigated potential impacts of barrier effects resulting from the Project are in most cases short term and temporary (restricted to the construction phase) but may in some cases be long term and irreversible (related to the railway and access track).

5.2.5.3 EDGE EFFECTS

Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats. Environmental conditions along habitat edges can promote the growth of different vegetation types (including weed species), facilitate invasion by pest animals specialising in edge habitats, or change the behaviour of resident native animals (Moenting and Morris, 2006). Edge zones can be subject to higher levels of predation by introduced mammalian and native avian predators. The distance of edge effect influences can vary and has been previously recorded from 50 m to greater than 1 km from an edge (Forman et al., 2003; Bali, 2005).

Within the Study area, many patches of vegetation are small, irregularly shaped, and fragmented, and as such are already subject to considerable edge effects. Therefore, it is unlikely that the Project would increase the overall extent of edge effects in these areas. However, in large habitat patches with low edge to area ratios (e.g. State forests or remnant vegetation), Project activities (vegetation clearing, temporary and permanent) may create edge effects resulting in habitat degradation and a reduction of the habitat available for a range of species.

Edge effects have the potential to impact on the range of flora and fauna species identified as potentially occurring in the Study area, especially upon the species with specific micro-habitat requirements that are less tolerant to disturbance (e.g. *Xerothamnella herbacea*, yakka skink (*Egernia rugosa*), and five-clawed worm-skink (*Anomalopus mackayi*)). Conversely, some threatened species appear to respond positively to edge effects, particularly ground disturbance, and colonise these edge areas reasonably quickly (e.g. king bluegrass (*Dichanthium queenslandicum*), Belson's panic (*Homopholis belsonii*), hawkweed (*Picris evae*), austral cornflower (*Rhaponticum australe*), austral toadflax (*Thesium australe*) and squatter pigeon (*Geophaps scripta scripta*)).

It is anticipated that MNES involving threatened species and wetland and waterway habitat, including habitat and microhabitat features for Murray cod (*Maccullochella peelii*), may be impacted greatest from edge effects, where avoidance of vegetated areas is not practicable. Clearing of this vegetation would result in a reduction of the microhabitat features that Murray cod rely on for breeding and spawning, creating an edge effect.

Unmitigated potential impacts of edge effects resulting from the Project are long term and irreversible.

5.2.6 NOISE AND VIBRATION

This section has been prepared to provide an assessment of the potential noise and vibration impacts to native fauna during construction and operation.

Sound that is clearly perceptible does not necessarily mean that it will be unpleasant, annoying or disturbing in nature. Often, the effects of sound and vibration are masked by the sounds in the daily environment. However, noise and vibration may adversely affect wildlife by interfering with communication, masking the sound of predators and prey, causing stress or avoidance

responses, and in some cases, may lead to changes in reproductive or nesting behaviour. Excessive noise may lead some species to avoid noisy areas, potentially resulting in the fragmentation of species habitat. On the other hand, many animals react to new noise initially as a potential threat, but quickly habituate, or 'learn' that the noise is not associated with a threat (Radle, 2007).

There are no current State or Commonwealth government policies, guidelines or standards that recommend noise thresholds or limits associated with impacts to fauna, in part because the effects of noise on most fauna species are poorly understood. This is because hearing characteristics are species specific. Where the hearing range of humans is typically 20 Hz to 20,000 Hz, fauna have varying hearing ranges (see Table 5-3).

It should be noted that as predicted sound pressure levels are generally assessed in A-weighted decibels (i.e., an expression of the relative loudness of sounds as perceived by the human ear) and given fauna species have varying hearing ranges to humans, therefore the actual loudness of sounds as perceived by different species may not be accurately described. However, in the absence of an established weighting for the hearing characteristics of animals, the A-weighted sound level continues to be used.

TABLE 5-3 TYPICAL HEARING RANGE FOR VARIOUS ANIMAL SPECIES

Species	Typical hearing range (Hz)
Human (for reference)	64 – 23,000
Lizards	100 – 4,000 (Wever, 2022)
Cow	23 – 35,000
Grey-headed flying fox	2 – 54,000
Horse	55 – 33,500
Sheep	100 – 30,000
Poultry	125 – 2,000
Bat (microbat)	2,000 – 110,000
Terrestrial frog	100 – 3,000
Treefrog	50 – 4,000
Small parrot (e.g., cockatiel)	250 – 8,000
Large parrot (e.g., glossy black-cockatoo)	200 – 8,500
Owl	200 – 12,000
Koala	20 – 1,290 (Charlton, 2015)
Insects	10 – 100,000

Source: Adapted from Fay and Popper (1994)

The US Department of Transportation (2004) summarises the hearing sensitivities of various wildlife groups as:

- Mammals: <10 Hz to 150 kHz (kilohertz);
- Birds (more uniform than mammals): 100 Hz to 8-10 kHz;
- Reptiles (poorer hearing than birds): 50 Hz to 2 kHz; and

- Amphibians: 100 Hz to 2 kHz.

Additional considerations to understanding the effects of noise on fauna include the varying responses to noise disturbance across species and genera. Table 5-4 provides a summary of research findings reviewed for this assessment.

TABLE 5-4 SUMMARY OF REVIEWED LITERATURE

Fauna taxa	Description	Source
Snakes and lizards	Snakes lack external ears and a tympanic middle ear ('ear drum'). <i>"The lack of a tympanic ear comes at the cost of a reduction in hearing sensitivity by some 40 dB or more"</i> .	Christensen et al. (2012)
	Some studies reviewed indicate hearing damage to some lizard species after exposure to steady noise levels above 95 dB.	Manci et al. (1988)
	A study on how snakes respond to airborne and ground-borne sounds. Snake responses were genus specific, with behavioural variability among different snake genera and across sound frequencies. Of the five genera involved in the study, only one genus (<i>Aspidites</i> , Woma Pythons) significantly increased their probability of movement in response to sound, but three other genera (<i>Acanthophis</i> (Death Adders), <i>Oxyuranus</i> (Taipans), and <i>Pseudonaja</i> (Brown Snakes)) were more likely to move away from sound, signalling potential avoidance behaviour	Zdenek et al. (2023)
Animals (domestic and wild)	If SEL of 100 dB(A) exceeded, there is a potential for effects on animals.	Hanson et al. (2012)
Invertebrates	Some insects (including bees) stop moving when exposed to high noise levels. Honey bees stopped moving for up to 20 minutes in response to frequencies of approximately 200 Hz-2000 Hz with intensities varying from 107 – 119 dB, and did not appear to habituate.	Manci et al. (1988)
	Terrestrial gastropod molluscs have no acoustic sense and are unlikely to be impacted by noise	Barker (2001)
Mammals	Noise disturbance below 65.5 dB(A) was less likely to elicit strong behavioural responses for insectivorous mammals. <i>"In the absence of national guidelines, and based on the findings of the applied research literature, a threshold level of LAeq 65 dB(A) be considered as a screening tool for ecological noise impacts"</i> .	Multiple references, as cited in Agnew and McBean (2020)
	<i>"Sound levels above about 90 dB are likely to be adverse to mammals and are associated with a number of behaviors such as retreat from the sound source, freezing, or a strong startle response. Sound levels below about 90 dB usually cause much less adverse behavior. Laboratory studies of domestic mammals have indicated that behavioral responses vary with noise types and levels, and that domestic animals appear to acclimate to some sound disturbance"</i>	Manchi et al. (1988)

Fauna taxa	Description	Source
Birds	Episodic noise can impact birds' behaviour at 60 – 80 dBA (nesting/roosting), and over 80 dBA (nesting/roosting/feeding)	Archer (2014)
	Average noise level at which population density of these birds began to decline ¹ Woodland birds - 42 dB(A) Grassland birds – 48 dB(A)	Forman et al. (2003, pp.125 and 274)
	- Quail: 80 dB - Accelerated hatching - Canary: 95-100 dB - hearing loss - Seabirds (general): sonic boom - Startle, flush from nest - Tern: sonic boom, frequent – reduced reproduction - California condor: blasting, drilling etc – flush from nest, abandon area - Raptors: sonic boom – alarm	Hanson et al. (2012)
	Noise disturbance below 65.5 dB(A) was less likely to elicit strong behavioural responses for birds	Multiple references, as cited in Agnew and McBean (2020)
	<i>“Anthropogenic noise can also trigger flight and alert responses in birds and altered behaviour after the noise disturbance, which can lead to reduced breeding success, at noise levels ranging from 65-85 dB(A). Complete habituation to such disturbances does not always occur, even in less noise-sensitive species”</i>	Dawe and Goosem (2008)
	Studies and reviews undertaken suggest that to minimise impacts on birds, traffic noise should ideally be kept below 55-60 dB(A)(18 hr exposure), especially during the morning chorus.	DTMR (2024)

¹ These studies focused on traffic noise from a highway, so exposure was to almost continuous noise.

As discussed above, the scientific and published literature is inconclusive with regard to thresholds or threshold criteria for terrestrial fauna, however, available literature indicates that moderate impacts to habitat use may occur when noise levels are above 60 to 65 dB(A) and fauna are likely to leave the area when noise levels are around 80 dB(A) or above. Table 5-5 provides a summary of the typical activities potentially impacted. Only minor disturbance of terrestrial fauna is anticipated at noise levels below 60 to 65 dB(A).

TABLE 5-5 LIKELY EFFECTS ON TERRESTRIAL FAUNA AS A RESULT OF PROJECT CONSTRUCTION ACTIVITIES

Disturbance effect	Steady or continuous noise sources (L _{Aeq} (15min) dB(A))	Episodic (single event or short-term) noise sources (L _{Amax} dB(A))	Typical activities potentially impacted
Occasional (Alert) – minor impacts on habitat use for most species	50 to 65	45 to 60	Nesting

Disturbance effect	Steady or continuous noise sources (L_{Aeq}(15min) dB(A))	Episodic (single event or short-term) noise sources (L_{Amax} dB(A))	Typical activities potentially impacted
Frequent (Alarm or Flight) – moderate impacts on habitat use	65 to 85	60 to 80	Nesting Roosting
Avoidance of area – by most of the population of some species	≥85	≥80	Nesting Roosting Foraging

Notes:

Source: SLR (2015)

Activities are based on bird responses, but are considered representative across a range of species.

Masking impacts, particularly on smaller songbirds, may occur at noise levels of approximately the alert threshold right up until the point of avoidance.

L_{Amax} limits have been specifically set below the L_{Aeq} limits in recognition of considerations related to startle responses.

5.2.6.1 CONSTRUCTION NOISE AND VIBRATION

The noise impact assessment undertaken for the Project (EIS Chapter 16, Appendix V: Construction Noise) has broken up acoustically significant construction activities/stages of works into a series of construction scenarios, each defined as a set of activities involving several scheduled equipment items, each operating within a specific area of authority, during specified times.

It is expected that the noise levels would frequently be lower than the assessed scenarios, as the predicted worst-case noise levels are based on each scenario occurring at the work site boundary and assumes all construction equipment operating simultaneously. Sound is also likely to travel shorter distances within vegetated areas, particularly woodland habitats associated with the state forests in the Inglewood area which provides substantial habitat for a range of species. This is due to the noise reduction effect associated with the extant vegetation and structurally complex environments. Outside of this area, the landscape is heavily disturbed (through agriculture and grazing impacts) and the presence of fauna is expected to be limited to species tolerant of disturbance such as grassland bird and reptile species and other ubiquitous animals. However, it is noted that several threatened species have habitat outside of the state forests and other structurally complex vegetated areas, including Condamine earless dragon, five-clawed worm-skink, brigalow woodland snail, and squatter pigeon.

Analysis of the sound power and frequency range associated with construction activities (around 63 Hz to 8 kHz) indicates that the harmonic ranges produced (i.e., Hz) overlap with the typical hearing range for species likely to occur within the area (refer to Table 5-3).

The extent of potential impacts of project noise is determined by the distance project-related noise travels to the point where it attenuates to levels where only minimal impacts are likely to occur. Modelling indicates that for most construction scenarios, while the unmitigated construction noise is typically loud at the source, noise levels generally reach less impactful levels (in the vicinity of 65 dB(A)) within 100m to 200m of the Project footprint. Fauna located close to work areas are likely to temporarily move away when construction starts, due to disturbance including noise, however fauna located greater than 100 m from the works are expected to experience only minor temporary disturbance, with minimal impact. From the modelling it can be derived that the habitat areas that will be at most risk of noise impacts

include the surrounds of the Bringalily State Forest, small riparian areas and patches of small woodlands, as these areas provide higher quality and a larger quantity of habitat compared to other areas of agricultural lands.

Landon et al. (2003) completed a study which examined impacts from noise and found that fauna vacated the area close to the noise disturbance as the first behavioural response. As most construction stage activities will be conducted in stages moving along the alignment, and are therefore considered short term (i.e., around one to four months), fauna are likely to return when construction works are completed.

Construction scenarios which are exceptions to this include:

- Whetstone MDC site establishment,
- Whetstone MDC combined activity noise with laydown areas,
- Borrow pit operations, and
- Project structures (bridges).

Noise modelling indicates that these scenarios are likely to emit a higher level of sound which dissipates over a greater distance from the source. Additionally, the works associated with these scenarios will continue for a longer duration (up to 48 months), and are therefore likely to have a greater impact on fauna. These construction scenarios are discussed in more detail below. Whetstone MDC and Borrow Pits

Noise modelling indicates that noise levels will be above 90 dB(A)_(LAeq,15min) at the boundary of work areas during construction and operation of the Whetstone MDC and the borrow pits, reducing to around 65 dB(A)_(LAeq,15min) within approximately 250 m. Construction and establishment of the borrow pits is anticipated to be completed in 1 month, and construction of the Whetstone MDC is anticipated to be between 6 and 12 months. Operation of the Whetstone MDC and borrow pits is anticipated to continue for up to 5 years (EIS Chapter 16, Appendix V: Construction Noise). However it should be noted that noise levels associated with these construction and operation activities will not be continuous and predicted noise levels will not occur on a daily basis.

Project Structures (bridges)

Bridge construction is comprised of three key stages:

- Substructure construction (both bored and driven piling scenarios),
- Pier construction, and
- Superstructure construction.

Each of the bridge construction stages will take between 20 and 160 days (approx. 5 months), and noise levels will vary depending on the scale of the bridge, the equipment used and the methods required for construction. Noise levels associated with construction of Project structures, notably foundations and piers are predicted to be above 90 dB(A)_(LAeq,15min) at the boundary of the work area during construction, reducing to 65 dB(A)_(LAeq,15min) within approximately 200 m. Noise levels of up to 75 dB(A)_(LAeq,15min) are predicted for superstructure construction, dissipating to 65 dB(A)_(LAeq,15min) within approximately 50 m. As described previously, species responses to noise differ. Where noise levels at the source are around 85 dB(A) or above, mobile species (i.e. birds, spotted tailed quoll or koala) are likely to move away from the immediate area. Less mobile species such as the Brigalow woodland snail, while less able to move away from the source, may potentially experience lower levels of impact given terrestrial gastropod molluscs have no acoustic sense and are unlikely to be impacted by noise (Barker, 2001). It is therefore considered unlikely that brigalow woodland

snail (*Adclarkia cameroni*) will be impacted by airborne noise associated with the Project. They are, however, sensitive to vibration.

There is no available literature on the impacts of construction vibration on Brigalow woodland snail (*Adclarkia cameroni*) however, the species has been recorded within 30 m of the Western Line rail corridor (ALA, 2024) which carries both freight and passenger trains (Queensland Rail, 2016) and are known to occur in the vicinity of the Southern railway line in the Darling Downs (Craig Eddie pers. comm, 2024). This indicates that either railway vibrations do not have an impact on the brigalow woodland snail, or they are able to habituate and are therefore unlikely to be significantly impacted vibration arising from construction activities.

Similarly, snakes lack external ears and a tympanic middle ear (ear drum) which means they have a reduced hearing sensitivity (Christensen et al., 2012). Christensen et al. (2012) conclude that pythons, and possibly all snakes, rely on an acute vibration sensitivity as opposed to hearing. Nevertheless, high impact construction noise may cause temporary or permanent hearing loss in reptiles and vibration may limit their ability to detect prey (DTMR, 2024). Reptiles including collared delma, Dunmall's snake, Condamine earless dragon and five-clawed worm-skink have the potential to be impacted by construction noise, however a study on how snakes respond to airborne and groundborne noise found the majority of snake genera studied were likely to move away from sound, signalling potential avoidance behaviour. It is considered likely that reptile species have the mobility and range to move away from the source of disturbance for the duration of works, and return on completion.

Noise will impact koala dispersal and/or foraging and breeding habitat. Continuous excessive noise has the potential to cause koalas (*Phascolarctos cinereus*) to avoid areas of disturbance, potentially causing stress and avoidance reactions, or changes to reproductive or breeding behaviour (Narayan, 2019). However, a study of the behavior of koalas (*Phascolarctos cinereus*) during and after a music festival in New South Wales found that koalas moved away but generally returned to their core activity areas soon after the cessation of festival activity, implying a relatively short-term influence on ranging behavior. Similarly, monitoring of habitat use by koalas during construction of the Moreton Bay Rail found that koalas freely moved around the rail corridor. Monitoring showed that they occupied and ranged in every available habitat on the site and used a range of native and exotic trees (Hanger et al., 2017). Koala (*Phascolarctos cinereus*) breeding season is October to May. Noise associated with the Project may cause disturbance to breeding, albeit temporarily during the construction period. Appendix M: Draft Koala Management Plan includes measures to ensure noise restrictions will be in place and relevant guidelines regarding continuous exposure are enforced during construction.

South-eastern long eared bats (*Nyctophilus corbeni*) has the potential to be impacted by construction noise. Other species of *Nyctophilus* have been recorded to have a sensitivity peak at 8-14 kHz and 22-45 kHz with the lower frequency band being used for social communication, and the higher band being used for foraging (West, 2016). As construction activities (around 63 Hz to 8,000 Hz) have the potential to overlap with the lower frequency band, it is likely to disrupt the social activities of the species. However, south-eastern long eared bats are highly mobile and are able to relocate to other areas during the short-term impacts of construction.

Given the temporary nature of construction works, it is considered likely that fauna will initially move away from the source of the noise disturbance. In this time, use of habitat areas for foraging, nesting and roosting may be affected however species will either habituate to the

sound when they realise that it is not associated with danger, or return on completion of works.

Potential impacts to use of breeding habitat during construction is considered to potentially have the largest impact, especially for construction activities that persist over a longer period of time, potentially effecting multiple breeding seasons.

The extent to which reptile species native to Queensland rely on aural cues for reproduction or other important behaviour is unknown (Sordello et al., 2020) and minimal information exists regarding breeding requirements of collared delma (*Delma torquata*), Dunmall's snake (*Furina dunmali*), and five-clawed worm-skink (*Anomalopus mackayi*). Christensen et al. (2012) conclude that pythons, and possibly all snakes, can hear, but rely on an acute vibration sensitivity. It is considered unlikely that noise disturbance associated with the Whetstone MDC and borrow pit sites will significantly impact these species, however, impacts associated with vibration may occur.

Listed wetland bird species including the Australasian bittern (*Botaurus poiciloptilus*), and Australian painted snipe (*Rostratula australis*) have the potential to use habitat in the area. and suitable breeding habitat exists in the area for both species. Australian painted snipe (*Rostratula australis*) breeds in response to rainfall patterns and wetland conditions, breeding across all months in Australia (DCCEEW, 2022). The species is considered likely to only utilise habitat in the area intermittently and opportunistically however, as there are more significant and suitable wetland areas in the greater landscape. The Australasian bittern (*Botaurus poiciloptilus*) was not recorded within the Project footprint and no records exist within the locality (10 km). Australasian bittern (*Botaurus poiciloptilus*) breed from October to February (TSSC, 2019).

The spotted-tailed quoll (*Dasyurus maculatus maculatus*) occupies home ranges of several hundred to several thousand hectares in size, having multiple dens (more than 20), and commonly moves between dens every 1-4 days (DCCEEW, 2015). Spotted-tailed quoll (*Dasyurus maculatus maculatus*) breeds in winter. Given the species mobility, it is considered likely individuals will avoid the area during construction and noise impacts are unlikely to disrupt breeding during this time.

Other species which have the potential to be impacted by construction noise includes grey-headed flying fox (*Pteropus poliocephalus*). Despite the nearest regularly used grey-headed flying fox (*Pteropus poliocephalus*) camp being located in Toowoomba, a camp of 500-1,000 individuals was also observed in Inglewood, 3 km outside of the Project footprint. Studies of the conditions and outcomes of six construction projects conducted in close proximity (ranging from abutting the construction site to 300 m away) to flying-fox camps shows that abandonment occurred (Eby, 2018, cited in DTMR, 2024). This may have been a direct result of construction disturbance but may also have been associated with environmental conditions (drought and food shortage). Abandonment of a camp could lead to a significant impact to roosting populations during critical periods in their reproductive cycle (i.e., when there are pregnant females or lactating females with dependent young present in the camp). In all cases however, construction works were within 300 m of the camp. The camps located in the vicinity of the Project are sufficiently far enough away that they are considered unlikely to be impacted by construction noise.

5.2.6.2 OPERATIONAL NOISE AND VIBRATION

The Project introduces new railway operations to areas where there is no existing railway infrastructure and increases train movements in brownfield areas where the South Western Line and Millmerran Branch Line rail corridors already occur.

The main sources of noise for a freight train are the diesel engine, the engine exhaust located near the top of the locomotive and the interaction of the wheels with the rails. The wheel-rail interaction results in rolling noise and vibration from both the locomotives and the wagons. Discrete noise events can also occur as trains transfer between tracks at turnouts, and when trains travel uphill, downhill, or along curved track sections. At crossing loops, noise can be produced by locomotive or train horns, crossing bells, idling locomotive engines, acceleration and braking operations and wagon bunching. Noise from railway operations will be infrequent and only occur when trains are passing in the immediate local area. Once a train has passed through, there will be no further railway noise until the next train is scheduled. It is estimated that once operational, the Project will involve an annual average of 14 train services per day during initial years of operation. This is likely to increase to an average of 20 trains per day after 15 years, and approximately one train an hour during peak operational periods.

Modelling has been undertaken for the predicted noise and vibration impacts associated with operational activities along the entire Project footprint. Analysis of sound power and frequency range associated with operational activities indicates that the harmonic ranges produced (i.e. Hz) overlap with the hearing range of birds and other species likely to occur in the area and therefore will be perceivable by these species.

Operational rail noise levels considered have been based on the single event maximum (SEM) levels which are an average L_{max} level from rail pass-by events. The unmitigated noise modelling completed shows that areas approximately 500m on average, on either side of the rail line will be impacted by 80 + dB(A) levels, reducing to around 60 dB(A) within approximately 1,500 m from the rail line. It should be noted that sound levels that exceed 80 dB(A) will only occur during locomotive pass by and is usually a result of locomotive or train horns.

The potential impacts from noise levels are heavily dependent upon landscape and topography (with open and flat areas allowing noise to travel further when compared to forested or hilly areas (Lucas et al., 2017)) and the species present. For instance, a study in the Netherlands found a reduction in the density of meadow birds close to railways (Waterman et al., 2002). In contrast, Więcek et al. (2015) counted birds at three different distances (30, 280 and 530 m) from the tracks and found, despite the noise level falling distinctly with increasing distance from the tracks, the abundance of birds and the number of species were the highest near the railway tracks and the noise from the trains did not adversely affect the birds within the study area.

Linear transport infrastructure already occurs throughout the Study area, in the form of highways, local roads and rail. Approximately 68 km of the Project will utilise existing rail corridor and, whilst the Project will result in an increased intensity of rail operation, operational rail noise is an existing component of the local conditions in these areas. Based on this, it is expected that most, if not all resident species in these areas are accustomed to some form of transport noise and are likely to have mechanisms to adapt to the increased train movements. For example, Ghosh et al. (2010) illustrated that house sparrows (*Passer domesticus*) were able to adapt to loud noise from passing trains (between 35 – 95 dB(A)) on rail lines (Ghosh et al., 2010; Lucas et al., 2017).

The greatest noise impacts to wildlife are likely to be in areas of newly constructed rail, particularly within the state forests, small riparian areas and patches of small woodlands, and

undeveloped areas where noise mitigation measures are not in place to minimise impacts to human sensitive receptors. Operational noise may lead to some fauna moving away from the noise disturbance to nearby habitat, particularly more mobile species such as Australasian bittern (*Botaurus poiciloptilus*), spotted-tailed quoll (*Dasyurus maculatus maculatus*) and koala (*Phascolarctos cinereus*). A study which examined fauna response to noise impacts found that the most frequently reported response to traffic noise from cars, trains and aircraft is animal movement away from the noise source (Erbe et al., 2022). However, many animals become habituated to noise (Radle, 2007). Wiącek et al. (2015) found that the noise generated by passing trains did not have a negative impact on either the abundance of birds or the numbers of woodland bird species.

There is no literature available to document the impact of transport noise on *Nyctophilus* bats. South-eastern long eared bats (*Nyctophilus corbeni*) have not been recorded close to a rail corridor, however this may be due to sampling bias rather than avoidance.

Reptiles appear to ignore rail traffic (Lucas et al., 2017) and are highly mobile, with large enough home ranges that they are able to move in and out of surrounding habitats to avoid disturbance if desired. Reptiles are not considered likely to be significantly impacted by noise and vibration as a result of operational activities.

While brigalow woodland snail has limited mobility, the species has been recorded within 30 m of the Western Line rail corridor (ALA, 2024) which carries both freight and passenger trains (Queensland Rail, 2016) and are known to occur in the vicinity of the Southern railway line in the Darling Downs (Craig Eddie pers. comm, 2024). This indicates that either railway vibrations do not have an impact on the brigalow woodland snail, or they are able to habituate and are therefore unlikely to be significantly impacted vibration arising operation of the Project.

There is no available literature documenting the effect of transport noise on Australian breeding wetland birds. One study of the effects of road traffic found no evidence of a relationship between road traffic noise and wetland birds, however none of the measurements in the study exceeded 62 dB(A) (Phoenix Environmental Sciences, 2011). Kushlan (1979) found that behavioural responses of wading birds to helicopter and aircraft flyovers at a nesting colony in southern Florida found that in 90% of the observations, birds either showed no reaction or merely looked up, and that no bird that left its nest failed to return within five minutes. It is likely that even if breeding birds are present, they will utilise suitable habitat away from the source of disturbance.

Koala breeding occurs from October to May. As discussed above, noise has the potential to cause koalas (*Phascolarctos cinereus*) to avoid areas of disturbance, and may lead to koala utilising habitat away from the train line during operations. However, they are known to occur in developed urban areas impacted by transport noise such as roads and trains (Hanger et al., 2017), showing an ability to adapt to disturbance.

Operational noise does have the potential to interfere with fauna connectivity, where fauna may be disinclined to use crossing structures as a result of higher levels of noise close to the rail line. This will be an important consideration to avoid indirect impacts of fragmentation, especially in areas where the rail line intersects known wildlife corridors. Mitigation measures to reduce the impacts of noise and vibration to sensitive receptors are discussed in Section 6.3.

5.2.7 AIR QUALITY AND DUST

The Project will lead to increases of airborne dust levels during construction across the Project footprint if unmanaged. Increased dust can result in respiratory issues in fauna, adverse impacts on plant photosynthesis and productivity (Chaston and Doley, 2006), changes in soil properties ultimately impacting plant species assemblages' (Farmer, 1993), and mortality and/or decrease in aquatic health on aquatic communities from poor water quality. Evidence of potential impacts on entire vegetation communities is scarce. Many studies focus on specific impacts to single species. Recent research on threatened flora in a semi-arid environment in Western Australia found no significant impact on plant health because of a range of dust accumulation loads caused by vehicle movements (Matsuki et al. 2016). The deposition of (unpaved) road dust on nearby freshwater wetlands caused by heavy traffic increases due to energy development projects found minimal impact on water quality or soils (Creuzer et al., 2016).

The Project impacts on air quality are assessed in detail in EIS Appendix R: Air Quality Technical Report. For the assessment of construction phase impacts, a qualitative construction dust risk assessment was undertaken in reference to the *Guidance on the assessment of dust from demolition and construction* (UK IAQM, 2014). The risk of dust soiling due to particulate matter on surrounding areas was determined based on the scale of activities and proximity to ecological values. The outcome of the assessment showed that the residual risk with the proposed mitigation measures is low or negligible.

For the assessment of operation phase impacts, a quantitative dispersion modelling assessment was undertaken using the dispersion model CALPUFF. Diesel exhaust emissions from locomotives were estimated for projected peak train movements for the Project in 2040. Twelve months of representative meteorological input was developed for use in CALPUFF. Ground level concentrations of particulate matter, NO₂, volatile organic compounds, and heavy metals were predicted using CALPUFF at nearby ecological values.

The assessment predicted that cumulative pollutant concentrations and deposition levels would be below the relevant air quality goals at all identified ecological values for all pollutants of concern except for 24-hour average PM₁₀.

Based on the intention of the *Environmental Protection (Air) Policy 2019*, the operation of the Project (as determined by CALPUFF) is not expected to significantly impact MNES flora and fauna species or their habitat.

5.2.8 LIGHTING

Artificial lighting may have a range of impacts across different groups of taxa and between species within these groups, which is ultimately dependent upon a species' visual systems.

Light can disrupt critical behaviour and cause physiological changes in wildlife, and consequently, has the potential to hinder the recovery of threatened species. For migratory species, the impact of artificial light may compromise an animal's ability to undertake long-distance migrations essential to its lifecycle. Artificial light impacts on terrestrial mammals can include reduced activity, reduced foraging times and increased predation. Bats (e.g. grey-headed flying-fox (*Pteropus poliocephalus*)) may be affected at roost sites, along commuting corridors or when foraging, with artificial light potentially causing changes in prey availability, habitat degradation and attraction or avoidance of artificial light (DCCEEW, 2023).

Frogs and nocturnal reptiles may congregate at artificial lights to feed on insects attracted to light (Perry et al. 2008). Similarly, many microbat species may congregate at artificial lighting (Rich and Longcore, 2006), although other species may avoid well-lit areas (Threlfall et al. 2013). Nocturnal mammals (e.g. greater glider (*Petauroides volans*), and rodents) have been shown to reduce the total duration of activity under artificial light, as they risk higher rates of predation (DCCEEW, 2023).

Artificial lighting can also impact plants, which rely on natural light cycles to regulate daily activities including photosynthesis, water and nutrient cycles, growth rest and repair. Natural light cycles also provide a signal to adjust morphology and physiology to match natural lighting conditions and for the timing of seasonal events (DCCEEW, 2023).

Lighting associated with construction of the Project will include temporary lighting at non-resident workforce accommodation facilities, the Turallin facility, site offices and fuel storage areas, laydowns and office. Temporary construction lighting may also include flashing beacons and temporary spotlights in support of short-duration night works, if required and will be relatively short term in nature.

In terms of operational lighting, the only proposed permanent lighting is associated with safety lighting associated with standard road lighting required for the Cunningham Highway Road Bridge near Yelarbon and at controlled active level crossings. There would also be transient lighting associated with train lighting which will exist as frequent pulses of short duration.

As described in EIS Appendix P: Fauna Connectivity Strategy, lighting associated with the Project also has the potential to impact wildlife connectivity at wildlife crossing locations. Artificial lighting installed in close proximity to wildlife crossing structures and priority crossing zones may deter some species.

Potential impacts and mitigation measures to reduce light spill are contained within EIS Chapter 10: Landscape and Visual Impact Assessment, Appendix K: Landscape and Visual Impact Assessment Technical Report (Appendix 3: Obtrusive Lighting Assessment. EIS Appendix K: Landscape and Visual Impact Assessment Technical Report also contains an obtrusive lighting assessment, which has been developed in compliance with the *Australian New Zealand Standard, AS/NZS4282:2019 Control of Obtrusive Effects of Outdoor Lighting criteria*, which also recognises the impact of artificial light on biota.

5.2.9 INCREASE IN WASTE

Improper waste disposal (wire, large packaging waste etc.) has the potential to cause injury to wildlife. When discarded as litter, human-made materials such as plastic, glass and aluminium have the potential to cause external injury to wildlife, entanglement, and if accidentally ingested, may cause starvation or suffocation. Littered objects may also provide suitable habitat for disease-spreading insects, such as flies and mosquitoes (Healthy Land and Water, 2019). Inappropriate storage and handling of waste materials may also result in changes to soil qualities, increased fire risk, release of contaminants and an increase in pest fauna.

Ecological values affected include all threatened flora (through habitat degradation, and alterations in recruitment and nutrient cycles) and fauna species (direct consumption, declines in habitat suitability and entanglement). This type of impact has the highest risk of occurring during the construction phase and the potential to be long in duration due to the varying times

of decomposition; however, it is likely to be localised and manageable through construction waste management processes.

MNES affected by this potential impact include all threatened flora (through alterations in recruitment and nutrient cycles) and fauna species (direct consumption, declines in habitat suitability and entanglement). This type of impact is likely to be greatest during the construction phase due to the litter generation from construction personnel and has the potential to be long-term in duration due to the varying times of decomposition; however, it is likely to be localised and manageable.

Regulated waste generated by the Project, will be managed in accordance with the *Queensland Environmental Protection Act 1994, Environmental Protection Regulation 2019*. As such, it is considered not likely to have an impact on MNES.

5.2.10 ALTERED HYDROLOGY AND FLOODING

The Project has the potential to alter flooding and hydrological regimes as modification of existing landforms and introduction of Project components such as the railway line foundation and the installation of drainage structures such as culverts has the potential to alter natural stream flows and flow paths in some locations (Chapter 14: Flooding and Geomorphology).

Potential impacts on local and regional flooding behaviour, the community and the environment have been assessed for the Project's Operations stage. A detailed hydraulic assessment has been undertaken to establish the existing flooding regime (the 'existing case') and the development of hydraulic models based on the revised reference design to model expected change (the 'developed case'). Modelling and analysis has identified changes to the existing flooding and fluvial geomorphic regime that can be expected as a result of the Project and to identify areas where additional mitigation is required.

The hydraulic models were run for a suite of flood events (i.e., 20% annual exceedance probability (AEP), 10% AEP, 5% AEP, 2% AEP, 1% AEP, 1 in 2,000 AEP, 1 in 10,000 AEP, and the probable maximum flood (PMF)). Changes in peak water levels, velocities, flow patterns and flood inundation extents and durations between the existing case and developed case were also mapped (the 'change maps') (Chapter 14: Flooding and Geomorphology, and EIS Appendix T1: Hydrology and Flooding Technical Report).

The hydraulic and flooding assessment has predicted that the Project will impact the existing flooding regime as specified in Chapter 14: Flooding and Geomorphology. Additionally, assessment of the flooding impacts concluded that residual risks are likely to be of low or medium magnitude (see Table 14-124 in Chapter 14: Flooding and Geomorphology for details). Changes to flood conditions due to the Project in one area during one flood scenario (e.g., 10% AEP) may closely represent the existing conditions under slightly different flood scenarios (e.g., 9.9% AEP or 10.1% AEP). Furthermore, sections of existing rail track (the South Western and Millmerran Branch Lines forming the brownfield portions of the Project), currently designed to approximately 20% AEP and featuring limited drainage infrastructure in many areas, will be decommissioned and replaced with the new Inland Rail track infrastructure incorporating a minimum flood immunity of 1% AEP with significantly more and larger drainage infrastructure. This is expected to provide opportunity for improved conditions in many locations currently experiencing active scour, erosion and constriction of flow associated with the dated

infrastructure, with the return of drainage and overland flow conditions more closely aligned to original natural state.

Changes to the flow distribution, water depth, water velocity and duration of inundation during flood events have the potential to impact protected matters in a variety of ways. This may include greater erosion and mobilisation of soils in areas of increased inundation and velocities, flushing of more coarse woody debris, snags and other microhabitat features due to increased water velocities, drying of areas in areas of decreased inundation, and increased stress on both plants and animals in areas of increased inundation duration. It should be noted that the species and habitats being impacted often inhabit floodplain environments and can persist through a variety of flood events and conditions.

Potential impacts to MNES and associated habitat can include both abiotic and biotic components of habitat. These impacts include potential drowning of individuals, waterlogging causing anoxia for plants and TECs, reduction in inundated areas (and therefore habitat for wetland and floodplain species), flushing of coarse woody debris on floodplains or snags in waterways, loss of soil, scouring and erosion exposing roots of plants, changes in sediment distribution, and potential increased prevalence of invasive weeds to areas of increased inundation (or inundation during more frequent flood events).

Unmitigated, the Project has the potential to impact the surrounding environment (including TECs, MNES species and associated habitat) by altering flooding and hydrological regimes, including increased and decreased areas of inundation. Impacts on MNES associated with flooding were assessed through a stepped process detailed in the following sections.

5.2.10.1 RISK ASSESSMENT

Protected matters were included in the initial flooding assessment if they met one of the following criteria:

- Sensitive to or threatened by changes in hydrological regimes as identified in the literature.
- Inhabits aquatic, wetland, riparian or floodplain environments (so that indirect impacts to habitats is considered).
- Have low and/or terrestrial mobility (highly mobile species (e.g., birds and bats) and species that do not come to the ground (e.g., gliders) can generally avoid changes in flood regimes). Additionally, the potential impacts to the habitat for these species (i.e., birds, bats and gliders) would have to be substantial for the habitat to become unusable for them (e.g., death of large trees, long-term reduction in flowering productivity, vegetation structural changes).

These criteria were used to assess whether protected matters are at negligible, low, medium or high risk to changes in hydrology (see Table 5-6). Although migratory shorebirds can inhabit wetland areas, their risk rating was determined to be negligible due to their likely increased use of the area following flood events. The changes to flooding caused by the Project are unlikely to impact these species, as they can be attracted to suitable habitat during and after floods. The Project will not impact on the overall frequency and size of flood events, and therefore, will not impact the use of the area surrounding the Project by these species.

TABLE 5-6 RISK ASSESSMENT FOR FLOODING IMPACTS TO MNES

Scientific name	Common name	EPBC Act	Low and/or terrestrial mobility	Inhabits aquatic, wetland, riparian, or floodplain environments	Threatened by changes in hydrology	Risk rating
Brigalow TEC		E	Yes	-	Yes	Medium
Box-gum grassy woodland TEC		CE	Yes	-	Yes	Medium
SEVT TEC		E	Yes	-	-	Low
Natural grassland TEC		CE	Yes	-	Yes	Medium
<i>Acacia lauta</i>	Tara wattle	V	Yes	-	-	Low
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	Yes	Yes	-	Medium
<i>Clematis fawcettii</i>	Stream clematis	V	Yes	Yes	-	Medium
<i>Dichanthium queenslandicum</i>	King bluegrass	E	Yes	-	-	Low
<i>Dichanthium setosum</i>	Bluegrass	V	Yes	-	-	Low
<i>Homopholis belsonii</i>	Belson's panic	V	Yes	-	-	Low
<i>Lepidium monoplacoides</i>	Winged peppergrass	E	Yes	Yes	Yes	High
<i>Picris evae</i>	Hawkweed	V	Yes	-	-	Low
<i>Rhaponticum australe</i>	Austral cornflower	V	Yes	-	-	Low
<i>Thesium australe</i>	Austral toadflax	V	Yes	-	-	Low
<i>Westringia parvifolia</i>	Small-flowered westringia	V	Yes	-	Yes	Medium
<i>Xerothamnella herbacea</i>	-	E	Yes	Yes	-	Medium
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	-	-	-	Negligible
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	-	Yes	Yes	Medium

Scientific name	Common name	EPBC Act	Low and/or terrestrial mobility	Inhabits aquatic, wetland, riparian, or floodplain environments	Threatened by changes in hydrology	Risk rating
<i>Calidris ferruginea</i>	Curlew sandpiper	CE; Ma; Mi	-	Yes	-	Negligible – see text above table
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	-	-	-	Negligible
<i>Grantiella picta</i>	Painted honeyeater	V	-	-	-	Negligible
<i>Lathamus discolor</i>	Swift parrot	CE; Ma	-	-	-	Negligible
<i>Rostratula australis</i>	Australian painted snipe	E; Ma	-	Yes	Yes	Medium
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (southeastern mainland population)	E	Yes	-	-	Low
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	-	-	-	Negligible
<i>Petauroides volans</i>	Greater glider (southern and central)	E (uplisted from V effective 05/07/22)	-	-	-	Negligible
<i>Phascolarctos cinereus</i>	Koala	E (uplisted from V effective 12/02/22)	Yes	-	-	Low
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V	-	-	-	Negligible
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	V	Yes	-	-	Low
<i>Delma torquata</i>	Collared delma	V	Yes	-	-	Low
<i>Egernia rugosa</i>	Yakka skink	V	Yes	-	-	Low
<i>Furina dunmalli</i>	Dunmall's snake	V	Yes	-	-	Low

Scientific name	Common name	EPBC Act	Low and/or terrestrial mobility	Inhabits aquatic, wetland, riparian, or floodplain environments	Threatened by changes in hydrology	Risk rating
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	Yes	Yes	-	Medium
<i>Maccullochella peelii</i>	Murray cod	V	-	Yes	-	Low
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	Yes	Yes	-	Medium

5.2.10.2 HABITAT MAPPING OUTSIDE OF THE PROJECT FOOTPRINT

Habitat for protected matters was mapped outside of the Project footprint to 5 km from the centreline of the Project footprint using the habitat mapping rules for each species and TECs according to their analogous REs, as presented in Appendix F Species and Community Profiles. This area covered the modelled changes in flooding for the 1% AEP scenario as presented in EIS Chapter 14: Flooding and Geomorphology. While using the same mapping rules, the key difference in habitat mapping in this 5 km buffered area to the habitat mapping within the Project footprint is the use of State regulated vegetation mapping (desktop based) in the 5 km buffer area compared to ground-truthed RE mapping (field verified) within the Project footprint. Where available in some areas (e.g., offset properties), ground-truthed RE mapping was used to inform habitat mapping. Ozius Biome Specht classified data (20m pixel (20m x 20m)) was also used to map habitat more accurately (Ozius Pty Ltd).

5.2.10.3 ASSESSMENT OF SUSCEPTIBILITY

This habitat mapping was overlaid with the change maps for inundation area for the 1% AEP flood scenario and the percentage of habitat impacted outside the Project footprint was calculated. This assessment was conducted for habitat within a 1 km buffer of the rail line to compensate for potential dilution of impacts to habitat due to not all flood impacts extending out to 5 km from the rail line. Each protected matter was assigned a susceptibility rating, based on the percentage of habitat impacted. Ratings were either negligible (<1% of habitat impacted), low (1-3%), medium (3-5%) or high (>5%) (see Table 5-7). Protected matters with a medium or high susceptibility rating (>3% of habitat impacted) were then assessed for flooding impacts in detail.

This assessment identified three species for further assessment, namely hairy-joint grass (*Arthraxon hispidus*), winged peppergrass (*Lepidium monoplacoides*), and small-flowered westringia (*Westringia parvifolia*). Habitat mapping outside of the Project footprint for these species is presented in Appendix F Species and Community Profiles. No TECs or fauna habitat were triggered for further assessment.

TABLE 5-7 FLOOD SUSCEPTIBILITY ASSESSMENT USING THE 1% AEP (1 IN 100 YEAR) FLOOD SCENARIO

Scientific name	Common name	EPBC Act	Risk rating	Habitat impacted by change in inundation area (%) ¹	Susceptibility rating ²
Brigalow TEC		E	Medium	2.94	Low
Box-gum grassy woodland TEC		CE	Medium	0.00	Negligible
SEVT TEC		E	Low	0.01	Negligible
Natural grassland TEC		CE	Medium	1.54	Low
<i>Acacia lauta</i>	Tara wattle	V	Low	0.11	Negligible
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	Medium	6.33	High

Scientific name	Common name	EPBC Act	Risk rating	Habitat impacted by change in inundation area (%) ¹	Susceptibility rating ²
<i>Clematis fawcettii</i>	Stream clematis	V	Medium	0.00	Negligible
<i>Dichanthium queenslandicum</i>	King bluegrass	E	Low	0.00	Negligible
<i>Dichanthium setosum</i>	Bluegrass	V	Low	1.13	Low
<i>Homopholis belsonii</i>	Belson's panic	V	Low	1.56	Low
<i>Lepidium monoplacoides</i>	Winged peppergrass	E	High	4.08	Medium
<i>Picris evae</i>	Hawkweed	V	Low	0.06	Negligible
<i>Rhaponticum australe</i>	Austral cornflower	V	Low	0.08	Negligible
<i>Thesium australe</i>	Austral toadflax	V	Low	0.00	Negligible
<i>Westringia parvifolia</i>	Small-flowered westringia	V	Medium	3.33	Medium
<i>Xerothamnella herbacea</i>	-	E	Medium	0.39	Negligible
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	Medium	0.00	Negligible
<i>Rostratula australis</i>	Australian painted snipe	E; Ma	Medium	0.00	Negligible
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (southeastern mainland population)	E	Low	0.56	Negligible
<i>Phascolarctos cinereus</i>	Koala	E (uplisted from V effective 12/02/22)	Low	0.76	Negligible
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	V	Low	0.17	Negligible
<i>Delma torquata</i>	Collared delma	V	Low	1.77	Low
<i>Egernia rugosa</i>	Yakka skink	V	Low	0.60	Negligible
<i>Furina dunmalli</i>	Dunmall's snake	V	Low	0.58	Negligible
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	Medium	0.37	Negligible
<i>Maccullochella peelii</i>	Murray cod	V	Low	0.82	Negligible

Scientific name	Common name	EPBC Act	Risk rating	Habitat impacted by change in inundation area (%) ¹	Susceptibility rating ²
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	Medium	1.30	Low

Table notes:

¹The percentage of habitat was calculated within 1 km of the rail line.

²Susceptibility ratings: negligible (<1% of habitat impacted), low (1-3%), medium (3-5%), high (>5%).

5.2.10.4 QUANTIFICATION OF FLOODING IMPACTS

Water flow changes for the flood events 20% AEP, 10% AEP, and 5% AEP were used to assess impacts to the three flora species and their habitats. These more frequent flood events are likely to be more relevant to threatened species, communities and their habitats. Any changes to water flow during larger, less frequent floods (2% AEP or 1 in 50-year flood and larger) are unlikely to be biologically meaningful during such large flood events.

In assessing potential impacts, each species was considered as well as potential changes to essential features of species habitat. Impacting variables and thresholds for significant impact used were species-specific. For flora species, this generally included areas of increased or decreased inundation, duration of inundation exceeding 36 hours (only where this was below 36 hours for the existing case) and increases in velocity greater than 1 m/s. The threshold of 36 hours for flora was used as an estimation of the inundation time for anoxia to occur.

For hairy-joint grass (*Arthraxon hispidus*) and small-flowered westringia (*Westringia parvifolia*), increased habitat areas experiencing inundation were considered to potentially impact the species. Alternately, for winged peppercress (*Lepidium monoplacoides*), decreased habitat areas experiencing inundation were considered to potentially impact the species. This is because winged peppercress inhabits areas that are periodically inundated and can suffer losses when drying occurs. Additionally, changes in velocity were not considered important for small-flowered westringia, as this species is a shrub and likely to be resilient to flood velocities predicted to be experienced in overland flow (estimated to be below 1.5 m/s in its habitat for the developed case). Changes to peak flood depth was not considered to be a significantly impacting variable when assessing potential impacts for these species.

5.2.10.5 IMPACT ASSESSMENT

A significant impact was determined to occur if over 10% of habitat is predicted to be impacted beyond the set threshold for the impacting variable. For example, for a significant impact to be determined for a flora species, over 10% of its habitat would be impacted by either additional (or reduced, depending on the species) inundation area, increased flow velocities >1 m/s, and/or increase in inundation duration to over 36 hours.

Quantification and determination of potential significant impacts for the three flora species are presented in Table 5-8. Where a decrease in inundation area was identified as an impacting variable, the depth and duration of inundation for the existing case was further interrogated to contextualise the change. Similarly, where an increase in inundation area was identified as an impacting variable, the depth and duration of inundation for the developed case was further

interrogated (see Table 5-8). No species were assessed as significantly impacted by changes to flooding.

TABLE 5-8 QUANTIFICATION OF FLOODING IMPACTS AND DETERMINATION OF SIGNIFICANT IMPACT

Species	Risk rating	Impacting variable(s)	Threshold for significant impact	Area significantly impacted (ha)
Hairy-joint grass (<i>Arthraxon hispidus</i>)	Medium	Increase in inundated area	>10% of habitat impacted	0 ha
			Greatest area of increased inundation was 18.69 ha (1.09% of habitat) for the 5% AEP flood scenario. This area is predicted to be inundated for <10 hours at a peak depth of <0.25 m under the developed flood case.	
		Duration of inundation	Increase to >36 hrs of inundation for >10% of habitat	0 ha
			Maximum time of inundation for developed case was 20 hrs for all flood scenarios.	
		Increase in velocity	>1 m/s increase in velocity for >10% of habitat	0 ha
			Greatest area of increase in velocity >1m/s was 22.47 ha (1.32% of habitat) for the 20% AEP flood scenario.	
Winged peppergrass (<i>Lepidium monophloeoides</i>)	High	Decrease in inundated area	>10% of habitat impacted	0 ha
			Greatest area of decreased inundation was 7.89 ha (1.35% of habitat) for the 5% AEP flood scenario. This area under the existing flood case is estimated to be inundated for <10 hours at a peak depth of <0.25 m.	
		Duration of inundation	Increase to >36 hrs of inundation for >10% of habitat	0 ha
			Greatest area of decreased inundation was 7.89 ha (1.35% of habitat) for the 5% AEP flood scenario. This area under the existing flood case is estimated to be inundated for <10 hours at a peak depth of <0.25 m.	
		Increase in velocity	>1 m/s increase in velocity for >10% of habitat	0 ha
			Greatest area of increase in velocity >1m/s was 15.79 ha (2.68% of habitat) for the 20% AEP flood scenario.	
	Medium		>10% of habitat impacted	0 ha

Species	Risk rating	Impacting variable(s)	Threshold for significant impact	Area significantly impacted (ha)
Small-flowered westringia (<i>Westringia parvifolia</i>)		Increase in inundated area	Greatest area of increased inundation was 11.10 ha (2.82% of habitat) for the 20% AEP flood scenario. This area is predicted to be inundated for <10 hours at a peak depth of <0.25 m under the developed flood case.	
		Duration of inundation	Increase to >36 hrs of inundation for >10% of habitat	0 ha
			Greatest area of increased duration of inundation to over 36 hours was 1.28 ha (0.33% of habitat) for the 5% AEP flood scenario. It should be noted that this does not include areas that were predicted to currently be inundated for periods greater than 36 hours under the existing flood scenario.	

The revised reference design has incorporated significant flooding infrastructure such as bridges and culverts to maintain existing flow paths and flood-flow distributions and minimise the potential for adverse impacts to the surrounding environment from changed overland flow and flooding conditions leading to erosion, sedimentation, increased risks of flooding and environmental concerns. This includes the Condamine River floodplain where significant bridges have been incorporated into the Project's revised reference design with a combined opening width of greater than 6 km. The Project's cross drainage infrastructure (bridges and culverts) includes 1,193 reinforced concrete box culverts, 2,134 reinforced concrete pipe culverts, a series of viaducts/bridge structures spanning approximately 11 km and rock scour protection at culvert outlets.

Bridge and culvert structures have been located and sized to minimise increases in peak water levels, flow distribution, velocities, time of inundation and hazard in order to minimise risks to surrounding property and the environment. The replacement of sections of existing rail track with limited drainage infrastructure, with the new Inland Rail track with larger drainage structures will return the drainage and flow conditions in these areas to a more natural state than currently exists. This includes areas around Yelarbon, where habitat for both winged peppercress (*Lepidium monoplacoides*) and small-flowered westringia (*Westringia parvifolia*) is present.

Site specific soil and geomorphology assessments have been undertaken to ensure potentially dispersive and other high risk soils have been identified, including in floodplains and watercourses, and design mitigations incorporated such as culvert configurations and scour and erosion protection measures, to mitigate erosion, sedimentation and landform risks.

The Project's impacts on hydrology and flooding in relation to non-ecological matters are discussed in detail within Appendix T1: Hydrology and Flooding Technical Report.

5.2.11 EROSION AND SEDIMENTATION

During construction and operation of the Project, there is potential for significant impact to topsoil structure and quality, as well as the underlying subsoil, resulting from disturbance. This can lead to the exposure of subsurface soils vulnerable to accelerated erosion, sedimentation, dispersivity, and/or salinity due to their physical and chemical characteristics. As described in detail in Chapter 9: Land Resources and revised draft EIS Appendix J – Soil Assessment Report, soils within the Project footprint are as follows:

- Vertosols (i.e. cracking clays and gilgai);
- Dermosols (i.e. non-cracking clays);
- Ferrosols (i.e. non-cracking clays);
- Hydrosols (i.e. saturated non-cracking clays);
- Anthrosols (i.e. non-cracking clays disturbed by human activities);
- Rudosols (i.e. sands, loams and clay loams with negligible pedological development);
- Tenosols (i.e. sands, loams and clay loams with some pedological development);
- Sodosols (i.e. sandy to loamy soils);
- Chromosols (i.e. sandy to loamy surface); and
- Kurosols (i.e. sandy to loamy surface).

Soils of particular concern for management and stability will be those that are dispersive, erosion prone soils (i.e. vertosols, sodosols, kurosols, dermosols, tenosols and ferrosols). However, regardless of soil type, erosion risk will be increased where the following activities occur:

- Clearing and disturbance of vegetative cover, including groundcover;
- Changes in topography, drainage patterns and localised concentration of storm water flows due to construction of both access tracks and the rail corridor;
- Excavation or cuttings and stockpiling of material;
- Construction during high rainfall events, particularly erosive rainfall events; and
- Constructing through areas with high soil erodibility risks (e.g. sodosols).

Terrestrial impacts associated with erosion and sedimentation include compaction of soils, loss of soil structure, nutrient degradation, and increased soil salinity, all of which can lead to reductions in the carrying capacity of the terrestrial environment due to decreasing habitat value. Erosion and subsequent sedimentation can be damaging to the ecological health of waterways and may be a proximate cause of environmental degradation

The primary impact of erosion on terrestrial habitat has potential to occur within areas of exposed soil, stockpile locations, or localised areas in proximity to Project infrastructure (e.g. culverts and bridges) during rainfall events. The changes to overland flow paths from erosion have the potential to have a localised direct impact on terrestrial habitats. These impacts are principally associated with a loss of substrate stability around vegetation and may result in a loss of vegetation quality and cover.

5.2.12 CHANGES TO GROUNDWATER RESOURCES

Construction for the Project includes activities that have the potential to impact on groundwater resources. These activities include site preparation, bulk earthworks (cut-and-fill sections), drainage construction, haul road and access track construction, bridge pilings, and the excavation of borrow pits for construction materials. Potential impacts may include groundwater level reduction, alteration of aquifer flow patterns, the settlement of compressible substates and reductions in groundwater quality.

During operations, the Project has the potential to result in alterations in existing groundwater flow pathways due to the new infrastructure and/or modified landforms, drawdown due to seepage, and contamination of groundwater as a result of unintended spills and leaks of hydrocarbons (oils, fuels, and lubricants) and other chemicals related to maintenance activities (accidental discharge, grinding and blasting) or rail incidents (e.g. loss of load). Terrestrial GDEs are susceptible to indirect impacts from changes to groundwater resources. For example, a reduction in groundwater level may cause spring wetlands to reduce in size or dry up, resulting in a contraction of wetland extent, loss of aquatic habitat and reduction in species diversity. A decline in groundwater quality may also affect aquatic organisms living underground (e.g. stygofauna) or present within surface waters that are sourced from impacted aquifers.

While none of the threatened TECs or species rely on GDEs as a key habitat requirement, the Project has the potential to indirectly impact the availability or quality of habitat through the changes to groundwater hydrology. Changes to groundwater resources may reduce habitat quality, as areas that have been historically moist dry up or vice versa. Some threatened flora

species such as small-flowered westringia (*Westringia parvifolia*) and threatened communities such as the natural grassland TEC are sensitive to changes in water availability. Additionally, changes to groundwater resources may impact water retention of soils and the overall leaf litter moisture content, which may in turn reduce habitat viability for brigalow woodland snail (*Adclarkia cameroni*).

An evaluation of the potential impacts of the Project on groundwater resources (Chapter 15: Groundwater) concluded that the majority of potential impacts are temporary in nature and related to the construction phase of the Project. A small number of locations were identified where construction activities have the potential to intersect shallow groundwater resources, however, it is unlikely that the Project will have a significant impact on drawdown, and any impact will be temporary. Several studies in the region have concluded that a significant impact to vegetation condition within GDEs occurs when drawdown is reduced by 9 meters or greater (Kath et al., 2014; Pfautsch et al., 2015). As such, engineering controls were assessed to be sufficient to mitigate the extent of impacts. Additionally, due to the nature of the floodplain, the region is accustomed to seasonal variation in surface water levels (Holland et al., 2016; DES, 2019a) to recharge the groundwater aquifer. Further details on the predicted changes to groundwater resources are provided in the Appendix U: Groundwater Technical Report.

5.2.13 CONTAMINATION

5.2.13.1 CREATION OF CONTAMINATED LAND

Land contamination may be created by activities undertaken during the construction and operation of the Project. Broadly, the potentially contaminating activities through these Project phases include:

- Movement of contaminated materials (soils or water) from a source of contamination to an uncontaminated location, for example:
 - The stockpiling of contaminated material on land that is not contaminated; and
 - The discharge or dispersion of contaminated water onto land that is not contaminated.
- Accidental leaks or spills leading to migration of contaminants through surface water, soil and/or groundwater. Such incidents may arise due to inappropriate storage of dangerous goods and hazardous materials or poor handling of these materials.

Significant soil and water contamination has the potential to impact on the health of species exposed to the contaminants and lead to habitat degradation.

During the construction phase, the following facilities will be provided for safe storage and distribution of construction chemicals:

- Laydown areas (see Section 1.6.8.7) -small quantities of lubricants and oil (i.e. drum in intermediate bulk container package stores) will be stored at these locations; and
- Diesel fuel depots (see Section 1.6.8.8) - up to 20,000 L will be stored at two nominated laydown areas.

During construction, laydown areas will be used for the storage and distribution of hazardous materials required for construction purposes. Storage areas will be bunded, capacity restricted to no larger than required for reasonable operations, and preferentially stored at the furthest point away from watercourses.

During operations, the Project has the potential to result in contamination as a result of unintended spills and leaks of hydrocarbons (oils, fuels, and lubricants) and other chemicals related to maintenance activities (accidental discharge, grinding and blasting) or rail incidents (e.g. loss of load).

5.2.13.2 DISTURBANCE OF EXISTING CONTAMINATED LAND

An assessment of contaminated land within the Study area was undertaken using a contaminated land risk assessment (Chapter 9: Land Resources) based on a contaminant (source)-pathway-receptor methodology, whereby:

- **Contaminant (source):** A substance present in or on land, water or site at above background concentrations that presents, or has the potential to present, a risk to human health, the environment, or any ecological value;
- **Pathway:** The route by which the source is brought into contact with the receptor. This can include the transport of contamination via water (i.e. surface and groundwater), aeolian deposition, vapours, excavation, and deposition; and
- **Receptor:** Humans, other living organisms, physical systems and built structures that could be affected by the source. A receptor will only be affected if a pathway from the source to the receptor is present. Groundwater and surface water systems can be considered as receptors as their quality is regulated by statutory bodies, and being pathways for contaminant migration to other receptors.

The source-pathway-receptor relationship allows an assessment of potential environmental risk to be carried out, based on the nature of the source, the degree of exposure of a receptor to a source (via pathways), and the sensitivity of the receptor.

A total of 23 lots (including 16 QR corridor and 7 developed/undeveloped lots) intersecting either the permanent project components (predominately the rail corridor and roads) or temporary disturbance components (laydowns, construction zones, camps, etc.) are currently identified on the Environmental Management Register (EMR). These include existing railway yards and corridors, waste disposal and commercial facilities.

Based on the findings of site assessments, potential sources of contamination and contaminants of concern are considered to include:

- Existing land uses - surrounding and directly intercepted by the Project (agricultural, commercial and mining) – storage and use of chemicals/fuel, farm buildings/structures, livestock dips/spray races, existing brownfield railway corridors and rail yards potentially historically sprayed pesticides and herbicides and associated with elevated arsenic;
- Existing rail corridor - Metals, asbestos, hydrocarbons, and pesticides/herbicides; and
- Unknown fill material exposed during site earthworks (e.g. associated with railway corridors and other developed land uses) - Asbestos, metals/metalloids, and hydrocarbons.

Construction activities for the Project have the potential to disturb existing contaminated land. The disturbance of contaminated soil or water during Project activities have the potential to contaminate previously unaffected soil or water, degrade ecosystem health and affect threatened species health through dermal contact or ingestion of contaminants.

5.3 POTENTIAL IMPACTS TO AQUATIC ECOLOGICAL VALUES

5.3.1 CLEARING OF RIPARIAN VEGETATION

Disturbance to riparian vegetation and aquatic environments within the bed and banks of watercourses will be minimised as much as practicable however will be unavoidable to enable infrastructure such as piers and bridge structures to be constructed. Crossings have been designed to reduce impacts to riparian vegetation and the bed and banks of defined watercourses as much as possible whilst still meeting the performance specifications for Inland Rail, including hydraulic and structural requirements of the crossing infrastructure in terms of structure's placement, size, and design criteria.

Clearing of riparian vegetation will result in the removal of habitat for some aquatic species. This is relevant to the Murray cod (*Maccullochella peelii*), as preferred micro-habitat for the species includes pieces of large submerged woody debris, tree stumps, logs, branches and other woody structures. The degree of riparian vegetation clearing and the scale of impact, will vary across the alignment, depending on the size and scale of waterways and the extent of existing disturbance (including existing rail infrastructure).

Clearing of vegetation for construction has the potential to alter temperature and light regimes of aquatic habitats. Increased light penetration into creeks which originally had dense canopy cover may potentially affect the flora composition of aquatic habitats, resulting in a reduction in the abundance and distribution of light-sensitive aquatic plants. Increased light can also be expected to promote the growth of algae and invasive aquatic plants, which may outcompete other plant species and reduce the complexity of aquatic habitats and species diversity. Increased light can also be expected to result in an increase in daytime water temperatures, affecting biological processes such as respiration rates of aquatic organisms, and displacing native species that are not tolerant of high temperatures.

5.3.2 MODIFICATION OF AQUATIC HABITAT

The installation of artificial structures such as culverts and bridge pylons within waterways will result in some impacts on aquatic flora and fauna habitat values including the natural materials, such as rocks and gravel, that comprise the habitat, the types of vegetation present, such as snags and aquatic plants, and the shape and nature of the habitat (e.g. pools and riffles).

Temporary waterway crossings may be necessary during construction where there is bridge infrastructure in the actual watercourse and construction is required in that specific area, to enable safe and efficient construction of waterway crossing structures. Temporary waterway crossings typically consist of rock-filled embankments, with culverts providing continuity of stream flow through the embankment. Culverts will be of appropriate size and number to ensure there is no impoundment of water upstream of the crossing.

Such works may involve the disturbance and removal of stream bed sediments, and changes in habitat structure from a soft bottom to a hard bottom both during construction as a result of access requirements and permanently. Some types of infrastructure may increase habitat availability for native and exotic fauna species that are able to utilise a broad range of habitat types, which are lacking in structural complexity. This will reduce available habitat for species that require structural complexity for habitation, nesting or breeding. For example, naturally occurring woody debris habitat generated by riparian vegetation may be replaced with bridge

pylons or culverts, resulting in a change in the abundance and diversity of fish species in that location and adjacent areas.

5.3.3 WATERWAY BARRIER EFFECTS

Permanent and temporary instream structures will be required for the Project at waterway crossings as described in Section 1.6.8.12 and Section 1.6.8.13 respectively. These structures have the potential to create physical and behavioral barriers to fish passage. Physical barriers would generally relate to where the Project introduces a new physical obstruction in the watercourse that may become a physical barrier to fish moving downstream. Behavioral barriers may relate to changes to the conditions of the watercourse at a particular area that may affect fish passage, such as shading from culverts or bridges affecting water temperatures or localised changes in flow speed/direction caused by instream structures that may present a barrier to movement for some species.

There are six major creeks (Pariagara Creek, Bringalily Creek, Nicol Creek, Native Dog Creek, Back Creek and Grasstree Creek) and two major rivers, being the Macintyre River and Condamine River with potential habitat for Murray cod (*Maccullochella peelii*), which will be intersected by the Project. Fish-friendly bridge crossings are proposed at most higher order waterway crossings to minimise potential physical and behavioural fish movement impacts.

5.3.4 ALTERED HYDROLOGY

The installation of artificial structures such as culverts has the potential to alter natural stream flows and volumes in some locations (see Chapter 14: Flooding and Geomorphology). Hydrologic and hydraulic modelling predicted minimal impacts from Project infrastructure on flood flows, floodplain coverage and flow velocities under a range of flow scenarios. Predicted changes in flow velocities were limited in scale to immediately upstream and downstream of culverts. At these locations, such changes may cause minor changes to the location, abundance and structure of aquatic habitats, such as pools, channels, riffles and dry creek beds. This can be expected to result in minor changes to the composition and diversity of aquatic organisms in affected locations and disturbance of aquatic species lifecycles may occur. Additionally, changes to hydrologic flow may result in habitat degradation through the introduction and establishment of weeds.

Murray cod (*Maccullochella peelii*) has the potential to be impacted by changes to hydrology which may occur as a result of the project. Flooding is a natural phenomenon and a component to which cod has become particularly well adapted. Murray cod recruitment success has been linked to increased water flow and the associated impacts, as higher water levels enhance the survival of eggs, larvae and juveniles (DoE, 2024d). However, a flood event or water release coinciding with spawning and the hatching and early development of larvae can flush larvae downstream out of the nest before they are ready to disperse. These larvae can then be diverted out of the main channel and into areas without suitable microhabitat features (DoE, 2024d). Increased flow rate associated with high flood events also negatively impact adult individuals as they prefer slow-flowing, turbid water (Kalatzis and Baker, 2010).

The Murray cod was included in the flooding impact assessment (see Section 5.2.10) and it was determined that the impacts are likely to be insignificant, with detailed quantification and assessment not being required.

5.3.5 WATER QUALITY

As discussed in detail in Section 5.2.13, construction activities have the potential to result in the introduction of contaminants into waterways, resulting in declines in water quality (e.g. from fuel spills). Similarly, the use of herbicides during future track maintenance has the potential to impact on vegetation and fauna living in and adjacent to waterways. An increase in access to aquatic habitat by people during construction (i.e. construction workforce) has the potential to result in litter being deposited within or adjacent to waterways. Such contaminants can be expected to reduce water quality and the quality of aquatic habitats in areas affected, and adjacent areas downstream.

Reduced water quality is a major threat impacting Murray cod (*Maccullochella peelii*), Construction activities have the potential to result in the introduction of contaminants into waterways, leading to declines in water quality.

5.3.5.1 INCREASED TURBIDITY AND SEDIMENTATION

Erosion and subsequent sedimentation can be damaging to the ecological health of waterways and may cause environmental degradation. Mobilised coarse sandy sediment tends to accumulate in areas of slow-flow and may smother bottom-dwelling organisms and their habitats. Deep, permanent river pools, that are valuable habitats for aquatic fauna and refuges for wildlife during summer and drought, may become filled by coarse sediments, which may render them ineffective in relation to their ability to support aquatic species. Large sediment accumulations can cause upstream flooding or deflect the flow into the adjacent stream bank or even onto adjacent land, causing further erosion. Transported sediments can fill the deep permanent pools of rivers to ruin this critical refuge habitat.

Works adjacent to waterways, and disturbance of bed and banks, will result in the exposure of soils which may be mobilised by rainfall and run off into adjacent aquatic habitats and also affect areas downstream. Stockpiling of soils close to waterways is also a potential source of sediment inputs into aquatic habitats. Increased runoff to waterways is likely to result in a decline in water quality, through an increase in turbidity and TSS concentrations, and potentially, an increase in the concentration of sediment-bound contaminants such as metals.

Suspended solids have the potential to impact on fish by disrupting the function of gills, reducing underwater visibility for predatory species such as EPBC Act listed Murray cod (*Maccullochella peelii*), and displacing species that are not tolerant of variable and turbid water quality conditions. This may result in localised fish kills or the displacement of aquatic species to adjacent areas. Metals and other contaminants bound to sediments that wash into waterways may have a toxic effect on aquatic organisms or reduce the quality of drinking water for stock. Such effects are likely to be relatively localised (over a scale of hundreds of meters) and will reduce with distance downstream from the source.

Mobilised coarse sandy sediment tends to accumulate in areas of slow-flow and may smother bottom-dwelling organisms and their habitats. Deep permanent river pools, that are valuable habitats for aquatic fauna and refuges for wildlife during summer and drought, may become filled by coarse sediments, which may render them ineffective in relation to their ability to support aquatic and terrestrial species.

Large sediment accumulations can cause upstream flooding or deflect the flow into the adjacent stream bank or even onto adjacent land, causing further erosion and transported sediments can fill the deep permanent pools of rivers to ruin this critical refuge habitat.

5.3.5.2 ALTERED WATER CHEMISTRY

Alterations to water chemistry include changes in salinity, nutrients or contaminants other than sediments. Alterations may impact on the aquatic ecosystem condition of the downstream waterway system and may be altered as a result of the following processes:

- Clearing and construction activities,
- Accidental spills and leaks of chemicals or fuels from construction equipment or fuel storages,
- Flow diversions,
- Erosion of stockpiled materials, which could lead to increased nutrient concentrations in overland flow.

Disturbance and exposure of saline soils during construction has the potential to increase salinity in overland flows. The Project footprint directly intersects moderate to high salinity hazard rating areas, which may result in discharge of saline runoff into proximal waterways. The risk is low where there is existing disturbance at points where the Project alignment crosses the waterways, e.g. existing rail corridor. Changes to riparian vegetation communities, stockpiling of sediment and Project-associated earthworks may result in saline discharge at drainage points into watercourses proximal to high salinity hazard areas.

Nutrient loading occurs when nutrients migrate into waterways with sediment lost from cleared areas, stockpiles and rehabilitation areas. This has the potential to:

- Change light conditions and water temperature.
- Smother aquatic life and prevent photosynthesis for aquatic flora.
- Affect downstream environments.
- Impact upon breeding and lifecycle of aquatic fauna.

Contamination of waterways may occur as a result of accidental spills and leaks of chemicals or fuels from construction equipment or fuel storages, which could introduce chemicals into overland flows and chemical spills, or due to inappropriate storage controls resulting in an introduction into waterways of fuels and oils used for construction machinery.

Contaminants may also leach from the following sources during construction:

- Residual heavy metals from rail grinding and welding,
- Pollutants within ballast materials,
- Dewatering activities leading to liberation of toxicants from potentially contaminated land, and
- Contaminated land disturbance, which has the potential to result in contaminated runoff into waterways.

5.3.6 INVASION OF AQUATIC WEEDS AND PEST SPECIES

Construction of new rail infrastructure has the potential to increase the abundance of weeds and pests and introduce new weed and pest species. The disturbance of existing weeds along

the riparian corridor may result in the spread of propagules downstream, or the transport of propagules to other areas either on machinery or through natural dispersal once disturbed.

Some farm dams likely to contain exotic species will need to be dewatered to facilitate construction of the Project. This may result in the spread of pest (e.g. exotic fish species) and weed species, such as alligator weed (*Alternanthera philoxeroides*) and para grass (*Urochloa mutica*), to adjacent waterways, if not managed appropriately, resulting in a reduction in aquatic habitat quality and species diversity. There are some aquatic weed species that are present in the GRC and TRC local government areas that are present in one and not the other or the surrounding local government areas (GRC, 2019; TRC, 2020). The movement of machinery and vehicles across the Study area during the pre-construction, construction and operational phases of the Project has the potential to spread weeds into new localities.

Introduced fish species such as mosquitofish (*Gambusia holbrooki*) or carp (*Cyprinus carpio*) are a known threat to Murray cod (*Maccullochella peelii*), with associated impacts including the predation, competition, habitat alteration and spread of parasites and infectious diseases (Murray Cod Recovery Team, 2010).

5.3.7 DISTURBANCE FROM NOISE, VIBRATION AND LIGHTING

A range of construction activities are likely to result in an increase in noise and vibrations in the vicinity of waterways, reducing habitat quality and increasing disturbance to sensitive fauna. Noise modelling conducted for the Project did not assess noise impacts in water (as modelling was primarily an assessment of airborne noise, however, noise impacts in water have not been addressed). Therefore, impacts to native fauna that reside within waterways (i.e., aquatic in nature) have not been quantitatively assessed with respect to noise and vibrations for either the construction or operation phases of the Project.

Noise may be created by earthworks, use of heavy machinery or piling in or adjacent to aquatic habitats. Species that are easily disturbed may move to adjacent areas to avoid being disturbed, if suitable habitat exists. Night works will involve the installation of temporary lighting for safety and operational purposes which may also result in disturbance to sensitive aquatic fauna. Increased light intensity may significantly impact Murray cod juvenile growth rate, however photoperiod was not found to have a significant impact (Di et al., 2023). Such effects are likely to result in a reduction in aquatic habitat quality and species diversity at the locations affected, and adjacent areas. Such noise and vibration may persist into the operation phase, at a reduced magnitude, and occur at frequent intervals each time that a train traverses the Project.

5.3.8 CHANGES TO GROUNDWATER RESOURCES AFFECTING GROUNDWATER DEPENDENT ECOSYSTEMS

Project activities have the potential to impact on groundwater resources through effects such as groundwater level reduction, alteration of aquifer flow patterns, the settlement of compressible substrates and reductions in groundwater quality. GDEs are susceptible to indirect impacts from changes to groundwater resources. For example, a reduction in groundwater level may cause spring wetlands to reduce in size or dry up, resulting in a contraction of wetland extent, loss of aquatic habitat and reduction in species diversity. A decline in groundwater quality may also affect aquatic organisms living underground (e.g. stygofauna) or present within surface waters that are sourced from impacted aquifers.

Regional aquatic GDE data from the GDE Atlas indicates that there are no high potential aquatic GDEs traversed by, or in proximity to, the Project footprint and one high potential terrestrial GDE located near Yelarbon. The nearest spring is Stone Spring, located 2 km west of Ch 173.0. There are numerous areas with low-to-moderate potential to support aquatic GDEs; therefore, there is potential for such GDEs to be impacted by possible dewatering or changes in groundwater quality and/or levels during the construction stage of the Project.

An evaluation of the potential impacts of the Project on groundwater resources (EIS Chapter 15: Groundwater) concluded that the majority of potential impacts are temporary in nature and related to the construction phase of the Project. As discussed previously in Section 5.2.12, a small number of locations were identified where construction activities have the potential to intersect shallow groundwater resources, however engineering controls were assessed to be sufficient to mitigate the extent of impacts. Controls to reduce the risk of contamination of groundwater quality from Project activities (e.g. spills) are also in place and are similar to those related to surface water quality. Further details on the predicted changes to groundwater resources are provided in revised draft EIS Appendix U: Groundwater Technical Report.

6. AVOIDANCE, MITIGATION AND MANAGEMENT MEASURES

The revised draft EIS has identified the proposed approach to environmental management and the mitigation measures that would be implemented to avoid or minimise the potential impacts of the Project. This section provides discussion of mitigation measures and controls that have been incorporated into the revised reference design development process (Section 6.2), and those measures that are proposed to be adopted for future phases of Project delivery (Section 6.3).

6.1 PRINCIPLES OF ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Ecologically sustainable development refers to using, conserving, and enhancing the community's resources so that ecological processes are maintained and the total quality of life, both now and in the future, can be increased. There are four principles of ecologically sustainable development:

- Precautionary principle
- Principle of inter-generational equity
- Conservation of biological diversity and ecological integrity
- Improved valuation and pricing of environmental resources.

It is impossible to construct major transport infrastructure, such as this Project, without causing environmental, social and/or economic impacts (beneficial and adverse). During Project development, the four principles of ecologically sustainable development were used as a guide to identify potential impacts and develop mitigation measures that afford equal weighting to environmental, social, economic, and engineering opportunities and constraints.

6.1.1 PRECAUTIONARY PRINCIPLE

The precautionary principle stipulates that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In applying the precautionary principle, decisions should be guided by:

- Careful evaluation to avoid, wherever practicable, serious, or irreversible damage to the environment; and
- An assessment of the risk-weighted consequences of various options.

The Project is aligned with the precautionary principle in the following ways:

- The assessment of potential impacts is based on best practice, using the best available information. The assessment has involved key stakeholders and the relevant government agencies.
- The impact assessment considered the maximum area of disturbance.
- The broader Inland Rail program has been subject to a number of options assessments considering various route options, in consultation with key stakeholders, to inform the finalised route cognisant of the various constraints. This has been undertaken to lead to the most optimal outcome for the delivery of the Project in a manner that avoids and minimises impacts to the greatest extent practicable.

- The revised draft EIS draws attention to aspects of the Project that may cause serious and/or irreversible environmental damage, especially if the nature and extent of the damage is uncertain. Where environmental damage cannot be avoided, mitigation and management measures to protect the receiving environment are proposed. This includes securing offsets for unavoidable impacts to biodiversity values.
- Lack of full scientific certainty has not been used as a reason for postponing measures to prevent environmental damage. For example, if the likelihood of a threatened species occurring within the Project footprint was uncertain, for instance where the habitat preferences of the species are not well known or because the species is highly cryptic, a precautionary approach was taken, and the species was considered to have potential to occur within the Project footprint. Measures to avoid and/or mitigate impacts on threatened species are proposed, on the basis that these threatened species may be present within the Study area.

The detailed design phase will aim to further minimise impacts, and site and species-specific mitigation measures will then be applied to ensure that the significance ratings of any potential impacts are classified as low as reasonably practicable, and the significant impacts are offset.

- During development of the Project, the Project footprint has been refined to:
 - Avoid sensitive vegetation, areas with known threatened flora and fauna communities, and key habitat areas, where possible;
 - Avoid known items/areas of cultural heritage significance;
 - Minimise flooding impacts; and
 - Minimise impacts on existing agricultural land and infrastructure, while also considering potential future land uses.

6.1.2 INTERGENERATIONAL EQUITY

The principle of intergenerational equity is that the present generation should maintain or enhance the health, diversity, and productivity of the environment for the benefit of future generations.

The Project is aligned with the principle of intergenerational equity in the following ways:

- When developing the revised reference design, minimising potential environmental impacts was a key consideration. This will conserve ecological values (hydrological regimes, water quality, habitat connectivity, cultural heritage sites, etc.) for existing and future generations.
- Climate change projections were factored into flood modelling for the Project, and climate change-specific mitigation measures are proposed.
- A Sustainability Management Plan will be developed prior to project works and sustainability initiatives will include engaging meaningfully with stakeholders, promoting long-term economic benefits and training and development opportunities for locals. The Sustainability Management Plan will guide detailed design and construction of the Project.

As part of the wider Inland Rail Program, the Project would benefit existing and future generations by providing a safer, more efficient, means of transporting freight between Melbourne and Brisbane.

Conversely, should the Project (and therefore Inland Rail) not proceed, the principle of intergenerational equity may be compromised. Future generations would experience increasingly worse safety and environmental impacts due to continued growth in road transport between Melbourne and Brisbane, particularly along the Newell Highway.

6.1.3 CONSERVATION OF BIOLOGICAL DIVERSITY AND ECOLOGICAL INTEGRITY

Conservation of biological diversity is defined as the preservation and protection of flora and fauna species in order to maintain a healthy and balanced ecosystem. Whilst ecological integrity is defined as the maintenance of the diversity and quality of ecosystems and enhancing their capacity to adapt to change and provide for the needs of future generations.

A broad range of impact reduction initiatives were identified and incorporated into the Project during the development of feasibility design which included protecting environmental values by rationalising the Project footprint.

Impacts on biological diversity and ecological integrity have been avoided to the greatest extent possible given the stage of the Project. For example, surveys were conducted to verify the presence, extent and quality of threatened species' habitat and ecological communities within the Project footprint. The results were used to inform the development of the revised reference design (e.g. the Project footprint has been adjusted to avoid direct and indirect impacts to SEVT TEC and narrowed to reduce impacts to box-gum grassy woodland TEC as a result of further surveys that were undertaken (refer to Sections 3.3.2.2 and 4.2.2)) and location of opportunities for fauna connectivity measures, fauna exclusion fencing, and landscaping, revegetation and rehabilitation works.

Consideration by the Project of biological diversity and ecological integrity, include the following:

- The revised reference design has been developed with the objectives of minimising potential impacts on the surrounding environment and landuse. The Project alignment was selected to avoid intersecting watercourses in the first instance, and where not possible, achieving hydraulic design criteria including 1% AEP flood immunity to rail formation level. A flooding and drainage regime has been developed that minimise impacts to the surrounding environment through the development of a flooding mitigation approach aligned to strict flooding targets (for velocity, afflux and time of inundation). Aligned with this approach, the Project has incorporated bridge and oversized culvert structures to maintain existing flow paths and flood-flow distributions through the surrounding hydraulic environment and riparian corridors.
- Regional fauna connectivity corridors for relevant target species that intersect the proposed project alignment have been identified. This has enabled regional fauna connectivity requirements to be recognised in the Project's on-going design development for required consideration of aspects such as fauna crossing structures. Cross drainage structures will be designed with consideration for DAF Accepted development requirements for operational work that is constructing or raising waterway barrier works when designing bridges and culverts across mapped Queensland Waterways for Waterway Barriers Works.
- A Rehabilitation and Landscaping Management Plan will be developed to guide the approach to rehabilitating disturbed areas. Rehabilitation will occur progressively

throughout the construction phase to reduce the impact of the Project on the surrounding environment.

- Other plans that will be developed to minimise potential impacts on biodiversity during the construction phase include a Biodiversity Management Plan, Biosecurity Management Plan and a Soil Management Plan as components of the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (Operational EMP).

Where impacts cannot be avoided, mitigation and management measures will be implemented. Where required, biodiversity offsets will be secured and the principles will be complied with. Revised draft EIS Appendix Q: Environmental Offset Delivery Strategy for the Project has been prepared and will inform the delivery of offsets in relation to significant impact upon MNES.

6.1.4 IMPROVED VALUATION, PRICING, AND INCENTIVE MECHANISMS

The principle of improved valuation, pricing and incentive mechanisms requires that environmental factors should be included in the valuation of assets and services, such as:

- Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance, or abatement;
- The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste; and
- Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

It is difficult to place a monetary value on the Project's environmental impacts. However, the value placed on environmental resources within and surrounding the Project footprint is apparent in the breadth and depth of environmental investigations undertaken to inform the revised reference design and mitigation measures.

The costs associated with environmental design and mitigation measures will be built into the overall Project cost. This includes the following:

- Offsets will be secured to achieve a neutral or net positive biodiversity outcome for the region.
- A range of mitigation measures will be implemented such that, during construction and operation, waste is avoided, reused, or recycled, wherever possible. Waste mitigation measures will be documented in a Waste Management Plan of the CEMP and the Operational EMP, including:
 - The management of waste activities associated with the Project will be underpinned by the 2018 *National Waste Policy* and *Waste Reduction and Recycling Act 2011* (QLD) waste and resource management hierarchy, as listed below in the preferred order to be considered:
 - Avoid or reduce;
 - Reuse;
 - Recycle;

- Recover energy;
 - Treat; and
 - Dispose.
- Increased economic growth and reduced freight transport costs because of Inland Rail have been recognised in revised draft EIS Chapter 18: Economics.

6.2 AVOIDANCE AND MITIGATION THROUGH THE REVISED REFERENCE DESIGN PHASE

Development of the revised reference design has progressed in parallel with the impact assessment process, and considered relevant statutory documents for protected matters. Consequently, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the revised reference design, including:

- The Project has been positioned to maximise the use of existing rail corridors and, where possible, to be co-located with existing road infrastructure. Co-location with existing linear infrastructure minimises the need to develop natural and rural landscapes that have not previously been subject to disturbance.
- The Project footprint has been restricted to the area required to construct and operate the works in a safe and efficient manner. Restricting the temporary construction footprint and the permanent operational footprint minimises the extent of disturbance required to vegetation and habitats during construction and operation. The location and layout of the project including construction laydowns and workforce accommodation sites was reviewed iteratively in conjunction with field survey information to avoid and reduce impacts to MNES.
- Greenfield components of the Project have been aligned to minimise the extent of impact to:
 - Habitat for EPBC Act threatened flora and fauna species,
 - TECs
 - Remnant vegetation;
 - Bringalily and Whetstone State Forests;
 - Watercourses;
 - Riparian vegetation and associated riverbanks; and
 - Steep slopes.
- Watercourse crossing structures (including culverts and bridges) have been designed to maintain aquatic fauna passage and minimise the risk of blockages.
- The Project has been designed to minimise impacts to watercourses, riparian vegetation, and instream habitats, and to maintain aquatic fauna passage by adopting high flood standards and through the incorporation of bridges and large culverts for permeability of overland flow and hydrological conditions through for landscape and catchments.
- Bridge and culvert structures have been located and sized to mitigate increases in peak water levels, flow velocities, and durations of inundation.
- The Project's drainage design was updated to include scour and erosion protection measures such as around culvert headwalls, drainage discharge pathways and bridge abutments to further reduce impacts at environmentally sensitive locations.

- The Project incorporates bridge and culvert structures designed to high flood standards to minimise change to the existing flood regimes and the potential for indirect impacts to threatened fauna and flora in the surrounding environment.

As part of the development of the revised reference design, and to reduce potential impacts to MNES within the disturbance footprint (including workforce accommodation and laydown areas), the following actions were undertaken:

- Proposed railway and access tracks and potential Project laydown areas were located in areas where maximum disturbance footprints had already been proposed.
- Potential habitat for ecological values (flora and fauna) was identified and avoided where possible, utilising ground-truthed habitat mapping. This included the identification of where multiple species existed within the same area.
- Both the permanent and temporary footprint was adjusted in response to field surveys to void and minimise impact upon ecological values.

Information related to the revised reference design is provided in revised draft EIS Chapter 5: Project Description.

Waterway and watercourse crossings are part of the Project and have been incorporated into the design of bridges, viaducts and culvert arrays associated with permanent road, railway, and railway maintenance infrastructure. The flooding infrastructure associated with the Project involves the construction of 1,193 reinforced concrete box culverts, 2,134 reinforced concrete pipe culverts and a series of viaducts / bridge structures spanning approximately 11 km. The Project has been designed to minimise change to overland flow and surrounding hydrological profiles attributable to the Project, including minimising impacts to riparian vegetation and the bed and banks of watercourses and floodplains. This has been achieved through:

- High flood immunity design standards applied to the Project (a minimum of 1% AEP) resulting in large flooding infrastructure such as bridges and culverts capable of achieving hydraulic permeability through the landscape and ensuring watercourses remain unconstrained for well drained regional and local catchments. This includes the existing (brownfields) portions of the rail alignment, currently 20% AEP, which will be replaced with the inland rail alignment designed to significantly higher design standards for flooding (>1% AEP) leading to less constrained watercourses as fauna passageways.
- The adoption of flood impact objectives (FIOs) for guiding design outcomes for flooding infrastructure (as measured by quantitative measures of flooding metrics afflux, time of inundation and velocity) ensuring changes to hydrological conditions as a result of the Project are minimised, including flow features relevant to aquatic ecological values such as passage, flow velocities and stream depth.
- An effective inspections and maintenance program for stormwater infrastructure in the operational stage ensuring any blockages of stormwater infrastructure are rectified in a timely manner to maintain the on-going function of flooding infrastructure for its intended purpose and that unnecessary impact to the surrounding environment (waterways and scour / erosion) is avoided.

6.2.1 FAUNA CONNECTIVITY STRATEGY

The Fauna Connectivity Strategy has been prepared which has identified existing connectivity corridors zones through the landscape and outlined requirements to adequately mitigate such

as the provision of suitably designed and located fauna passage infrastructure connecting habitat fragmented by the rail corridor for affected target species. Recommendations from this strategy will be considered and integrated into the detailed design stage of the Project to uphold the intent and purpose of the strategy. A Wildlife Connectivity Plan will then be developed which will outline the final details as to how the Project will mitigate connectivity impacts to fauna. The following section provides a brief summary of the strategy in relation to MNES.

The Fauna Connectivity Strategy assessed the likely impact on connectivity of all known, likely and potential MNES species either individually or grouped into guilds. The strategy determined that the unmitigated Project is likely to impact the following MNES species and guilds containing MNES species:

- Woodland birds (regent honeyeater, squatter pigeon, painted honeyeater),
- Spotted-tailed quoll,
- Gliding mammals (greater glider),
- Koala
- Cracking clay reptiles (five-clawed worm-skink),
- Condamine earless dragon,
- Murray cod, and
- Brigalow woodland snail.

Important biodiversity corridors and movement pathways in the landscape have been identified for target species and guilds, referred to as priority connectivity zones (PCZs). These as well as connectivity structures elsewhere will provide fauna movement and connectivity opportunities such that habitat fragmentation outcomes are acceptable including a long-term impact to functional population dynamics. Preliminary performance outcomes, design goals and mitigation measures have been detailed in the Fauna Connectivity Strategy which describes the rationale and identifies the required fauna connectivity structures and measures to be incorporated into the Project's detailed design. These measures are specific to each relevant species and guild, and once finalised, will be incorporated into the Wildlife Connectivity Plan. Specific mitigations to be adopted for each target species to maintain ecological connectivity have been identified and include:

- The provision of additional fauna crossing structures, where suitable crossing opportunities are required and are currently absent.
- Modification of existing drainage infrastructure (culverts or bridges) for fauna crossing suitability (co-use).
- Installation of glider poles and canopy bridges to bridge gaps in canopy cover for successful crossing by arboreal mammals.
- Investigate the potential to reduce vegetation clearing widths particularly at watercourse crossings and other PCZs to reduce the size of gaps in tree-cover to facilitate movement of gap-sensitive woodland birds and gliders, and disturbance to riparian vegetation providing functional connectivity for target species.
- Koala refuge poles and rails within and adjacent to crossing structures.

- Measures to facilitate successful fauna crossings such as inclusion of fauna furniture within and adjacent to the approaches of crossing structures.
- Landscaping and strategic revegetation within PCZs and on approach to fauna crossing structures to enable consideration of ground coverings for fauna movement.

Design considerations for the suite of connectivity mitigation measures, as well as those specific to each species and guild, are summarised in the revised draft EIS Appendix P: Fauna Connectivity Strategy and will be further developed in detailed design and constructed as detailed in the Wildlife Connectivity Plan.

6.3 PROPOSED MITIGATION MEASURES

Mitigation measures that are proposed to be implemented to avoid or minimise the potential impacts of the Project are described in Sections 6.3.1, 6.3.2 and 6.3.4 for detailed design, pre-construction and construction, and operation stages, respectively. These mitigation measures address Project specific issues and opportunities and will form the basis for the development of the Project Biodiversity Management Plan, or where indicated, highlight how mitigation will be achieved through the implementation of other relevant plans. These mitigation measures have been considered in the assessment of significant residual impacts for all MNES/MSES protected matters in Section 7.

Information related to government conservation advices, threat abatement plans and recovery plans has been incorporated into the identified mitigation measures wherever applicable. Mitigation measures have been selected based on the best available information, including government guidelines (e.g. TMR's *Fauna Sensitive Transport Infrastructure Delivery manual* (DTMR, 2024a)), and the appropriateness and effectiveness in managing the identified impacts including mitigation measures used on similar projects that have been subject to legislative approval.

Revised draft EIS Chapter 24: Draft Outline Environmental Management Plan provides further context and the framework for implementation of these proposed mitigation and management measures. A summary of inspections, monitoring, auditing, and reporting to be undertaken for the project during the pre-construction and construction phase is provided in Section 6.4.

6.3.1 MITIGATION MEASURES DURING DETAILED DESIGN

Table 6-1 outlines the proposed mitigation measures that have been developed and will be implemented during detailed design.

TABLE 6-1 PROJECT IMPACT MITIGATION MEASURES DURING DETAILED DESIGN

Aspect	Mitigation and management measures
Habitat loss through clearing	- Undertake targeted detailed ecological surveys of the Project footprint in accordance with the relevant survey guidelines for nationally threatened species. Data obtained from these detailed surveys will be used to refine the detailed design, including minimisation of the Project footprint and impacts to identified habitat, to the extent required for construction and safe operation. They will also be used to inform the construction methodology for the Project Surveys will include the following: - Protected plant surveys, during appropriate seasons, in accordance with the requirements of the <i>Flora Survey Guidelines - Protected Plants</i> (DES, 2020). Relevant flora MNES species will be targeted through these surveys. - Terrestrial and aquatic fauna surveys, according to relevant fauna survey guidelines. Relevant fauna MNES species will be targeted through these surveys. Surveys for some species will need to be conducted during seasons when the species is likely to be present in the region. Aquatic surveys will occur during periods of surface water flow. - Opportunities for potential translocation of threatened flora identified within the Project footprint will be investigated. This will include the following: - Appropriate habitat outside the Project footprint will be identified and surveyed during pre-construction surveys to inform potential translocation recipient sites. Offset sites will be used as a first preference for potential translocation recipient sites. - If required, a species-specific Translocation Management Plan, in accordance with the <i>Guidelines for the Translocation of Threatened Plants in Australia</i> (Commander et al., 2018) will be developed and relevant additional approvals will be sought. - Detailed design and construction methodology will seek to minimise the construction and operation footprints and avoid impacts on mature native vegetation, protected matters and other ecologically important areas such as biodiversity corridors and PCZs as far as reasonably practicable. - Consult with TRC and GRC to further inform mitigation and management measures specific to MLES where practicable. This will include consultation with TRC to identify measures to avoid, retain or mitigate clearing of particular areas of remnant vegetation that are of concern where it is possible and reasonable to do so. These areas will include, but may not be limited to: - Remnant roadside trees along the Gore Highway; - Koala habitat trees at Southbrook west of Geitz Road, Southbrook; - Remnant patches near Murlaggan Road, Pittsworth; - Trees along existing rail line near Ware Street, Brookstead; - Remnant riparian vegetation at both the main branch and northern branch of the Condamine River; - Remnant riparian vegetation at Grasstree Creek; - Vegetation along Owen's Scrub Road, Millmerran; - Remnant riparian vegetation at Back Creek; - Remnant riparian vegetation at Bringalily Creek; and

Aspect	Mitigation and management measures
Fauna species injury and mortality	◦ Remnant riparian vegetation at Native Dog Creek.
	• Opportunities for potential translocation of threatened fauna individuals within the Project footprint will be investigated, particularly for reptile species and the brigalow woodland snail. This will include the following: ◦ Appropriate habitat outside the Project footprint will be identified and surveyed during pre-construction surveys to inform potential translocation recipient sites. Offset sites will be used as a first preference for potential translocation recipient sites. ◦ Development of a species-specific Translocation Management Plan, in accordance with the <i>Protected Animal Translocation Interim Policy</i> (DES, 2022).
	• Reduce train strike risk through the assessment and development of the design and location of fauna exclusion fencing, pursuant to the Fauna Connectivity Strategy having regard for the following: ◦ The compatibility of each crossing structure approach with the general fencing principles at each location. ◦ Safety requirements for the rail corridor and adjoining properties (e.g., rail corridor fencing has not been proposed across the Condamine River floodplain to prevent the possibility of debris accumulation in fencing during flood events). ◦ Consultation with adjoining landowners to confirm the acceptability of a localised fencing approach and confirm compatibility with their land use operation. ◦ Maintenance constraints that a fauna connectivity or fencing opportunity may introduce. ◦ The provision of escape mechanisms such as jump outs, escape poles and one-way gates at regular intervals, which will be based on a review of results of monitoring of fauna fence escape mechanisms on other sections of Inland Rail (and other relevant studies) and incorporate these results into the detailed design of the Project. ◦ Guidelines documented in the <i>Fauna Sensitive Transport Infrastructure Delivery manual</i> (DTMR, 2024a). Where required, additional expert guidance in relation to specific design features will be sought during the detailed design process as required.
Introduction and spread of weeds, pathogens and pest species	• Priority will be given to fauna exclusion fencing in PCZs identified as important zones for landscape-scale corridor connectivity to channel fauna toward safe movement options (i.e. culverts) to limit vehicle strikes and associated incidents.
	• Consultation with TRC and GRC on the approach and priorities of biosecurity management for the Project to be consistent with the <i>Toowoomba Region Biosecurity Plan 2020</i> and the <i>Goondiwindi Regional Council Strategic Biosecurity Plan 2022</i>. • Liaison with GRC and DDMRB will be undertaken to confirm the fencing specifications for the wild dog check and rabbit exclusion fence, respectively.

Aspect	Mitigation and management measures
	Where the Project footprint impacts the operational sections of the wild dog check fence, the detailed design will require reinstatement of the fence on a like-for-like basis in consultation and agreement with the relevant stakeholders, including DESI, impacted landholders and lessees, DAF and GRC.
Habitat fragmentation (Loss of connectivity and barrier effects)	- Incorporation of design requirements outlined in the Fauna Connectivity Strategy in Appendix P of the revised draft EIS in the Project's detailed design and documented in the Wildlife Connectivity Plan will be undertaken. Fauna crossing structures and other design features will be progressively developed over the Project's design duration to integrate fauna connectivity in design decisions iteratively at the appropriate level of design maturity in conjunction with other requirements and constraints such as safety, cost, engineering and flooding through detailed design review gates. This will provide for ecological connectivity and dispersal function through the following: - The provision of additional fauna crossing structures, where suitable crossing opportunities are currently absent and considered required for the target species. - Modification of revised reference design drainage structures (size, configuration, shape, etc.) to facilitate fauna movement through the structure where required. E.g., Converting pipe culverts to box culverts, converting culverts to a bridge structure, or modifying dimensions. - Location and configuration of glider poles and canopy bridges to bridge gaps in canopy cover for successful crossing by arboreal mammals. These structures will extend to adjacent habitat trees that are a safe distance from the rail corridor to enable direct tree canopy to crossing structure movements for arboreal species. - Inclusion of fauna furniture within and adjacent to approaches of crossing structures, including but not limited to koala refuge poles and rails. - Vegetation clearing to be minimised as much as possible at watercourse crossings and PCZs identified as important zones for landscape-scale corridor connectivity, to reduce the size of gaps in tree-cover to facilitate movement of gap-sensitive woodland birds and other target species. - Fauna-exclusion fencing to funnel fauna into crossing structures and prevent them from accessing the railway to reduce the risk of wildlife-train collisions. - Noise and light controls (e.g., baffles or walls) where noise and light impacts have the potential to impede the use of the fauna crossing structures. These controls will be detailed in the Wildlife Connectivity Plan. - Landscaping and strategic revegetation within PCZs and in approaches to all fauna crossing structures to enable consideration of ground coverings and low shrubs for fauna movement. - Bridge design at major watercourses will aim to minimise disturbance to riparian vegetation as far as practicable to support fauna movement, particularly in PCZs. - Permanent physical barriers will not be created in defined watercourses that could present a risk to aquatic fauna by restricting flow or result in changed flow conditions such as increased velocity, changed flooding behaviour or introduced turbulence that may adversely impact aquatic fauna. - Placement of bridge piers and other infrastructure required in the bed of defined waterways will avoid low flow zones to minimise disturbance to aquatic fauna passage and water flow during periods of low flow.

Aspect	Mitigation and management measures
Noise and vibration	Management measures for any indirect noise and vibration impacts will be considered and detailed in the Wildlife Connectivity Plan where required, with reference to the rationale and approach of the Fauna Connectivity Strategy and <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024).
Lighting	A risk-based Wildlife Lighting Assessment would be undertaken and a Wildlife Lighting Management Plan would be prepared in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023b) to consider and manage impacts of artificial light on wildlife for both the construction and operational Project stages. The Wildlife Lighting Management Plan would also incorporate mitigation recommendations outlined in the <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024). The outcomes of the assessment will be incorporated into construction methodology and design attenuation measures to manage artificial light for those species where artificial light has been demonstrated to affect behavior, survivorship or reproduction. Mitigation measures will consider the use of blue light filters, shields for reducing light spillage, at-receptor treatments and any attenuation measures required to mitigate adverse impacts of artificial light on biodiversity corridors and fauna passage function. Project lighting will be developed in accordance with the minimum level required to meet safety requirements for the Project.
Altered hydrology and flooding	- The Project design will continue to refine the cross drainage to preserve existing flood patterns and characteristics as far as practicable to minimise and manage indirect impacts to ecological receptors through the following: - Minimising changes in natural flow patterns and changes to flood-flow distribution across floodplain areas. - Maintaining drainage paths that are conveying runoff from adjoining terrain, minor watercourses, and gullies, to avoid ponding of water and/or excessive duration of inundation. - Reassessing flooding mitigations, if required based on the outcomes of additional ETV analysis using site-specific and direct assessments by a suitably qualified specialist (e.g. flume method). - Minimising water ponding through surface levelling and use of cross-drainage and longitudinal drains within the rail corridor. - Designing water retention structures, such as sediment basins, to prevent downward leakage of water, with the use of lining or similar. - Avoiding, where possible, the need for diversions or alterations to water resources.
Erosion and sedimentation	- Additional geotechnical and soils investigations will be undertaken to inform the design of earthworks, drainage infrastructure, foundations, and construction methodology for the Project including: - Cuts and embankments; - Bridge piers and abutments; - Floodplains, streams and gullies; - Disturbance of potentially erodible soils and in areas in or near high value receiving environments such as watercourses, floodplains, high value vegetation and agricultural land; and - Disturbance of any potentially hazardous soils, specifically material within or on the floodplains in cut off relict streams and billabongs or lakes adjacent to Macintyre River, Macintyre Brook, Condamine River and Oxley Creek.

Aspect	Mitigation and management measures
	- The following will be considered during detailed design as described in revised draft EIS Chapter 9: Land Resources: - The erosive threshold velocity (ETV) for natural ground surfaces will be established from a site-specific assessment by a suitably qualified specialist, and in consideration of engineering guidelines. Drainage design and mitigations will be re-visited in response to updated assessments. - Identify and pursue further opportunities to minimise disturbance to existing landform to construct, operate and maintain the Project safely and efficiently. - Opportunities for embankment batter slope optimisation will be investigated with respect to soil type and geological profiles to incorporate best practice treatment controls and erosion protection in the final project design. - Optimise civil earthworks to minimise the overall fill deficit of the project, maximise opportunities for material re-use and lead to as close to a net balance in earthworks as possible, including reusing excess material for works within the permanent footprint (e.g. landscaping) and for restoration of modified landform within the temporary footprint (e.g. restoring borrow pits). - Reuse of excess material for other developments (i.e., neighbouring construction activities), with priority given to other adjoining Inland Rail projects. - Identify opportunities for optimised embankment and batter slopes for optimal stability and erosion protection. - Identify sources of materials which may be needed for any soil stabilisation requirements (e.g., lime) from licenced facilities and seek required approvals. Appropriate risk mitigation and safety measures will be identified for the safe transport and onsite storage of stabilisation materials including to lime and gypsum, to avoid spillage and minimise associated dust. The placement and treatment of the stabilisers during construction will also be planned to avoid spillage and minimise associated dust.
Aquatic habitat degradation	- The Project will be designed to avoid then minimise the potential for diversion of watercourses (as defined under the Water Act) and waterways (as defined under the Fisheries Act) where practicable. - Develop the detailed design to further minimise impacts to waterways, riparian vegetation and in-stream flora and habitats, in accordance with the intent of the following: - Adopting a waterway crossing structure hierarchy: bridges preferred to culverts, to maintain permeability for fauna through identified priority connectivity zones such as riverine corridors, biodiversity corridors for target fauna, however local conditions and constructability impacts must be considered when determining the preferred environmental solution. - Continuing to refine the Project in response to hydraulic modelling outcomes. This includes addressing flood impact objectives which include consideration of peak water levels, flow distribution, velocities, and duration of inundation, and implications for fish passage. This will confirm bridge lengths, culvert sizing and numbers, localised scour, and erosion protection measures for both rail, road and other permanent Project infrastructure. - An in-stream monitoring program will be developed and commenced to inform design and management measures to be used at proposed waterway crossing activities during construction.

Aspect	Mitigation and management measures
	Design watercourse crossing structures (including culverts and bridges) to maintain fish passage where applicable in accordance with <i>Accepted development requirements for operational work that is constructing or raising waterway barrier works</i> (DAF, 2018) or conditions of development approval for operational work that is constructing or raising waterway barrier works. Detailed design to minimise the need for ongoing maintenance and inspection to maintain fish passage.
	Further seasonal fish surveys, for any waterway intersections that do not meet accepted development requirements for waterway barrier works requirements, to be conducted during times of adequate flow to gain an understanding of the baseline fish species composition and population abundance of these species.
	Stormwater controls, such as scour protection, will be developed and incorporated, where necessary, in accordance with the Project's flooding and geomorphology mitigation framework to manage impacts to the surrounding environment including water quality of wetlands and waterways and subsequent impacts to aquatic and terrestrial species that rely upon receiving environments a source of water. Measures will be appropriate to the site conditions, responding to the erosion risk assessment, environmental receptors, climatic zone, and seasonal factors.
	Design modifications during the detailed design phase will be subject to re-runs of the existing flood models to demonstrate continued compliance with the design objectives of the Project, including for extent and time of inundation, afflux and flow velocities.

6.3.2 MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTRUCTION

Table 6-2 outlines the proposed mitigation measures that have been developed and will be implemented during pre-construction and construction.

TABLE 6-2 PROJECT IMPACT MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTRUCTION

Aspect	Mitigation and management measures
Habitat loss through clearing	- A Biodiversity Management Plan will be developed and implemented as part of the CEMP for relevant works. This plan will include appropriate criteria, directives and procedures in relation to the following: - Methods and sequencing of protected plant preclearance surveys. Flora species to be targeted through these surveys include MNES and MSES flora identified as known, likely or with potential to occur within the Project footprint. - Methods and sequencing of pre-clearance fauna surveys for relevant species.

Aspect	Mitigation and management measures
	◦ Staging works so that they avoid animal breeding periods (for species that breed within Australia) as much as possible within areas of habitat where relevant works are proposed ◦ Staged and sequential clearing protocols to all areas impacted by the Project where threatened species have been identified. ◦ Animal handling protocols, including engagement of an approved fauna handler with a valid damage mitigation permit. ◦ Relocation of plants and habitat features for threatened species, where possible, and documented evidence of previous relocation success. ◦ Requirements for inspections and corrective actions during construction and rehabilitation activities. ◦ Biodiversity/fauna and flora management actions will be undertaken by suitably qualified persons. ◦ Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction. ◦ Corrective actions if the outcomes do not achieve the adopted objectives. • Clearing limits and location of known sensitive areas (e.g. known MNES/MSES threatened species records and habitat areas) identified through pre-construction habitat surveys undertaken during the detailed design stage, will be supplied to the Principal Contractor via environmental constraints maps. • Construction personnel are to be informed of the environmentally sensitive aspects of the Project site, including plans for impacted and adjoining areas showing vegetation communities, important flora and fauna habitat areas, and locations where threatened species, populations or ecological communities have been recorded. • Clearing of native vegetation is to be minimised to the greatest extent practicable with the objective of reducing impacts to threatened ecological communities and threatened species. Clearing extents will be limited to the area safely and reasonably required for permanent and temporary works, avoiding impacts to native vegetation and habitats as far as practicable. • Prior to any pre-construction clearing works being undertaken, the clearing extents/site boundary/limit of works will be clearly defined and marked. Designated revegetation/rehabilitation zones and other no-go areas (including large significant trees and any threatened flora to be retained) will also be marked. High-visibility tape, barricade webbing or similar will be used. All contractors will be briefed on clearing requirements and restrictions (including fines) to prevent over-clearing of these areas. Construction areas, including compounds, stockpiles, fuel storage areas, laydown areas and staff parking, will be located and established outside the tree protection zone as defined in <i>AS4970-2009 Protection of trees on development sites</i>. • Pre-clearance surveys, including terrestrial and aquatic habitats undertaken in accordance with the Fauna Management Plan to include demarcation of habitat resources and habitat features that are suitable for translocation or salvage.

Aspect	Mitigation and management measures
	- Salvage and relocation of microhabitat features for offset properties or other adjacent suitable habitat will be undertaken as part of rehabilitation, reinstatement, habitat enhancement and beneficial re-use activities, as far as practicable, including in areas identified as important for functional movement corridors (e.g. priority connectivity zones) with consideration of the <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024). Destruction and disposal of microhabitat features will only be considered where there are no practicable re-use options. - Post-clearance surveys of disturbed areas to be undertaken to record extent of clearing that has occurred and to confirm that approved clearing limits have not been exceeded. - Where necessary, clearing activities are to be conducted in accordance with approved performance requirements under the accepted development vegetation management codes. - Where threatened flora species are retained or found to occur within the Project footprint, species-specific biosecurity controls will be implemented in proximity to the area of occurrence, where required. - A Rehabilitation and Landscaping Management Plan will be prepared as a component of the CEMP and finalised prior to project works. This plan will be based on the Inland Rail Landscape and Rehabilitation Strategy, Inland Rail Landscape and Rehabilitation Framework. It will establish the following: - Location-specific objectives, indicators, and success criteria for rehabilitation, reinstatement and/or stabilisation based on the hierarchy for rehabilitation. - Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas (including biodiversity, vegetation establishment and erosion and sediment control outcomes to be achieved). - Consideration for maintenance or performance issues of rehabilitation, e.g. use of groundcover that does not grow and obscure signals or impact the longevity of rail infrastructure, and suitable monitoring and contingency procedures for rehabilitation maintenance and redesign if required. - How the objectives align with relevant recovery plans, threat abatement plans, conservation advices, or policy guidance for target species in areas identified for rehabilitation. - Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, whilst minimising the duration of exposure in disturbed areas. - How the reinstatement approach considers native flora species to the Darling Downs and Toowoomba regions, the pre-cleared regional ecosystems and other suitable species appropriate to the landscape context and nursery/seed stock sources. - Revegetation of areas affected by the proposed project is to occur and will include cut and fill embankments. - Include rehabilitation requirements such as: - Milling and removal of bitumen pavement; - Removal of any decommissioned culverts; - Tying and ripping of base and sub-base material;

Aspect	Mitigation and management measures
	◦ Application of soil ameliorants; ◦ Topsoiling and/or compost blanket; and ◦ Stabilisation and rehabilitation (e.g., planting and/or seeding). ◦ Timeframes, measurable performance objectives and responsibilities for the success of rehabilitation and/or reinstatement/stabilisation areas. ◦ Where appropriate, how the objectives align with relevant recovery plans, threat abatement plans, conservation advices, or policy guidance for target species in areas identified for rehabilitation. ◦ Corrective actions if the outcomes of rehabilitation and/or reinstatement/stabilisation are not achieved. • Where temporary construction facilities are required, land will be returned to a stable condition that complies with the applicable landowner agreements and if relevant, regulatory approvals. • Reinstatement, stabilisation and rehabilitation of disturbed areas will be undertaken progressively, as work fronts are completed.
Fauna species injury or mortality	• In accordance with the Fauna Management Plan, the following mitigation measures will be incorporated into the Biodiversity Management Plan and implemented as part of the CEMP to prevent fauna injury or mortality during vegetation clearing activities: ◦ Local wildlife groups will be contacted at least seven days prior to clearing to confirm they can receive any injured wildlife ◦ Pre-clearance surveys to be undertaken by a suitably qualified ecologist within 48 hours of tree felling works and include the following: ◦ Identification and marking of habitat resources and habitat trees (e.g., those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows and boulder piles). ◦ Identification of threatened species or habitat features that are suitable for translocation or salvage. ◦ Tree felling to be completed within 48 hours of pre-clearance surveys to limit the potential for new issues to arise (such as new active nests being built), adhering to recommendations made during the pre-clearance surveys. ◦ Tree felling supervision will be undertaken by a suitably qualified Fauna Spotter Catcher after pre-clearance surveys have identified potential habitat features. ◦ Prior to felling habitat trees identified in the pre-clearance survey, the following must be undertaken: ◦ Completion of action of actions recommended from the pre-clearing surveys including salvage of identified habitat trees, additional assessments to determine threatened fauna usage of the area (if required), identification of active burrows or dens, any actions required to discourage fauna occupation and weed or feral animal requirements. ◦ Removal of any non-habitat trees/vegetation as close to the habitat tree as possible in order to create disturbance to discourage fauna usage of the habitat trees ◦ Shaking of habitat trees (with heavy machinery) as appropriate may be undertaken to encourage fauna to abandon trees.

Aspect	Mitigation and management measures
	◦ On the day of felling habitat trees, the following must be undertaken: ◦ All habitat trees will be subject to a visual inspection to survey for threatened species. ◦ Trees previously identified as containing fauna will be shaken and then felled, providing no fauna are identified. ◦ The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery. ◦ If fauna are identified in a habitat tree on the day of felling, the Fauna Spotter Catcher is to advise the most appropriate method to minimise harm. This may include leaving the tree overnight, further shaking, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in place, or measures to capture and relocate the animal to secure habitat. ◦ Uninjured animals shall be released on the day of capture into nearby secure habitat and should not be held for extended periods of time. ◦ Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised. ◦ All felled trees shall remain in place for at least one night to allow any remaining fauna to escape. ◦ Handling and relocation of terrestrial and aquatic fauna to suitable habitat and insuring injured and/or sick fauna are assessed and treated accordingly will be undertaken and recorded by a suitably qualified Fauna Spotter Catcher. ◦ Allow safe and responsible handling of fauna (where required) and repatriation in pre-identified appropriate habitat outside of the Project footprint, in consultation with applicable landholders. • If any fauna is to sustain injury at any time during construction, the fauna must be handed over to appropriate wildlife carer personnel or veterinary clinic within 24 hours and correct ARTC personnel notified. • Management measures will be implemented to minimise fauna entrapment in excavations, including: ◦ Minimising to the extent practicable, the period of time the excavation is left open, ◦ Providing opportunities for fauna to exit the excavation; ◦ Daily pre-start inspections of work areas and removal of trapped fauna by suitably qualified fauna handler as required. • In the event that native fauna are detected within the construction footprint, all mobile construction in the area will cease work. Mobile construction equipment will not recommence until a wildlife handler has removed the individual or it has been confirmed that the individual has left the workspace. Any captured wildlife will be removed and relocated to nearby adjacent habitat away from the construction area in accordance with the fauna handling procedure and recorded in the fauna handling record sheet. • Works which have the potential to impact on a protected animal breeding place will be subject to a Species Management Program.

Aspect	Mitigation and management measures
	- A protected matters unexpected finds procedure will be prepared prior to construction and implemented as part of the CEMP Biodiversity Management Plan. In the event that unexpected threatened flora, fauna or TECs are discovered during construction the unexpected finds procedure will be implemented as follows: - Stop works, protect threatened species and inform ARTC. - Engage suitably qualified ecologist to undertake assessment and provide recommendations for management - Where impacts can be avoided: - Works may proceed. - Where impacts cannot be avoided: - Consult with agencies and submit management plan for approval, and - Recommence works with updated controls where necessary. - Update Biodiversity Management Plan and include species in subsequent inductions, toolbox talks, etc. - Vehicle speed limits will be controlled onsite to no more than 40 km/hr. - Temporary fencing will be installed around construction works where practicable, to discourage fauna from entering active construction zones. - The salvage and relocation of fish within isolated aquatic environments will be managed in accordance with the guidelines for fish salvage (Queensland Government, 2024). - An appropriately qualified person will be consulted to make an assessment on the method of recovery, transport and release of fish and other aquatic fauna, as required. As a minimum, the following will be implemented: - Relocation will be undertaken by a suitably qualified person; - Dewatering pumps will have an intake screen; and - Records of all fish recovered, and the location of their release will be maintained. - Dewatering of dams/waterbodies to be supervised by a suitably qualified Fauna Spotter Catcher. - In the event of a spill incident during construction, any impacted aquatic environments will be assessed for the presence of fauna. If necessary, salvage and recovery efforts will be undertaken.
Reduction in biological viability of soil	- A Soil Management Plan will be developed and implemented as part of the CEMP which will include measures to avoid compaction and manage topsoils. - Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species. Topsoil stockpiles will be a maximum of 2.5 m in height to avoid heat sterilisation of the seed bank. - Structural impacts to soils will be minimised by restricting the temporary construction footprint to what is required to enable safe and efficient construction of the Project.

Aspect	Mitigation and management measures
	- Construction activities will be sequenced to avoid longer than necessary duration of land disturbance and to enable timely rehabilitation post occupation when the land is no longer required to support the Project establishment. - High traffic and heavy load works within areas of clayey and silty soils will be minimised during wet periods where possible - Land that is temporarily disturbed in support of construction activities (e.g. for access tracks, laydown areas and storage areas, etc.) will be rehabilitated at the end of its use for construction progressively and as soon as possible, in accordance with the Rehabilitation and Landscaping Management Plan.
Introduction and spread of weeds, pathogens and pest species	- A Biosecurity Management Plan will be developed and implemented in accordance with the requirements of the <i>Biosecurity Act 2014</i> (QLD), as part of the CEMP. This will be developed in consultation with TRC and GRC to provide an approach and priorities that align with the <i>Toowoomba Region Biosecurity Plan 2020</i> and the <i>Goondiwindi Regional Council Strategic Biosecurity Plan 2022</i>. The plan will be based on current weed and pest listing advice and will include the following: - Requirements for pre-clearing surveys to determine current risks of weeds or pest animals being present within the Project footprint. - Maps of the existing extent, confirmed through surveys, and severity of weed infestation (e.g. restricted matters including mother-of-millions (<i>Bryophyllum delagoense</i>), opuntoid cacti, African boxthorn (<i>Lycium ferocissimum</i>), lippia (<i>Phyla canescens</i>) and lantana (<i>Lantana camara</i>) and weed management requirements. - Pest animal management controls, including protocols for severing, realigning, and reinstating the wild dog check fence and the Darling Downs Moreton Rabbit Board (DDMRB) rabbit fence. - Measures to confirm that soil movement complies with Queensland biosecurity requirements for managing the spread of imported fire ants (<i>Solenopsis invicta</i>). - Site hygiene and waste management procedures to deter pest animals. - Locations and procedures for vehicle washdown (light vehicle and oversize vehicles), wheel washes and rumble grids. - Weed surveillance and treatment during construction and rehabilitation activities such as: - Vehicle and plant washdown requirements for fleet moving from low-risk areas to and high-risk areas; and - Weed certification requirements for vehicles, plant and materials arriving onto the construction site. - Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of MNES or MSES habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides (e.g. organic farming practices). - Erosion and sediment control risks associated with broad scale weed removal or treatment. - Monitoring of the effectiveness of weed hygiene measures as a component of the environmental monitoring procedure for the Project. - Corrective actions should the outcomes not achieve the adopted objectives.

Aspect	Mitigation and management measures
	- Property-specific weed hygiene requirements will be developed in consultation with the relevant landowners/operators prior to pre-construction/construction activities occurring on that property, outside of the permanent footprint. Protocols will be documented in individual property management agreements. - Where the Project crosses the DDMRB fence at Ch 120.2 km, the fence will be reinstated, and a rabbit trap will be established in accordance with the design solution developed in consultation with DDMRB through the detailed design process. - Any vegetated material containing, or with the potential to contain, weed seed material will not be used for on-site mulching or erosion protection. - A complaints management system will be developed to enable members of the public, landholders or other stakeholders to make enquires or complaints, including concerns regarding weeds and pests on a 24-hour, seven-days-a-week basis during the construction stage.
Habitat fragmentation	- Implementation of the Wildlife Connectivity Plan, in accordance with the Fauna Connectivity Strategy to construct connectivity opportunities to maintain ecological connectivity and dispersal function is maintained. - Fauna movement opportunities will be constructed to reinstate safe fauna passage as soon as possible, in accordance with the detailed design and Wildlife Connectivity Plan. - Cleared vegetation, which may be mulched or stored as is depending on the reinstatement/rehabilitation requirements for specific areas, will be stockpiled separately in a manner that does not unreasonably impede wildlife - Rehabilitation to the banks of watercourses will occur as soon as possible after construction works in the area have been completed and will consist of suitable substrate to support fauna movement, with details documented in the Wildlife Connectivity Plan. - Construction works will be undertaken sequentially to allow fauna to move around construction work areas.
Noise and vibration	- A Noise and Vibration Management Plan will be prepared and implemented as a component of the CEMP, to minimise noise and vibration impacts as a result of construction of the Project through the following: - Plant and equipment will be selected to minimise noise emissions, in-so-far-as possible whilst maintaining efficiency of function. Mufflers will be fitted, and all noise control equipment will be maintained in good working order. - Where possible, plant will be located away from ecologically sensitive receptors. Appropriate mitigation measures will be investigated. If required, site access roads will be located as far as practicable away from noise sensitive areas.

Aspect	Mitigation and management measures
	- Construction personnel are to be informed of any environmentally sensitive aspects of the Project site, including plans for impacted and adjoining areas showing fauna breeding habitat within a 500 m buffer, identified during pre-clearance surveys, and locations where threatened species, populations or ecological communities have been recorded. - Works to be staged so that they avoid animal breeding periods as much as possible within areas of breeding habitat. Works which have the potential to impact an identified protected animal breeding place will be subject to a Species Management Program. - Where possible, plant will be located/oriented to direct noise away from ecologically sensitive receptors. Materials and stockpiles are to be used to increase acoustic shielding, where feasible. If required, site access roads will be located as far as practicable away from noise sensitive areas. - Where practicable, night works near ecologically sensitive receptors (e.g., breeding places, 'koala hotspots') will be scheduled to a restricted number of nights per week, with night-time traffic redirected away from noise-sensitive receptors. - All workers will be briefed on the importance of threatened fauna species, their location (where they are found to occur within or near the Project footprint), and procedures for working around them. Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration impacts.
Air quality and dust	Implement controls to prevent or minimise dust generation during activities involving excavation or disturbance of soils or vegetation, or handling ballast (e.g. use water sprays or water carts for dust suppression as required) in accordance with the Air Quality Management Plan that will be prepared and implemented as part of the CEMP. This will reduce impacts to flora species and vegetation communities, as increased dust and reduced air quality can impact photosynthesis, and therefore the health of individual plants and vegetation.
Lighting Increase in waste	- Implementation of the Wildlife Lighting Management Plan to consider and manage impacts of artificial light on wildlife during construction in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023b). - As a minimum, off-site lighting impacts will be minimised by: - External lighting is installed as low intensity lighting (except where required for safety or emergency purposes; - External lighting does not shine above the horizontal; and - Management of light generated during construction complies with <i>Australian Standard AS4282 (INT) 1997 – Control of obtrusive effects of outdoor lighting</i>, or its latest version. - Implementation of the Waste Management Plan as part of the CEMP to manage site hygiene and waste to avoid impacts relating to fauna.

Aspect	Mitigation and management measures
Altered hydrology and flooding	• After implementing reuse opportunities where practicable, dispose of spoil (material with no reuse potential) offsite at a licensed facility.
	• Short term impacts to fauna as a result of altered hydrology and flooding will be mitigated through construction planning and the layout of construction work sites and compounds which would be undertaken with consideration of overland flow paths and flood risk, avoiding flood liable land and flood events where practicable.
	• Design temporary earthworks for the Project to avoid unwanted water ponding. This objective will be achieved through surface levelling and drainage, where required.
	• Design water retention structures, such as sediment basins, to prevent downward leakage of water, with the use of lining or similar. • Avoid, where possible, the need for diversions or alterations to water resources.
Erosion and sedimentation	• A Soil Management Plan will be developed and implemented as part of the CEMP. The plan will include measures, process and responsibilities to minimise the potential for soil and water impacts, including impacts to groundwater, during construction. • An Erosion and Sediment Control Plan (ESCP) as a component of the CEMP will be developed prior to commencement of project works to manage project activities and works in a manner that minimizes harm to the surrounding environmental values. The ESCP will guide development of area, site, or section specific ESCPs and include detailed erosion hazard assessments and erosion and sediment control structure designs. The erosion and sediment control measures will be developed by a certified practitioner in erosion and sediment control and be in accordance with the <i>International Erosion Control Association Best Practice Erosion and Sediment Control</i> (2008). Details will include the following: ◦ Locations for specific temporary/permanent erosion and sediment control measures, such as: ◦ Sediment retention basins; ◦ Scour protection (included in the revised reference design); ◦ Sediment fencing; and ◦ Berms and other surface flow diversions. • Nomination of location-specific erosion controls will include consideration of site conditions, proximity to environmental receptors, adjoining land uses, climatic and seasonal factors, and will be based on an erosion risk assessment. • Minimisation of the area of disturbance during each stage to that required to enable the safe construction, operation and maintenance of the project • Revegetating sites in a timely manner following completion of construction • Minimising disturbance (timing of clearing to minimise amount of exposed soil) • Scheduling of works with consideration to periods of higher rainfall (summer months)

Aspect	Mitigation and management measures
	- Establishing and specifying the monitoring and performance objectives for handover on completion of construction - Stockpiling and management/segregation of topsoil where it contains native plants, seedbank or weed material. Establish and specify the monitoring and performance objectives for handover on completion of construction.
Contamination of land	- A Contaminated Land Management Plan will be developed by a suitably qualified person, as recognised under the EP Act, and incorporated into the CEMP prior to commencement of Project works. To minimise/remove adverse impacts to ecological receptors during Project earthworks, this plan will include the following: - Specify management controls for works on land that is known or suspected of being contaminated and will outline the process to identify, document and manage contaminated sites. - Seek to minimise soil disturbance in areas listed on the Environmental Management Register (EMR). - Establish the methodology and sampling and analysis plan for environmental site investigation where soil disturbance is required on an EMR site in the potentially contaminated area. - Establish an unexpected finds protocol/procedure if potentially contaminated materials, including unexploded ordnance (UXO), are encountered during construction activities.
Modification of aquatic habitat	Avoid, then minimise the extent of temporary and permanent waterway diversions. Where temporary diversions are unavoidable, implement water quality and ESCP measures to minimise impacts to downstream environments and water users. Where permanent diversions are unavoidable, waterway diversion design to include simulation of natural features e.g. meanders, pools, riffles, shaded and open sections, deep and shallow sections, and different types of sub-strata, depending on the pre-disturbance environmental values, as per relevant guidelines and legislation. Maintenance activity locations, construction compounds and storage areas will be positioned away from waterways to the extent possible.
	Scheduling of construction activities to minimise time of works in or adjacent to drainage lines, waterways, or watercourses particularly during periods of flow.
	Laydown sites and stockpiles will be located an appropriate distance from riparian habitat to avoid indirect impacts on aquatic habitats. Direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided, as far as practicable.
Waterway barrier effects	- Works within the bed and banks of a waterway or adjacent to watercourses will be conducted in accordance with the intent of the following: - Riverine protection permit exemption requirements (WSS/2013/726) or conditions of a riverine protection permit issued for the Project. - Accepted development requirements (ADR) for construction works that is constructing or raising waterway barrier works (DAF, 2018), for example, construction methodologies within waterways. Where the Project is unable to comply with the ADR for construction works that is constructing or raising waterway barrier works, a development approval will be sought.

Aspect	Mitigation and management measures
	Vehicle crossings for construction of the Project will in the first instance, aim to meet the requirements for bed level crossings within the ADR for operational work that is constructing or raising waterway barrier works. Any waterway crossings that cannot meet the specifications within the ADR will require a development approval.
Water quality	- A Surface Water Management Plan will be prepared and finalised prior to Project works and implemented as a component of the CEMP. The plan will be prepared in consultation with local governments, relevant agencies and other stakeholders, after the establishment of location-specific water quality objectives and prior to construction commencing. The Plan will provide a surface water monitoring framework which will be prepared in accordance with the <i>Receiving Environment Monitoring Program Guideline – for use with environmentally relevant activities under the EP Act</i> (DESI, 2014). The Surface Water Management Plan will provide information to support (if necessary) an evaluation of the potential impacts of releases of contaminants into wetlands and waterways (both ephemeral and permanent), including impacts on aquatic species, aquatic habitats, and species that rely upon the receiving environment as a water source. As a minimum the Plan will establish: - A description of the Project and construction activities of relevance to surface water quality; - A description of the receiving waters; - Water quality indicators (chemistry, turbidity, temperature, turbidity, electroconductivity) as specified in the Water Quality Guidelines; - Management strategies and mitigation measures proposed to satisfy the performance criteria and achieve the surface water environmental outcomes; - Monitoring details such as locations of monitoring sites, sampling frequency and timing having regard to seasonal variations, sampling methods and analysis of results; - Spill prevention measures, as well as spill response procedures (should an accidental discharge take place); - Spill management and discharge permitting system to reduce the risk of accidental discharge from site; - Compliance and corrective action requirements; and - Reporting requirements and schedule. - The Surface Water Monitoring Framework (see Chapter 13: Surface Water) will consider, where appropriate, aligning with the in-stream monitoring program. The in-stream monitoring program is to be developed for the purposes of monitoring impacts to riparian vegetation, aquatic fauna and habitats. It will be developed through the detailed design process to inform engineering design and management measures to be used at proposed waterway crossing activities during construction. - Refuelling will only occur at designated locations within the Project footprint and sited at suitable separation distances from ecological values, including surface water features and drainage lines. These refuelling locations will be equipped with on-site chemical and hydrocarbon absorbent socks/booms, spill kits and banded as appropriate.

Aspect	Mitigation and management measures
	Where the dewatering of excavations (e.g., trenches, pier holes, etc.) is required, water will need to meet the established water quality objectives for receiving waterways before being released/discharged into local waterways. This will be managed in accordance with applicable guidelines and standards.
Invasion of aquatic weeds and pest species	If dewatering of existing storages is required, dewatering strategies will be required to comply with the Biosecurity Act to take reasonable measures to avoid the spread of pest species, for example, screening of pump intake.
Changes to groundwater resources affecting GDEs	A Construction Groundwater Management and Monitoring Program will be developed, with monitoring and sampling requirements dependent on the likelihood of construction activities encountering groundwater and the location of such activities. Monitoring will be targeted in areas where construction activities have potential to impact on groundwater quality and/or levels, as confirmed through detailed design.

6.3.3 MITIGATION MEASURES DURING OPERATION

Table 6-3 outlines the proposed mitigation measures that have been developed and will be implemented during operation.

TABLE 6-3 PROJECT IMPACT MITIGATION MEASURES DURING OPERATION

Aspect	Mitigation and management measures
Threatened flora	Should individuals of a threatened flora species be retained or be found to be growing within the Project footprint during or following rehabilitation, annual monitoring will be conducted for three years and corrective actions to be implemented where Project-associated impacts are identified.
Fauna species injury or mortality	ARTC will provide a communication mechanism for members of the public to notify ARTC of issues, including concerns regarding fauna injury or mortality, and the spread of weeds, pest animals and pathogens.
	Fauna exclusion fencing, fence escape mechanisms, connectivity structures and adjoining fauna furniture and vegetation within the rail corridor will be inspected and maintained in accordance with the Wildlife Connectivity Plan to retain integrity and reduce the likelihood of interaction between trains and fauna species
	Vegetation maintenance on the habitat side of the fauna exclusion fencing will be required to maintain a clearance zone such that species cannot use vegetation to climb onto the exclusion fencing, in accordance with the Wildlife Connectivity Plan.
	The rail corridor will be inspected for trapped fauna during standard operational maintenance, in accordance with ARTC's rail corridor maintenance procedures and policies.

Aspect	Mitigation and management measures
	◦ When an animal is detected within the rail corridor, if possible and safe to do so, the animal will be encouraged towards a fauna escape ramp, other escape mechanism or fence end, whichever is closest and provides a safe exit from the corridor. ◦ Where required, a suitably qualified wildlife carer/handler will be engaged to remove trapped fauna and a health assessment will be undertaken by a wildlife veterinarian. ◦ Information on the likely location of fauna breach of the fence will be used inform potential further measures to be applied to minimise/eliminate the risk of future incidents. • All fauna detected within the rail corridor including healthy, injured, sick or dead fauna will be recorded and reported in the operations fauna management and incident register. • Injured or sick fauna as assessed by a wildlife veterinarian must be handed over to appropriate wildlife carer personnel or veterinary clinic in accordance with the Fauna Management Plan. • Permanent boundary fencing will be inspected and maintained as part of standard operational maintenance, in accordance with the ARTC's rail corridor maintenance procedures and policies to maintain integrity and reduce the likelihood of fauna entanglement. • Rail maintenance access roads will be speed limited to no more than 40 km/hr to reduce the risk of vehicle strike.
Introduction and spread of weeds, pathogens and pest species	• A Biosecurity Management Plan will be developed in accordance with the requirements of the Biosecurity Act (QLD), GRC and TRC biosecurity plans and <i>ARTC operation and maintenance procedures and policies</i>, as part of the Operational EMP and implemented. This plan will be based on relevant weed and pest listing advice and will include the following: ◦ Identification, locations and procedures for vehicle wash down, requirements for operational surveys to determine current risks of weeds or pest animals and appropriate weed management procedures. ◦ Maps of the existing extent, confirmed through surveys, and severity of weed infestation (e.g. restricted matters and Weeds of National Significance) and weed management requirements. ◦ Pest animal management controls. ◦ Site hygiene and waste management procedures to deter pest animals. ◦ Weed surveillance and treatment during maintenance activities. ◦ Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of MNES or MSES receptors and habitat, or land uses sensitive to spray-drift from the application of pesticides and herbicides. ◦ Erosion and sediment control risks associated with broad scale weed removal or treatment. • Monitoring of the effectiveness of weed hygiene measures as a component of the environmental monitoring procedure for the Project. Ongoing weed monitoring within the rail corridor will aim to maintain the pre-construction condition of TECs and habitats that adjoin the rail corridor.

Aspect	Mitigation and management measures
	Any outbreak of priority weeds and/or weeds of national environmental significance would be managed in accordance with the <i>Biosecurity Act 2014</i>, the <i>Weeds of National Significance: Weed Management Guide</i> (DEH, 2003), and the requirements of relevant authorities.
	Where threatened flora species are found to occur within the Project footprint and will be retained, species-specific biosecurity controls will be implemented in proximity to the area of occurrence.
	A predator monitor and control program will be developed as a component of the Wildlife Connectivity Plan to assess the abundance and use of crossing structures by predators that may reduce usage rates by target species. The program will be implemented for up to five years or until the habitat has been restored to a level that provides threatened fauna with protection from predators.
Habitat fragmentation and fauna connectivity	The post construction monitoring, evaluation and reporting program will be developed and detailed the Wildlife Connectivity Plan and will include monitoring of target fauna movements at crossing to assess the success of the fauna connectivity measures and crossing structures at managing fauna train strike risk and managing connectivity.
Lighting	Lighting associated with operation of the Project including from rollingstock and static infrastructure such as safety lighting at road-rail interfaces will be maintained in accordance with the Wildlife Lighting Management Plan to consider and manage impacts of artificial light on wildlife in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023b).
Aquatic habitat degradation	Maintenance activities within or adjacent to watercourses will be conducted in accordance with <i>riverine protection permit exemption requirements</i> (WSS/2013/726) or conditions of a riverine protection permit issued for the Project.
Waterway barrier effects	- Works will be conducted in accordance with the <i>Accepted development requirements for operational work that is constructing or raising waterway barrier works</i> (DAF, 2018) or conditions of development approval for operational work that is constructing or raising waterway barrier works, as required.
	Drainage infrastructure that provides for the flow of watercourses would be inspected and maintained in accordance with ARTC's standard operating procedures to address any issues that may contribute to the blockage of fish passage.
Erosion and sediment control	- The effectiveness and maintenance of permanent erosion controls (e.g. scour protection or vegetated swales) and surface and subsurface drains (including longitudinal drainage) would be monitored in accordance with ARTC's standard operating procedures. This will minimise detrimental effects on adjacent TECs, threatened flora species, wildlife habitat, wetlands and waterways, particularly downstream environments. - Additional inspections would be undertaken during and/or after flood events, dependent on the ability of operators to complete an inspection safely. - Controls that are found to be failing or not performing as intended will either be modified or replaced.

Aspect	Mitigation and management measures
	Where defects are identified and where it is deemed necessary, corrective actions will be undertaken as soon as reasonably practicable and where it is safe to do so.
	Rail embankment slopes will be maintained to prevent slope face degradation.

6.3.4 MITIGATION MEASURES SPECIFIC TO MNES

Table 6-4 outlines proposed mitigation measures that are specific to an MNES protected matters.

TABLE 6-4 PROJECT IMPACT MITIGATION MEASURES SPECIFIC TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

MNES	MNES specific mitigation and management measures
Detailed design (in addition to those specified in Table 6-1)	
Koala (<i>Phascolarctos cinereus</i>)	- Prior to the construction phase beginning, qualified koala specialists will undergo baseline surveys (koala scent detection dogs, visual assessments (can include the use of drones)) to determine areas of high-koala activity and focal areas for heightened koala management. The surveys may commence up to six months prior the construction process. - Update and finalise the Koala Management Plan prior to construction. This will include implementation of any relevant detailed design mitigation measures.
Brigalow woodland snail (<i>Adclarkia cameroni</i>)	- Opportunities for potential translocation of individuals within the Project footprint will be investigated. This will include: - Targeted surveys for brigalow woodland snail in identified habitat (Condamine River floodplain brigalow and eucalypt woodland). Surveys to be carried out in accordance with expert advice. Appropriate habitat outside the Project footprint will also be identified to inform potential translocation recipient sites. - Development of a species-specific Translocation Management Plan, in accordance with the <i>Protected Animal Translocation Interim Policy</i> (DES, 2022c).
Pre-construction and construction (in addition to those specified in Table 6-2)	
TECs: - Brigalow, - Natural grasslands, - Box-gum grassy woodlands, and - SEVT	- Surveys will be carried out during detailed design to confirm for identified TECs within, or adjacent to the Project footprint. Surveys will be carried out using diagnostic criteria/condition threshold detailed in relevant Approved conservation advice for the community. Where TECs are found to occur, condition assessment will be undertaken (using BioCondition assessment) with regular monitoring against initial assessment values. Corrective actions to minimise impacts are to be implemented where Project-associated impacts are identified. - The area of TECs to be removed will be quantified to enable the Environmental Offsets Delivery Strategy to be refined.

MNES	MNES specific mitigation and management measures
	- The CEMP Biosecurity Management Plan will include reference to relevant guidelines to control potential deleterious pathogens including <i>Phytophthora cinnamomi</i> and Myrtle rust (e.g. DCCEEW, 2024a) which may impact eucalypt species and TEC areas adjacent to the construction zone. - Rehabilitation of disturbed areas including on land required for temporary construction activities and within the permanent footprint but outside the rail corridor. This may include using locally native species that may constitute a TEC, subject to landholder agreement.
Murray cod (<i>Maccullochella peelii</i>)	- Construction activities to avoid/minimise instream works and associated riparian habitat in identified Murray cod habitat, where practicable. - Construction works will, where practicable, take place outside of the wet season when low flows in floodplain systems are more likely and potential impacts to Murray cod habitat can be reduced (e.g. erosion and sedimentation impacts to water quality, and barriers to fish passage). - High-risk construction activities will not be carried out in known Murray cod habitat during the Murray cod spawning period between September and November (inclusive), unless otherwise agreed by Queensland Department of Agriculture and Fisheries (DAF). High-risk construction activities are defined as: - piling within the waterway and within the bed and banks; - construction and/or removal of temporary work platforms within the waterway; - installation and removal of temporary waterway crossings; and - high noise impact noise generating construction activities, including construction of foundations and piers. - Consider alternative construction methodologies to driven piling (i.e. bored piles with a screw in casing) in Murray cod habitat to avoid the potential for impacts associated with noise. - Where a temporary impoundment or diversion is required for construction purposes and the species is found to be present, an appropriately qualified person will be consulted to make an assessment on the method of recovery, transport and release of fish and will follow relevant State fish salvage guidelines (Queensland Government, 2024) during construction activities. - Where possible, instream habitat will be reinstated to pre-construction state immediately upstream and downstream of bridges (e.g. replacement of large woody debris to provide no or limited change to instream flows and allow fish passage). - Prior to construction, beneficial aquatic habitat for Murray cod is to be provided within one kilometre upstream of the bridge crossing of the MacIntyre River. The beneficial aquatic habitat must be placed on the northern bank of the MacIntyre River within QLD and must include the placement of woody debris (snags) to provide Murray cod breeding habitat. Prior to the commencement of these habitat improvement works, consultation must be undertaken with DAF on the location, type and timing of Murray cod habitat improvement works.
South-eastern long-eared bat (<i>Nyctophilus corbeni</i>)	Undertake pre-clearance surveys for south-eastern long-eared bat and retrieval of tree hollows, where safe to do so, prior to vegetation clearing allowing for inspections for denning or roosting for the south-eastern long-eared bat. Allow safe daytime storage of roosting bats and evening release of individuals. This will be undertaken by a Fauna Spotter Catcher who is trained and experienced in the safe and appropriate handling and relocation of bats.

MNES	MNES specific mitigation and management measures
Koala (<i>Phascolarctos cinereus</i>)	- Implementation of the Koala Management Plan, including the following: - Qualified koala specialists will undergo baseline surveys (Koala scent detection dogs, visual assessments (can include the use of drones)) to determine areas of high-koala activity and focal areas for heightened koala management. The surveys may commence up to six months prior to commencement of project works in suitable habitat areas. - Koala-specific clearing protocols. - Koala encounter procedures, including treating sick or injured koalas and relocation of koalas. - Sequential clearing protocols will be undertaken in all areas where koalas have been identified, including all Koala Districts, areas with known koala records and mapped koala habitat. Sequential clearing will comply with the sequential clearing conditions provided in the Nature Conservation (Koala) Conservation Plan 2017. - Vegetation clearing within the Project footprint in koala habitat will be carried out in a manner to minimise stress on potential individuals as much as is practicably possible (e.g. sequential clearing and minimising time of disturbance to animals). Where practicable, clearing activities will take place outside the breeding season for koala (October to May). - The CEMP Biosecurity Management Plan will include reference to relevant guidelines to control potential deleterious pathogens including chlamydia, <i>Phytophthora cinnamomi</i> and myrtle rust (e.g. DCCEEW, 2024a) associated with Project activities. Both <i>Phytophthora cinnamomi</i> and myrtle rust may impact eucalypt species, and therefore koala. Measures in the CEMP Biosecurity Management Plan will include: - Handling and assessing of koalas for chlamydia by experienced personnel, with those with suspected infection to be sent to veterinarians/wildlife carers for treatment prior to release; - Monitoring for indirect impacts associated with reduced animal health contributing to increased occurrence of disease. This should include liaising with site personnel and the community for knowledge on 'sick' koala incidences - Prioritising the protection of offset properties from the introduction and spread of <i>Phytophthora cinnamomi</i> and myrtle rust; - Community engagement on impacts of <i>Phytophthora cinnamomi</i> and myrtle rust; - Potential for further research on options of how to manage <i>Phytophthora cinnamomi</i>; and - Requirements in relation to pesticide and herbicide use, including any limitations on use. - Rehabilitation of temporary construction areas where woodland habitat has been cleared (depending on agreement with the landowner). Revegetation plant species will be obtained from a reliable source that is certified free of pathogens and should include some locally important koala tree species, such as <i>E. tereticornis</i>, <i>E. chloroclada</i>, <i>E. melliodora</i>, <i>E. camaldulensis</i>, <i>E. crebra</i>, <i>E. fibrosa</i>, <i>E. melanophloia</i>, <i>E. orgadophila</i>, and <i>E. populnea</i>. Plantings of these species in temporary construction areas near crossing structures targeted for koalas may assist in encouraging use of structures. - Implement a community koala education program regarding vehicle management measures. - Throughout the construction phase, any koala with a high risk of entering the vicinity of the location of active works (job front) will be monitored. - Implementation of the koala encounter procedure (and other procedures as relevant) when a koala is detected within the Project footprint. These are detailed in the revised draft EIS Appendix M: Draft Koala Management Plan. - Implementation of measures such that between each stage and the next there is at least one period of 12 hours that starts at 6 pm on a day and ends at 6 am on the following day, during which no trees are cleared in that site. - Implementation of measures such that no tree in which a koala is present, and no tree with a crown overlapping a tree in which a koala is present, is cleared.

MNES	MNES specific mitigation and management measures
	Construction management processes will minimise the use of unnecessary artificial light and remove temporary construction lighting on completion of works, with no light spill to occur in areas identified as 'koala hotspots' in the KMP. Further, noise restrictions will be in place and relevant guidelines regarding continuous exposure will be enforced.
Grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	- Surveys of riparian will be conducted during detailed design. The surveys will identify whether camps occur within or near to the Project footprint including the known flying-fox roost site in Inglewood (3 km south of Project). - Should a roost site be found to occur, the Project will comply with the mitigation standards detailed in the Commonwealth's <i>Referral guideline for management actions in grey-headed and spectacled flying-fox camps</i> (DoE, 2015c).
Operation (in addition to those specified in Table 6-3)	
TECs: - Brigalow, - Natural grasslands, and - Box-gum grassy woodlands.	Should a TEC patch be retained within the Project footprint, annual monitoring will be conducted against the initial BioCondition assessment for five years. Corrective actions to be implemented where Project-associated impacts are identified.
Koala (<i>Phascolarctos cinereus</i>)	Mortality of koalas will be measured from train driver reporting, tracking results and targeted wildlife-train collision surveys conducted during and after construction.

6.4 FLORA AND FAUNA MONITORING

ARTC will monitor the effectiveness of the proposed mitigation measures for up to five years following commencement of operations or as deemed appropriate for specific measures. Learnings through the Project monitoring, evaluation and reporting will be used to inform adaptive management of the Project. An adaptive management framework will facilitate change and improvement to the management strategies where the objectives of the proposed measures are not met.

Ecological monitoring to be conducted during operation of the Project include the following:

- Should a TEC patch be retained within the Project footprint, annual monitoring will be conducted against the initial BioCondition assessment for five years following commencement of operations. Corrective actions to be implemented where Project-associated impacts are identified.
- Should individuals of a threatened flora species be retained or be found to be growing within the Project footprint during or following rehabilitation, annual monitoring will be conducted against the pre-construction flora surveys and will be continued for five years following commencement of operations. Corrective actions to be implemented where Project-associated impacts are identified.
- Evidence of fauna incursions into the fenced rail corridor will be recorded and investigated, including wildlife-train collisions.
- An ongoing weed monitoring program will measure the effectiveness of weed hygiene and control measures and target problem areas for weed control.
- Ongoing collection and analysis of koala DNA samples from adjacent and broader areas from the Project and an analysis of gene flow at five-yearly intervals for 20 years.
- A monitoring program to assess the abundance and use of crossing structures by predators that may reduce usage rates by target species will be undertaken in accordance with the Wildlife Connectivity Plan. A predator control program will be undertaken at crossing structures within priority connectivity zones for up to five years or until the habitat has been restored to a level that provides threatened fauna with protection from predators.
- The fauna crossing structures and wildlife populations on either side of the Project will be monitored where practicable before construction, during construction and after construction to determine their level of effectiveness in maintaining ecological connectivity, avoiding risk to ecological function due to habitat fragmentation and minimising the risk of injury and mortality of fauna from wildlife-train collisions. Preliminary SMART mitigation goals and survey methods to evaluate the effectiveness of the crossing structures are outlined in Table 6-5 as per the Fauna Connectivity Strategy. These will be finalised and detailed in the Wildlife Connectivity Plan, the monitoring, evaluation and reporting (MER) and the wild dog predation monitoring program. This monitoring and evaluation program will adopt a scientifically robust approach in accordance with the *Fauna Sensitive Transport Infrastructure Delivery* manual (DTMR, 2024).
- Noise and vibration monitoring at fauna crossing structures may be considered if monitoring of structures indicates the level of effectiveness of the structures is inadequate to determine whether levels may be a deterrent for utilisation, particularly within areas of

known wildlife corridors. This will be used to determine behavioural responses of fauna to train pass-bys and inform potential modifications to structures should noise or vibration from train pass-bys be identified as discouraging use of the structures by wildlife.

TABLE 6-5 PRELIMINARY SMART MITIGATION GOALS FOR THE TARGET SPECIES AND GUILDS¹

Target species	SMART goals	Survey methods and study design considerations to evaluate success at achieving SMART goals
Woodland birds	- The rate of daily movement across the Project at designated bird crossing locations (i.e., under bridges and at the at-grade crossings) and elsewhere along the alignment occurs at a similar rate to movement across comparable control sites with similar gap sizes and vegetation characteristics before construction and at five years after operation. - Higher rates of daily crossing at designated bird crossing locations compared to elsewhere on the Project.	- Assessment to adopt a replicated Before-After-Control-Impact study design. - Field studies quantify the rate of movement of woodland birds across gaps in woodland cover. Study design to take into account woodland type, gap size, type of barrier (e.g., rail, powerline, farmland, etc.), and to commence prior to clearing of vegetation for Project construction. Studies to commence before construction, continue during construction and for at least five years after construction. - Targeted surveys of dead birds due to wildlife-train collisions within areas where woodland birds have been observed crossing the railway..
Spotted-tailed quoll	- Spotted-tailed quoll use the crossing structures (e.g. culverts and bridge underpasses) at five years after construction at rates in proportion to their occurrence in the landscape in the vicinity of each wildlife crossing structure. - No genetic differentiation of populations on opposite sides of the Project at 10 years post operation.	- Installing motion-triggered cameras on targeted crossing structures and in adjacent habitat to assess presence, abundance, and rate of use of crossing structures. - Use GPS or satellite tracking to assess movement of animals living in the vicinity of the Project. - If insufficient spotted-tailed quolls occur in the broader area for effective monitoring, consider using other species of small- to medium-sized ground-dwelling mammals as surrogates. - Explore DNA survey options if spotted-tailed quoll are found in proximity to the Project. Investigate feasibility of evaluating effectiveness of crossing structures using DNA sampling or tracking methods before and after construction. - Undertake mortality surveys of quolls on railway.
Gliding mammals	Gliding mammals use the crossing structures (e.g. above-rail and below-rail canopy bridges and glider poles) at five years after construction at rates in proportion to their occurrence in the landscape in the	Install motion-triggered cameras on targeted crossing structures and in adjacent habitat to assess presence, abundance, and rate of use of crossing structures.

Target species	SMART goals	Survey methods and study design considerations to evaluate success at achieving SMART goals
	vicinity of each wildlife crossing structure. No genetic differentiation of populations on opposite sides of the Project at 10 years post operation.	- If insufficient greater gliders in area for effective monitoring, use other species of glider and/or possums as surrogates. - Explore DNA survey options if greater gliders are found during field assessment in proximity to rail. Investigate feasibility of evaluating effectiveness of crossing structures using DNA sampling or tracking methods before and after construction. - Undertake mortality surveys of greater glider on railway.
Woodland reptiles, cracking-clay reptiles, Condamine earless dragon	- Target reptile species are present in habitat within Project footprint leading to the crossing structures at five years after construction. - Target species use crossing structures (e.g. culverts and bridge underpasses) at five years after construction for dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each crossing structure.	- Undertake surveys of target species in habitats adjacent to crossing structures and in habitats away from the railway. - Use capture-mark-recapture methods, sensitive cameras and/or other techniques to detect reptiles using the crossing structures.
Brigalow woodland snail	- Brigalow woodland snail are present in habitat within Project footprint leading to snail crossing structures at five years after construction. - Brigalow woodland snails use the crossing structures (e.g. culverts and bridge underpasses) at five years after construction for dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each crossing structure.	- Undertake surveys of target species in habitats adjacent to crossing structures and in habitats away from the railway. - Use capture-mark-recapture methods and/or other techniques to detect snails using the crossing structures. - If insufficient brigalow woodland snails occur in the area for effective monitoring, use other species of snail as surrogates. - Undertake genetic studies to measure gene flow.
Koala	- The movement of koalas around and across the railway will reach pre-construction levels within five years of opening to train movements. - Koalas use the crossing structures (e.g. culverts and bridge underpasses) at five years after construction for daily movements and dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each crossing structure. - Sufficient gene flow across the Project within 10 years of operation that ensures no genetic differentiation of populations on opposite sides due to the Project.	- The movement of individual koalas will be assessed using GPS tracking using same methods as currently employed by the University of Southern Queensland. - Ongoing collection and analysis of koala DNA samples from adjacent and broader areas from the Project and an analysis of gene flow at five-yearly intervals for 20 years. Koala DNA samples to be collected from a range of sources, including scat samples, tissue biopsies to be collected as part of ongoing research sponsored by ARTC, roadkill animals, rescued animals, etc. - The use of targeted crossing structures by koala is measured using

Target species	SMART goals	Survey methods and study design considerations to evaluate success at achieving SMART goals
		camera traps and tracking of koalas in vicinity of the Project. • Mortality of koalas to be measured from train driver reporting, tracking results and targeted wildlife-train collision surveys conducted during and after construction.
Murray cod	• No reduction in cross-rail movement within 12 months of construction. • Murray cod use bridge underpasses for daily movements and dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each bridge structure. • Murray cod present in waterways upstream and downstream of each bridge. • No genetic differentiation of populations on opposite sides of the Project at five years post operation.	• Investigate feasibility of eDNA and other genetic sampling techniques to assess presence of Murray cod in waterways and to measure changes in population structure across the Project. • The rate of use of crossing structures by Murray cod is in proportion to their occurrence in the adjacent area. • Use surrogate fish species if Murray cod occur at low densities and are unable to be effectively studied.

¹ Table source: Revised draft EIS Appendix P: Fauna Connectivity Strategy (WSP, 2024).

7. SIGNIFICANT IMPACT ASSESSMENT

Potential impacts (both direct and indirect) associated with pre-construction and construction, commissioning and operation of the Project have been assessed in accordance with both the quantitative and the qualitative impact assessment methodology outlined in Section 3.5. Potential impacts associated with the Project are summarised in Section 5.2.

Significant impact assessments have been undertaken in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE, 2013a) and are presented in Sections 7.1 (threatened communities), 7.2 (threatened flora) and 7.3 (threatened fauna).

7.1 SIGNIFICANT IMPACT ASSESSMENT FOR THREATENED ECOLOGICAL COMMUNITIES

Assessment of the significance of impact in accordance with the criteria contained within the *Significant Impact Guidelines* (DoE, 2013a) has been undertaken for each of the three TECs that are known to occur within the Project footprint. While the Project footprint excludes the TEC semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions (SEVT TEC), it has been assessed for indirect impacts as a result of the Project. The TECs assessed and a reference to the respective significant impact assessment sections are presented in Table 7-1 Table 7-6.

TABLE 7-1 THREATENED ECOLOGICAL COMMUNITIES INCLUDED IN THE SIGNIFICANT IMPACT ASSESSMENTS

Community name	Abbreviated name	EPBC Act status	SIA section
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	Brigalow TEC	E	7.1.1
Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	Natural grassland TEC	CE	7.1.2
White box-yellow box-Blakely's red gum grassy woodland and derived native grassland	Box-gum grassy woodland TEC	CE	7.1.3
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions	SEVT TEC	E	7.1.4

7.1.1 BRIGALOW (*ACACIA HARPOPHYLLA* DOMINANT AND CO-DOMINANT)

TABLE 7-2 SIGNIFICANT IMPACT ASSESSMENT - BRIGALOW TEC (ENDANGERED)

Criteria	Potential impact to brigalow TEC
Reduce the extent of an ecological community	Unlikely The Project footprint contains 103.69 ha of brigalow TEC which is required to be cleared for the Project. Brigalow TEC is present in areas around the Project footprint, including in Bringalily State Forest. According to the listing advice (TSSC, 2001), the extent of the Brigalow TEC is approximately 804,264 ha. The Project will remove approximately 0.013% of this area. The Project is not near the limit of the threatened community's range (refer to Appendix F Species

Criteria	Potential impact to brigalow TEC
	and Community Profiles), and will not reduce the extent of the ecological community.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	Likely The Project is linear in nature and will cause fragmentation to this TEC in multiple locations along the Project footprint. Clearing will remove some narrow linear patches that remain along existing roads and rail lines, which may impact connectivity between existing fragments. Fragmentation of patches will also occur where part of a patch of being removed. In most cases the remaining section of the patch is likely to still be viable, with the smallest viable patch being 0.5 ha, according to the conservation advice (DoE, 2013c). Three patches of TEC that are fragmented will leave the remaining TEC unviable. This adds a total of 0.81 ha (0.24 ha, 0.29 ha and 0.28 ha for each patch) to the total area of impact. Patches of brigalow TEC that are split by the Project are within the state forests where the viability of the remaining split patches on either side of the Project footprint will continue.
Adversely affect habitat critical to the survival of an ecological community	Likely The conservation advice states <i>"The areas considered critical to the survival of the Brigalow ecological community includes all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community; plus the buffer zones, particularly where these include native vegetation"</i>. Impacts to buffers were undertaken by assessing Brigalow TEC extents within 100 m of the Project footprint whose 30 m buffer intersected the Project footprint. Buffer distances are not directly inferred in the Brigalow TEC Conservation Advice, so a 30 m buffer was adopted based on the approved Conservation Advice for the Poplar Box Grassy Woodland on Alluvial Plains TEC. Furthermore, there are many examples of functioning vegetation community corridors in the Brigalow Belt South Bioregion that are 30 m in width of which many meet brigalow TEC thresholds. Buffers were only applied in areas where this included remnant or mature regrowth vegetation, as immature regrowth and non-remnant areas are unlikely to be of a condition to promote regeneration of the TEC beyond its boundary and provide adequate protection of the TEC patch. All buffer areas within the Project footprint are TECs and therefore are included in the TEC areas to be impacted by the Project. The application of buffers for brigalow TEC does not increase the area of impact for the TEC. While no TEC buffer areas are impacted by the Project, direct impacts to Brigalow TEC within the Project footprint will adversely affect habitat critical to the survival of the ecological community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Unlikely The Project has the potential to indirectly impact the availability or quality of habitat through the generation of dust, soil erosion and changes to surface water and groundwater hydrology. Impacts to groundwater as a result of the Project will be minimal and drawdown will be wholly contained within the Project footprint and will not affect the survival of the TEC patches outside of the Project footprint. Localised soil compaction is expected to occur within the Project footprint only and therefore will not impact remaining TEC patches outside of the Project footprint. Changes to flood water distribution and other flood conditions due to the Project are likely to have low impacts on brigalow TEC. This TEC occurs on floodplains (which are naturally highly variable in flood regime), and therefore it is considered likely to have a relatively higher tolerance to impacts from

Criteria	Potential impact to brigalow TEC
	flooding changes associated with the Project. See Section 5.2.10 for further details. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to remaining patches of brigalow TEC. Following implementation of these mitigation measures, the Project is not considered likely to modify or destroy abiotic factors essential to the survival of the TEC.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	Unlikely The Project does not propose any activities or changes to fire regimes that are likely to cause a substantial change in the composition of the remaining TEC patches. No harvesting of flora or fauna will occur. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of both the CEMP and the Operational EMP). Whilst the Project may be a potential point source of ignition for fires this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. Therefore, the Project is unlikely to cause a substantial change in the species composition of an occurrence of an ecological community.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: - Assisting invasive species, that are harmful to the listed ecological community, to become established, or - Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	Unlikely Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal.
Interfere with the recovery of an ecological community	Likely There is no recovery plan for the brigalow TEC and a recovery plan is not required. The conservation advice (DoE, 2013c) identifies the following priority recovery and threat abatement actions that are relevant to the Project: - Protect and conserve remnant and regrowth areas of the ecological community. Prevent clearance of this endangered ecological community and of nearby native vegetation including buffer zones and connecting corridors. - Where further clearance is unavoidable:

Criteria	Potential impact to brigalow TEC
	◦ mitigate the severity of impacts (e.g. avoid higher quality areas, avoid dissection of patches, act to minimise hydrological disruption and the spread of weeds); and, ◦ offsetting should consider the location and emulate qualities of affected patches. • Manage all weeds appropriately within and close to the Brigalow ecological community; e.g.: spot application of herbicides, rather than aerial spraying; avoid fertiliser application; minimise tree thinning and soil disturbance. • Devise and implement water management, sediment erosion and pollution control and monitoring plans. The total extent of this TEC within the Project footprint that will be removed as part of the proposed works is 103.69 ha, with an additional 0.81 ha of Brigalow TEC becoming unviable. Although some impacts have been reduced or mitigated, patches of brigalow TEC will be dissected and areas to be cleared include some remnant areas of the TEC. Removal and fragmentation of this TEC will interfere with the recovery of the ecological community.
Likelihood of significant impact	The Project is likely to result in a significant impact on 104.50 ha the brigalow TEC.

7.1.2 NATURAL GRASSLAND ON BASALT AND FINE-TEXTURED ALLUVIAL PLAINS OF NORTHERN NSW AND SOUTHERN QUEENSLAND

TABLE 7-3 SIGNIFICANT IMPACT ASSESSMENT – NATURAL GRASSLAND TEC (CRITICALLY ENDANGERED)

Significant impact criteria	Potential impact to natural grassland TEC
Reduce the extent of an ecological community	Unlikely The Project is not near the limit of the extent of the natural grassland TEC. The Project footprint contains 66.07 ha of natural grassland TEC which is required to be cleared for the Project. According to the listing advice (TSSC, 2009), the TEC has an estimated extent of 29,318 ha, and the Project will clear approximately 0.225% of this area. Therefore, the Project is unlikely to reduce the extent of the ecological community.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	Likely The Project is linear in nature and will cause fragmentation to this TEC in various locations along the Project footprint. Surveys for natural grassland TEC have not been conducted outside of the Project footprint. Most patches that will be cleared are narrow roadside patches or narrow patches between cropping areas. However, five patches of remnant natural grassland TEC (including REs 11.3.21 and 11.8.11) are to be cleared in areas where patches likely extend beyond the Project footprint. The extent of these patches outside the footprint have not been ground-truthed and cannot be ascertained from satellite imagery. It is assumed that all patches of the TEC to be impacted will result in fragmentation to that patch and may result in the splitting of some remnant TEC patches.
Adversely affect habitat critical to the survival of an ecological community	Likely The conservation advice does not define habitat critical to the survival of this ecological community. Therefore, all areas of the ecological community that meet the minimum condition criteria have been considered critical to the survival of this ecological community. A total of 66.07 ha of land containing this TEC will be cleared to construct the

Significant impact criteria	Potential impact to natural grassland TEC
	Project and will therefore adversely affect habitat critical to the survival of an ecological community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Unlikely The Project is not considered likely to modify or destroy abiotic factors essential to the survival of the TEC. Impacts to groundwater as a result of the Project will be minimal and is not predicted to affect the survival of the remaining TEC patches outside of the Project footprint. The Project has the potential to indirectly impact the availability or quality of habitat through the generation of dust, soil erosion and changes to surface water and groundwater hydrology. Localised soil compaction is expected to occur within the Project footprint only and therefore will not impact on remaining TEC patches. Changes to flood water distribution and other flood conditions due to the Project are likely to have low impacts on natural grassland TEC. See Section 5.2.10 for further details. Managing disruptions to water flows and any changes to hydrology which may result in changes to the water table levels, increased salinity and increased runoff or sediment, is listed as a priority action in the Conservation Advice for this TEC, due to the potential for consequent habitat loss, disturbance and modification. Mitigation measures will be implemented to manage these indirect impacts. This includes implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP to ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to remaining patches of natural grassland TEC. Following implementation of these mitigation measures, the Project is not considered likely to modify or destroy abiotic factors essential to the survival of the TEC.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	Unlikely Buffers were not applied to natural grassland TEC patches, however, impacts to buffers are predicted to be unlikely to lead to the loss of function due to the structural nature and composition of the grasslands community. The Project does not propose any activities or changes to fire regimes that are likely to cause a substantial change in the composition of the remaining TEC patches. No harvesting of flora or fauna will occur. The Project will adopt appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). Whilst the Project may be a potential point source of ignition for fires this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. Therefore, the Project is unlikely to alterations to cause a substantial change in the species composition of an occurrence of an ecological community.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community,	Unlikely Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target

Significant impact criteria	Potential impact to natural grassland TEC
including, but not limited to: - Assisting invasive species, that are harmful to the listed ecological community, to become established, or - Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal.
Interfere with the recovery of an ecological community	Likely There is no recovery plan for the natural grassland TEC and a recovery plan is not required. The conservation advice (DEWHA, 2008a) identifies the following regional priority recovery and threat abatement actions that are relevant to the Project: - Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the ecological community. - Ensure road widening and maintenance activities (or other infrastructure or development activities as appropriate) in areas where the ecological community occurs do not adversely impact on known sites. - Manage disruptions to water flows and any changes to hydrology which may result in changes to the water table levels, increased salinity and increased run off or sediment. - Manage sites to prevent introduction of invasive weeds, which could become a threat to the ecological community, using appropriate methods. The total extent of this TEC within the Project footprint that will be removed as part of the proposed works is 66.07 ha. Any removal of this TEC will interfere with the recovery of the ecological community.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on the natural grassland TEC.

7.1.3 WHITE BOX-YELLOW BOX-BLAKELY'S RED GUM GRASSY WOODLAND AND DERIVED NATIVE GRASSLAND

TABLE 7-4 SIGNIFICANT IMPACT ASSESSMENT - BOX-GUM GRASSY WOODLAND TEC (CRITICALLY ENDANGERED)

Significant impact criteria	Potential impact to box-gum grassy woodland TEC
Reduce the extent of an ecological community	Unlikely The estimated extent of box-gum grassy woodland TEC was 416,325 ha at the time of listing (TSSC, 2006), but has likely reduced since this time. The Project footprint contains 2.54 ha of box-gum grassy woodland TEC which is required to be cleared for the Project and this

Significant impact criteria	Potential impact to box-gum grassy woodland TEC
	area has been reduced through refinement of the Project footprint. Although the Project is close to the eastern limit of the ecological community's main area of extent, the removal of 2.54 ha is unlikely to reduce the extent of the ecological community.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	Likely In clearing of 2.54 ha of white-box grassy woodland TEC, one patch of TEC will be severed and split into two patches. The patch of remaining TEC to the west of the footprint is the largest (confirmed to be approximately 6 ha with another 12 ha of potential box-gum grassy woodland TEC). The TEC here also possibly extends beyond areas surveyed outside of the Project footprint. The small patch of remaining TEC to the east of the footprint is mapped as approximately 0.36 ha and is considered to remain viable due to its classification as class B (the minimum patch threshold for class B patches is 0.1 ha; TSSC, 2006). Although the remaining patches of box-gum grassy woodland TEC will continue to be viable, the severing and splitting of this patch will cause fragmentation to the ecological community.
Adversely affect habitat critical to the survival of an ecological community	Likely The conservation advice states "all areas of the ecological community that meet the minimum condition criteria... should be considered critical to the survival of this ecological community" (DCCEEW, 2023c). A total of 2.54 ha of land currently containing this TEC will be cleared to construct the Project and will therefore adversely affect habitat critical to the survival of an ecological community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Unlikely The Project is not considered likely to modify or destroy abiotic factors essential to the survival of the TEC. Impacts to groundwater as a result of the Project will be minimal and will not affect the survival of the remaining patches of TEC. This habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, soil erosion and changes to surface water and groundwater hydrology. Localised soil compaction is expected to occur within the Project footprint only and therefore will not impact on remaining TEC patches. Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on box-gum grassy woodland TEC. See Section 5.2.10 for further details. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to remaining patches of box-gum grassy woodland TEC. Following implementation of these mitigation measures, the Project is not considered likely to modify or destroy abiotic factors essential to the survival of the TEC.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally	Unlikely Buffers were not applied to the box-gum grassy woodland patch, as areas surrounding the identified areas consisted of grasslands, with no other structural vegetation present directly adjacent. Therefore, these areas would be unlikely to perform as functional buffers to protect the structure and composition of the TEC.

Significant impact criteria	Potential impact to box-gum grassy woodland TEC
important species, for example through regular burning or flora or fauna harvesting	The Project does not propose any activities or changes to fire regimes that are likely to cause a substantial change in the composition of the remaining TEC patches. No harvesting of flora or fauna will occur. The Project will adopt appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as a component of the both the CEMP and Operational EMP). Whilst the Project may be a potential point source of ignition for fires this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. Therefore, the Project is unlikely to alterations to cause a substantial change in the species composition of an occurrence of an ecological community.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: - Assisting invasive species, that are harmful to the listed ecological community, to become established, or - Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	Unlikely Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal.
Interfere with the recovery of an ecological community	Likely The White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland National Recovery Plan includes the following recovery plan objectives: - Achieve no net loss in extent and condition of the ecological community throughout its geographic distribution. - Increase protection of sites with high recovery potential. - Increase landscape functionality of the ecological community through management and restoration of degraded sites. - Increase transitional areas around remnants and linkages between remnants. - Bring about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland. The direct and indirect impacts of the Project will interfere with the recovery of the ecological community.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on the box-gum grassy woodland TEC.

7.1.4 SEMI-EVERGREEN VINE THICKETS OF THE BRIGALOW BELT (NORTH AND SOUTH) AND NANDEWAR BIOREGIONS

TABLE 7-5 SIGNIFICANT IMPACT ASSESSMENT - SEVT TEC (ENDANGERED)

Significant impact criteria	Potential impact to SEVT TEC
Reduce the extent of an ecological community	Unlikely The Project footprint does not contain any areas of semi-evergreen vine thicket TEC. A small patch (0.08 ha) of SEVT adjoins the Project footprint. As direct impacts to this TEC have been avoided, the extent of SEVT TEC will not be reduced.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	Unlikely The Project footprint does not contain any areas of SEVT TEC, therefore will not cause further fragmentation to this TEC.
Adversely affect habitat critical to the survival of an ecological community	Unlikely The conservation advice states “all areas that meet the definition of this ecological community are considered habitat critical for the community’s long-term survival” (DCCEEW, 2023d). The TEC is present as a small patch outside of the Project footprint. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of this ecological community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community’s survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Unlikely The Project has the potential to indirectly impact the availability or quality of habitat through the generation of dust, soil erosion and changes to surface water and groundwater hydrology. The SEVT TEC patch located outside of the Project footprint will not be affected by localised impacts to groundwater or soil compaction. All impacts to these abiotic factors will be localised within the Project footprint only. Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on SEVT TEC. See Section 5.2.10 for further details. Implementation of the the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to remaining patches of SEVT TEC. As such, the Project is not considered likely to modify or destroy abiotic factors essential to the survival of the TEC.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	Unlikely The Project does not propose any activities or changes to fire regimes that are likely to cause a substantial change in the composition of the TEC patch. No harvesting of flora or fauna will occur. The Project will adopt a Biosecurity Management Plan that outlines appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operational phase of the Project. Whilst the Project may be a potential point source of ignition for fires this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape.

Significant impact criteria	Potential impact to SEVT TEC
	Areas directly adjacent to the SEVT TEC patch are cleared and would not provide a functional buffer to support ongoing viability of this small patch. Therefore, buffers were not applied to this patch of SEVT TEC. The Project is unlikely to alterations to cause a substantial change in the species composition of an occurrence of an ecological community.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: - Assisting invasive species, that are harmful to the listed ecological community, to become established, or - Causing regular mobilization of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	Unlikely Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community, outside but adjacent to the Project footprint. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal.
Interfere with the recovery of an ecological community	Unlikely The National recovery plan for the "Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions" ecological community (McDonald, 2010) outlines the following recovery objectives: - Identify and evaluate the extent, biodiversity value and condition of remnant and regrowth areas of SEVT EC in the Brigalow Belt (North and South) and Nandewar Bioregions. - Establish a comprehensive, adequate and representative system of SEVT EC areas across the Brigalow Belt (North and South) and Nandewar Bioregions, protected either by reservation or conservation agreements (including MOUs). - Ensure "best-practice" management is applied to sites containing the SEVT EC. - Encourage involvement of landholders and the community in the conservation and management of the SEVT EC. - Enhance the ability of government and non-government organisations at the national, regional and local levels (including consent authorities) to recognize and incorporate SEVT EC conservation issues into all planning processes. The Project does not propose any activities that will interfere with these recovery objectives and therefore will not interfere with the recovery of this ecological community.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on the semi-evergreen vine thicket TEC.

The significant impact assessments for TECs have been used to inform the biodiversity offset requirements for the Project (Section 8).

7.2 SIGNIFICANT IMPACT ASSESSMENT FOR THREATENED FLORA

The following sections assess the potential for significant impacts to the three endangered and nine vulnerable flora species identified as known, likely or potentially occurring within or adjacent to the Project footprint. The species assessed and a reference to the respective significant impact assessment sections are presented in Table 7-6.

The ecology, life history and distribution of these species are summarised in Appendix A and Appendix F Species and Community Profiles. Relevant Commonwealth documents applicable to each species including threat abatement plans, approved conservation advice, and recovery plans are also summarised in Appendix F Species and Community Profiles.

The assessment of significant impacts associated with the Project is based on:

- The revised reference design and incorporated mitigation measures (Section 1.6.6 and Section 6.2);
- Currently known information about the MNES affected (Appendix F Species and Community Profiles);
- Targeted threatened flora surveys, other associated surveys and field verified habitat mapping for each species (Appendix A);
- Information on potential impacts of Project construction and operation (Section 5.2); and
- Proposed mitigation measures (Section 6.3).

TABLE 7-6 THREATENED FLORA SPECIES INCLUDED IN THE SIGNIFICANT IMPACT ASSESSMENTS

Common name	Scientific name	EPBC Act status	SIA section
King bluegrass	<i>Dichanthium queenslandicum</i>	E	7.2.1.1
Winged peppergrass	<i>Lepidium monoplacoides</i>	E	7.2.1.2
-	<i>Xerothamnella herbacea</i>	E	7.2.1.3
Tara wattle	<i>Acacia lauta</i>	V	7.2.2.1
Hairy-joint grass	<i>Arthraxon hispidus</i>	V	7.2.2.2
Stream clematis	<i>Clematis fawcettii</i>	V	7.2.2.3
Bluegrass	<i>Dichanthium setosum</i>	V	7.2.2.4
Belson's panic	<i>Homopholis belsonii</i>	V	7.2.2.5
Hawkweed	<i>Picris evae</i>	V	7.2.2.6
Austral cornflower	<i>Rhaponticum australe</i>	V	7.2.2.7
Austral toadflax	<i>Thesium australe</i>	V	7.2.2.8
Small-flowered westringia	<i>Westringia parvifolia</i>	V	7.2.2.9

7.2.1 ENDANGERED FLORA SPECIES

The following sections assess the potential for significant impacts on three endangered flora species identified as known, likely or potentially occurring within the Project footprint in accordance with the *Significant Impact Guidelines* (DoE, 2013a).

7.2.1.1 KING BLUEGRASS (*DICHANTHIUM QUEENSLANDICUM*)

King bluegrass (*Dichanthium queenslandicum*) is listed as Endangered under the EPBC Act and is known to occur within the Project footprint, due to direct sightings during field surveys. An in-depth description of the species, its distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-7.

TABLE 7-7 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – KING BLUEGRASS

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Unlikely King bluegrass was observed along the edge of the Project footprint (marginally inside), near Pittsworth, during the field surveys and 50.31 ha of habitat for the species is present within the Project footprint. These records are considered part of the Dalby district population, the majority of which occur 40 km north of the individuals within the Project footprint. However, the size of this population has not been quantified (DSEWPC, 2013a). Due to the location of records at the edge of the Project footprint, direct impact to identified individuals may be avoided by refinement of the Project footprint during detailed design. Mitigation measures aim to limit the indirect impacts (e.g., dust and changes in surface water and groundwater hydrology). With the appropriate management and mitigation measures in place, the Project is considered unlikely to lead to a long-term decrease in the size of the population of king bluegrass.
Reduce the area of occupancy for the species	Unlikely The area of occupancy of king bluegrass is unknown, however is likely to be restricted based on its estimated extent of occurrence of 245 km² (DSEWPC, 2013a). While 50.31 ha (0.205% of the extent of occurrence) of king bluegrass habitat will be impacted during clearing in the construction phase of the Project, all identified individuals of king bluegrass may be avoided. Despite the Project being located near the southern limit for records of the species, records remain further south of the Project footprint, and therefore the extent of occurrence of the species will not be impacted. As the Project will not result in the clearing of individuals, it is unlikely that the Project will reduce the area of occupancy for the species.
Fragment an existing population into two or more populations	Unlikely The known records of king bluegrass within close proximity to the Project footprint are isolated individuals at the southern-most extent of the Dalby district population. The Project will separate these individuals from the remainder of the known Dalby district population; however, they are already separated by highly fragmented areas. Wind pollination and dispersal is likely a primary dispersal mode for king bluegrass, like other <i>Dichanthium</i> species. The mechanism of wind facilitated pollination and dispersal is unlikely to be significantly impacted by the Project, and therefore it is unlikely that the Project will functionally fragment a population.
Adversely affect habitat critical to	Unlikely The Project will remove 50.31 ha of potential or currently occupied habitat by clearing. This habitat consists of 17.58 ha of remnant and 32.73 ha of

Criterion	Assessment against significance criteria
the survival of the species	non-remnant vegetation. Habitat critical to the survival of the species has not been defined in the species conservation advice (TSSC, 2013). Due to the small number of records in the wider area, it is considered unlikely that the habitat within the Project footprint represents habitat critical to the survival of the species. As such, it is considered unlikely the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Unlikely King bluegrass uses wind-based pollination and seed dispersal. The Project is not likely to impact the processes associated with wind dispersal and seed dispersal. Therefore, it is considered unlikely that the Project will disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The records identified within the Project footprint are close to the southern-most records of the species and the area of habitat is considered minimal when compared to the species extent of occurrence. The Project will remove 50.31 ha of potential or currently occupied habitat by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on king bluegrass. See Section 5.2.10 for further details. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known king bluegrass individuals. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including king bluegrass. The majority of records for the Dalby district population occur north of the Project Area, and as such, the Project is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	Unlikely The introduction of invasive weeds, particularly <i>Parthenium hysterophorus</i> and <i>Parkinsonia aculeata</i> is one of the main potential threats to king bluegrass (DSEWPC, 2013a). These species have not been recorded in the Project footprint. Fifteen invasive weed species have been recorded in the Project footprint. The Project will adopt Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the approved conservation advice for the species, there are no known diseases associated with king bluegrass. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely There is no adopted or made recovery plan for the species. Relevant priority actions noted in the Conservation Advice for the species are: • Monitor known populations to identify key threats.

Criterion	Assessment against significance criteria
	• Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary. • Identify populations of high conservation priority. • Ensure there is no disturbance in areas where king bluegrass occurs, excluding necessary actions to manage the conservation of the species / ecological community. • Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate and/or secure inclusion in reserve tenure if possible. • Manage any other known, potential or emerging threats, including mining practices, grazing, weed invasion and climate change. • Develop and implement a management plan for king bluegrass for the control of parthenium (<i>Parthenium hysterophorus</i>) and parkinsonia (<i>Parkinsonia aculeata</i>) in the region. • Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on king bluegrass. • Develop and implement a stock management plan for roadside verges and travelling stock routes. The Project has the potential to assist through the management of invasive weeds within the Project footprint and disturbance from indirect impacts will be mitigated through development and implementation of Erosion and Sediment Control Plans, Soil Management Plans and Biosecurity Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species, and the control of weeds. As the Project will not involve the clearing of individuals, it is considered unlikely that the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on king bluegrass

7.2.1.2 WINGED PEPPERCRESS (*LEPIDIUM MONOPLOCOIDES*)

Winged peppercress (*Lepidium monoplacoides*) is listed as Endangered under the EPBC Act and is known to occur within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-8.

TABLE 7-8 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – WINGED PEPPERCRESS

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Likely Whilst there are no formally recognised populations of winged peppercress within Queensland (DoE, 2024c), numerous individuals have been recorded within the Project footprint. The identified records are the northern-most records of the species. The species is not known to occur in other areas of QLD. Given this, the local occurrences are interpreted to represent a separate population.

Criterion	Assessment against significance criteria
	The Project footprint contains 79.86 ha of winged peppercress habitat and a total of 180 individuals were identified within the footprint. Project footprint impacts are permanent; however, the species is known to utilise areas adjacent to road and rail and it is uncertain how the species may utilise the area once Project activities are complete. As a precautionary approach, it is considered that there will potentially be a long-term decrease in the size of the population present within the Project footprint. The flooding impact assessment found that some areas of winged peppercress habitat outside the Project footprint is likely to be impacted by decreases in inundated areas, increased duration of inundation, and increased velocity under 20% AEP, 10% AEP and 5% AEP flood scenarios. The areas and quantum of impacts were, however, determined to be insignificant (see Section 5.2.10). Variations in the time of inundation are not expected to significantly impact the species, as habitat will continue to be periodically inundated, which is a key habitat preference for the species. ARTC will refine the revised reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat. It is likely that the Project will lead to a long-term decrease in the size of the known populations of winged peppercress within the project footprint.
Reduce the area of occupancy for the species	Likely A total of 79.86 ha of suitable habitat will be removed, reducing the area of occupancy.
Fragment an existing population into two or more populations	Unlikely The local occurrences are interpreted to represent a separate population. The Project will perpetuate existing fragmentation but will not create or increase fragmentation. The species has continued to persist in the impact area, on either side of linear infrastructure corridors and it is known to utilise these corridors as habitat. This species has also been identified on the adjoining property, Glenlovely, which will form part of the Project offset portfolio. The species may persist on either side of the rail corridor post-construction of the Project, it is therefore unlikely that clearing for the Project will result in further fragmentation of a population.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species has not been formally defined. The 79.86 ha of winged peppercress habitat that will be impacted by the Project is considered habitat critical to the survival of the species due to its very restricted occurrence in QLD. As such, it is likely the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Unlikely There is limited published literature regarding the species' biology and ecology, however, the winged structures of the fruit suggest wind dispersal. As such, the Project is unlikely to disrupt the breeding cycle of individuals remaining outside of the Project footprint and the population more broadly across the landscape. Despite some mature individuals being removed from the breeding pool, the breeding cycle of individuals remaining outside of the footprint will not be impacted.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Likely The Project will clear 79.86 ha of habitat that supports the species. This habitat consists of 30.17 ha of remnant, 0.61 ha of mature regrowth, 9.08 ha of immature regrowth, and 40.00 ha of non-remnant vegetation. While this will be significant to the local population, due to the large distribution of the species in NSW and Victoria, the disturbance within the Project footprint is not considered to impact the habitat to the extent that the species is likely to decline broadly. However, given the species limited distribution in Queensland, the Project is considered to have potential to lead to the

Criterion	Assessment against significance criteria
	decline of the species in Queensland, as the area of 79.86 ha will no longer support the species. The species is known to utilise areas of roadsides and rail corridors in the area, and the adjoining property, Glenlovely, and populations of this species are known to fluctuate, largely in response to climatic variables. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including winged peppercress. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known occurrences.. Changes to flooding regimes are a potential impact on the species (Mavromihalis, 2010) which is extremely localised in Queensland. The flooding impact assessment found that some areas of winged peppercress habitat is likely to be impacted by decreases in inundated areas, increased duration of inundation, and increased velocity under 20% AEP, 10% AEP and 5% AEP flood scenarios. The areas and quantum of impacts were, however, determined to be insignificant (see Section 5.2.10). Variations in the time of inundation are not expected to significantly impact the species, as habitat will continue to be periodically inundated, which is a key habitat preference for the species. ARTC will refine the drainage components of the revised reference design during the detailed design process to mitigate potential impacts from changes to hydrology and flooding on MNES species habitat, such that no significant impacts will occur. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal.
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	Unlikely Winged peppercress is threatened by the introduction of exotic grasses including <i>Vulpia</i> spp., <i>Bromus</i> spp., <i>Lolium</i> spp., and <i>Avena</i> spp. Additionally, African boxthorn (<i>Lycium ferocissimum</i>) and Pattersons curse (<i>Echium plantagineum</i>) are known threats to the species at multiple known sites (Mavromihalis, 2010). African boxthorn and African lovegrass (<i>Eragrostis curvula</i>) are known to occur within the Project footprint, and grasslands are already subject to significant invasion by introduced pastoral grass species. The Project will adopt the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat. As such, the Project is considered unlikely to result in invasive species becoming established in this species habitat.
Introduce disease that may cause the species to decline	Unlikely There are no known, identified diseases associated with winged peppercress. It is considered unlikely that the Project will introduce disease that may cause the species to decline.

Criterion	Assessment against significance criteria
Interfere with the recovery of the species	Unlikely The <i>National Recovery Plan for the Winged Peppercress (Lepidium monoplacoides)</i> (Mavromihalis, 2010) was based on the assumption that the species only lived in NSW and Victoria. It recognised that little was known about the species so identifies the following, largely research based, priority actions: • Determine distribution, abundance and population structure; • Determine habitat requirements; • Manage threats to populations; • Identify key biological functions; • Determine growth rates and viability of populations; • Establish a seed bank; and • Build community support for conservation. The Project is considered unlikely to interfere with the species recovery strategies. The Project has the potential to reduce known threats to the species including the management of weed infestations through the Project's CEMP and Operational EMP Biosecurity Management Plans. The Project will assist through the management and mitigation of potential indirect impacts through development and implementation of Erosion and Sediment Control Plans and Soil Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, and management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species. Additionally, ARTC has engaged with the University of the Sunshine Coast to investigate key aspects of the recovery plan for this species and ensure that relevant threats in Queensland can be managed appropriately. As such, it is considered unlikely that the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on winged peppercress

7.2.1.3 XEROTHAMNELLA HERBACEA

Xerothamnella herbacea is listed as Endangered under the EPBC Act, and is known to occur within the Project footprint, due to direct sightings within the Project footprint in Yelarbon. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-9.

TABLE 7-9 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – XEROTHAMNELLA HERBACEA

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Likely The species has a restricted distribution and is only known to occur in four locations across Queensland, each constituting their own local population. The Project footprint contains 11.99 ha of <i>Xerothamnella herbacea</i> habitat which will be impacted by the Project. Numerous individuals (70) of the species were recorded within the Project footprint during field surveys south-west of Yelarbon. Individuals in the currently known populations are

Criterion	Assessment against significance criteria
	present either side of the Project footprint (one population within and one population outside of the Project footprint). The Project is likely to result in complete removal of the known population within the Project footprint but the known population adjacent to the Project footprint will remain. Therefore, it is considered likely that the loss of 70 individuals and clearing of 11.99 ha of species habitat within the Project footprint will result in a long-term decrease in the size of a population.
Reduce the area of occupancy for the species	Likely Clearing of 11.99 ha of species habitat within the Project footprint will reduce the area of occupancy. The species' conservation advice suggests the species can exist in cleared areas or non-remnant vegetation post disturbance, depending on prevailing land uses (DEWHA, 2008c), however its likelihood of persistence in the rail corridor post-construction is not known. Therefore, clearing of species habitat within the Project footprint is considered likely to reduce the area of occupancy for the species.
Fragment an existing population into two or more populations	Unlikely The Project is linear and relatively narrow, although it is unlikely that this will represent a barrier for dispersal or cross-pollination for the species should the species persist on either side of the rail corridor post-construction. The Project footprint follows the existing Southwestern System rail line in this area. Therefore, it is unlikely the Project will fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species has not been formally defined in the conservation advice, as the species is not well enough studied. Therefore, for the purposes of this assessment, the definition as per Significant Impact Guidelines has been used. A total of 11.99 ha of <i>Xerothamnella herbacea</i> habitat will be impacted through the clearing process. It is considered the Project is likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Unlikely There is limited information available on the breeding cycle of <i>Xerothamnella herbacea</i>, however as the species flowers, it is likely to reproduce sexually and as such, pollination and seed dispersal vectors are relevant. However, the species' ability to root at the nodes also suggests the potential for individuals to reproduce vegetatively. Although some individuals will be removed from the population, the Project is not likely to impact the processes associated with wind dispersal and seed dispersal. Therefore, it is considered unlikely that the Project will disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The species was recorded within the Project footprint and the Project will result in a loss of individuals and supporting habitat. The Project will clear 11.99 ha of habitat that supports the species. This habitat to be removed includes 4.68 ha of remnant vegetation, 2.79 ha of immature regrowth vegetation and 4.51 ha of non-remnant vegetation. However, of the four known populations of the species, three occur in cleared areas or non-remnant vegetation (DEWHA, 2008c), suggesting the species is able to persist following disturbance. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions due to the Project are likely to

Criterion	Assessment against significance criteria
	have negligible impacts on <i>Xerothamnella herbacea</i>. See Section 5.2.10 for further details. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known occurrences. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including <i>Xerothamnella herbacea</i>. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. It is considered the Project is unlikely to impact known habitat for the species to the extent that the species is likely to decline.
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	Unlikely <i>Xerothamnella herbacea</i> is threatened by the introduction of exotic grasses including green panic (<i>Megathyrsus maximus</i> var. <i>pubiglumis</i>) and buffel grass (<i>Cenchrus ciliaris</i>) (DEWHA, 2008c). Both buffel grass and green panic are known to occur within the Project footprint, albeit minimal records exist. The Project footprint is subject to significant invasion by introduced pastoral grass species. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat. As such, the Project is considered unlikely to result in invasive species becoming established in this species habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice, there are no known, identified diseases associated with <i>Xerothamnella herbacea</i>. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Likely There is no recovery plan for the species and a recovery plan is not required. The species conservation advice (DEWHA, 2008c) identifies the following research priorities and regional priority actions: • Monitor known populations to identify key threats and the progress of management actions; • Ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where <i>Xerothamnella herbacea</i> occurs do not adversely impact on known populations; • Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on <i>Xerothamnella herbacea</i>; • Develop and implement a management plan for the control of Green Panic and Buffel Grass in the local region; and • Develop and implement a suitable fire management strategy to minimise the intensity and frequency of fires in remnant Brigalow and Semi-evergreen vine thicket communities.

Criterion	Assessment against significance criteria
	The Project will interfere with priority actions as it is an infrastructure development which will require substrate and vegetation disturbance in areas where <i>Xerothamnella herbacea</i> occurs. However, the Project has the potential to reduce known threats to the species including weed infestation through the implementation of management measures within the Project's Biosecurity Management Plans. The Project will also assist through the management and mitigation of potential indirect impacts through development and implementation of Erosion and Sediment Control Plans and Soil Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, and management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species. Additionally, ARTC has engaged with the University of the Sunshine Coast to investigate key aspects of the species including the identification of relevant threats which will be further incorporated into mitigation management considerations. Additionally, whilst the Project may be a potential point source of fire ignition, this is considered a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. It is considered likely the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is considered likely to result in a significant impact on <i>Xerothamnella herbacea</i>.

7.2.2 VULNERABLE FLORA SPECIES

The following sections assess the potential for significant impacts on nine vulnerable flora species identified as known, likely or potentially occurring within the Project footprint in accordance with the *Significant Impact Guidelines* (DoE, 2013a).

7.2.2.1 TARA WATTLE (*ACACIA LAUTA*)

Tara wattle (*Acacia lauta*) is listed as Vulnerable under the EPBC Act and has the potential to occur within the Project footprint, due to the presence of potential habitat near Inglewood. The species was not recorded, despite targeted searches within the Project footprint. An in-depth description of the species, its distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the important population criterion is shown in Table 7-10. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-11.

TABLE 7-10 IMPORTANT POPULATION ASSESSMENT – TARA WATTLE

Criterion	Assessment against criteria
Key source population for breeding or dispersal	As per the species conservation advice (DEWHA, 2008d), there are three isolated populations which are endemic to the Darling Downs region. These include: 'Marron Glen' population (approximately 25 ha in size) (15 km south-east of Inglewood) with approximately 1,890 individuals; 'Spinifex Corner' (10 ha) (15 km north of Tara) with approximately 110 individuals; and

Criterion	Assessment against criteria
	'Goranba Lane' (0.3 ha in size) (16 km east of Tara) with eight (8) individuals. The 'Marron Glen' population is located approximately 16.5 km east of the Project footprint (east of Inglewood). This population is likely a key source population for breeding and dispersal due to the high population size in relation to the surrounding isolated populations. There are no known populations within the Project footprint, therefore, should one exist, it would be small and not a key source for breeding or dispersal.
Populations that are necessary for maintaining genetic diversity	The Marron Glen population located east of Inglewood is isolated from the two surrounding populations (approximately 141.40 km distant from the other two populations). As such this population is considered likely to be genetically unique, and thus, essential to the maintenance of the species overall genetic diversity.
Populations that are near the limit of the species' range	The Marron Glen population located east of the Project footprint is the southern-most known distribution of this species and is near the limit of the species range.
Assessment as an important population	As no records exist within the Project footprint, it is considered unlikely that there is an important population within the Project footprint.

TABLE 7-11 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – TARA WATTLE

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Unlikely No important population exists for Tara wattle within the Project footprint.
Reduce the area of occupancy of an important population	Unlikely As no Tara wattle individuals have been recorded within the Project footprint, it is considered unlikely that an important population exists. The clearing of 410.00 ha of species habitat is therefore unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely As no Tara wattle individuals have been recorded within the Project footprint, it is considered unlikely that an important population exists. The clearing of 410.00 ha of species habitat is therefore unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely The Project will remove 410.00 ha of potential habitat by clearing. This habitat consists of 220.47 ha of remnant, 8.56 ha of mature regrowth, 76.51 ha of immature regrowth, and 101.64 ha of non-remnant vegetation. Habitat critical to the survival of Tara wattle is not defined in the conservation advice (DEWHA, 2008d), therefore the definition as per Significant Impact Guidelines has been used. As the species was not recorded within the Project footprint despite targeted surveys, it is unlikely that potential Tara wattle habitat within the Project footprint is necessary for dispersal or long-term maintenance of the species or to maintain genetic diversity. Due to the Project being located 16 km from the closest known important population, it is also unlikely to be used for the recovery of the species, and as such this potential habitat is not considered habitat critical to the survival of the species. Therefore, the Project will not adversely affect habitat critical to the survival of the species.

Criterion	Assessment against significance criteria
Disrupt the breeding cycle of an important population	Unlikely Tara wattle disperses through falling seeds and in some instances via ant-dispersal methods. No Tara wattle individuals have been recorded within the Project footprint and known records are >5 km away. However, should Tara wattle be found to be within or in close proximity to the Project footprint, it is unlikely that the Project will impact upon cross-pollination and seed dispersal mechanisms. It is considered unlikely that the Project will disrupt the breeding cycle of Tara wattle.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Potential habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology outside of the Project footprint. Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on Tara wattle. See Section 5.2.10 for further details. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed to prevent impacts to individuals that may occur within the Project footprint. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. The species was not recorded within the Project footprint despite targeted surveys. The 'Marron Glen' population is approximately 16.5 km east of the Project footprint, with the closest known individuals occurring approximately 11 km away, near Coolmunda Dam. The Project is not expected to impact upon these areas, and as such, the Project is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely Weed and pest species are not a formally identified threat to Tara wattle (DEWHA, 2008d). The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008d), there are no known, identified diseases associated with Tara wattle. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no adopted or made recovery plan for Tara wattle. The species conservation advice (DEWHA, 2008d) identifies a range research priorities and regional priority actions which all relate to the sites of known occurrence. As the species has not been recorded within the Project footprint, they are therefore not relevant to the Project.

Criterion	Assessment against significance criteria
	The Project is unlikely to interfere with the recovery / priority actions as listed in the conservation advice (DEWHA, 2008d), and therefore, it is considered unlikely the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on Tara wattle.

Pre-clearance surveys will target Tara wattle, and should individuals be discovered within the Project footprint, the individual will be considered in the refinement of the revised reference design during detailed design and, if necessary, the SIA will be reassessed. Should residual significant impacts to the species subsequently be determined, a requirement for offsets will be triggered.

7.2.2.2 HAIRY-JOINT GRASS (*ARTHRAOXON HISPIDUS*)

Hairy-joint grass (*Arthraxon hispidus*) is listed as Vulnerable under the EPBC Act and while not recorded by field surveys, 13.13 ha of potential habitat has been mapped within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. Important populations of hairy-joint grass have not been formally defined within the species conservation advice (DEWHA, 2008e). An assessment against the important population criterion is shown in Table 7-12. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-13.

TABLE 7-12 IMPORTANT POPULATION ASSESSMENT – HAIRY-JOINT GRASS

Criterion	Assessment against criteria
Key source population for breeding or dispersal	The species was not recorded during targeted field surveys of the Project footprint. The nearest records of the species occur approximately 11 km east of the alignment. There are many records of the species across a large extent of occurrence, including a number of isolated populations; the Project is not near any of those.
Populations that are necessary for maintaining genetic diversity	As there is no known local population, and many others across a wide extent of occurrence, the local habitat is not considered necessary to the maintenance of the species genetic diversity.
Populations that are near the limit of the species' range	The nearest population to the Project footprint (15 km east of the Project footprint) is deemed to be in the western portion of the species identified distribution and not near the limit of the species range. Should a population exist within the footprint it could be near the western limit of the species' range.
Assessment as an important population	As no records exist within the Project footprint, it is considered unlikely that there is an important population within the Project footprint. The nearest important population is located 15 km east of the Project footprint.

TABLE 7-13 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – HAIRY-JOINT GRASS

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Unlikely The Project footprint contains 13.13 ha of potential hairy-joint grass habitat, which will be cleared, however the species was not recorded within the Project footprint despite targeted surveys. No important population exists within the Project footprint and it is considered unlikely the Project will lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Unlikely As described in the preceding criteria, no important population exists within the Project footprint. The clearing of 13.13 ha of species habitat is therefore unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely As no hairy-joint grass individuals have been recorded within the Project footprint, it is considered unlikely that an important population exists. The clearing of 13.13 ha of species habitat is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely The Project will remove 13.13 ha of potential habitat by clearing. This habitat consists of 12.99 ha of remnant and 0.14 ha of non-remnant vegetation. As per the species conservation advice (DEWHA, 2008e), there is no official definition for habitat critical to the survival of hairy-joint grass, therefore the definition as per Significant Impact Guidelines has been used. As the species was not recorded within the Project footprint despite targeted surveys, it is unlikely that potential hairy-joint grass habitat within the Project footprint is necessary for dispersal or long-term maintenance of the species or to maintain genetic diversity. Due to the Project being located 11 km from the nearest records, it is also unlikely to be used for the recovery of the species, and as such this potential habitat is not considered habitat critical to the survival of the species. The Project will not adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely No hairy-joint grass individuals have been recorded within the Project footprint and no important population exists within the Project footprint. Hairy-joint grass disperses through wind-based pollination and seed dispersal. The Project is not likely to impact the processes associated with wind dispersal and seed dispersal. It is considered unlikely that the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. The flooding impact assessment found that some areas of hairy-joint grass habitat outside the Project footprint is likely to be impacted by increases in inundated areas, increased duration of inundation, and increased velocity under 20% AEP, 10% AEP and 5% AEP flood scenarios. The areas and quantum of impacts were, however, determined to be insignificant (see Section 5.2.10). ARTC will refine the drainage components of the revised reference design during the detailed design process to mitigate potential impacts from changes to hydrology and flooding on MNES species habitat, such that no significant impacts will occur. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation

Criterion	Assessment against significance criteria
	and dust will be managed to prevent impacts to individuals that may occur within the Project footprint. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. Approximately 13.13 ha of potential hairy-joint grass habitat will be cleared by the Project. The species was not recorded within the Project footprint despite targeted surveys. The closest important population is approximately 15 km east of the Project footprint. The Project is unlikely to impact upon this population, and the Project is considered unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice, hairy-joint grass is currently threatened by the introduction of exotic grasses, including mist flower (<i>Ageratina riparia</i>), crofton weed (<i>Ageratina adenophora</i>), lantana (<i>Lantana camara</i>), paspalum (<i>Paspalum dilatatum</i>) and kikuyu (<i>Pennisetum clandestinum</i>). Lantana is present within the Project footprint and will be managed by the Project. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008e), there are no known, identified diseases associated with hairy-joint grass. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no adopted or made recovery plan for hairy-joint grass. The species conservation advice (DEWHA, 2008e) identifies (but not limited to) the following research priorities and regional priority actions: • Monitor known populations to identify key threats; • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary; • Identify populations of high conservation priority; • Investigate further formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible; • Raise awareness of hairy-joint grass within the local community; • Control access routes to suitably constrain public access to known sites on public land; • Identify, remove, and prevent introduction of weeds in the local area, which could become a threat to Hairy-joint Grass, using appropriate methods; • Control introduced grasses in areas with known populations; and • Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on hairy-joint grass.

Criterion	Assessment against significance criteria
	There are no records of the species within the Project footprint despite targeted surveys. The Project is unlikely to interfere with the recovery / priority actions as listed in the conservation advice (DEWHA, 2008e), and therefore it is considered unlikely the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on hairy-joint grass.

Pre-clearance surveys will target hairy-joint grass, and should individuals be discovered within the Project footprint, the individuals will be considered in the refinement of the revised reference design and, if necessary, the SIA will be reassessed. Should residual significant impacts to the species subsequently be determined, a requirement for offsets will be triggered.

7.2.2.3 STREAM CLEMATIS (*CLEMATIS FAWCETTII*)

Stream clematis (*Clematis fawcettii*) is listed as Vulnerable under the EPBC Act and while not recorded by field surveys, 2.27 ha of potential habitat has been mapped within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the important population criterion is shown in Table 7-14. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-15.

TABLE 7-14 IMPORTANT POPULATION ASSESSMENT – STREAM CLEMATIS

Criterion	Assessment against criteria
Key source population for breeding or dispersal	The species was not recorded during field surveys within the Project footprint; however, it is noted that the species is not always obvious due to its occurrence in canopies. The nearest records of the species occur approximately 1.25 km north of the Project footprint, and further records within 5 km to the east. However, as no plants were identified within the footprint, it is unlikely that the habitat supports a key source population for breeding or dispersal.
Populations that are necessary for maintaining genetic diversity	As there is no known population within the Project footprint and the species was not recorded during Project related surveys. There are records of the species within 5 km east of the alignment. The nearest population to the Project footprint (within 1.25 km north of the Project footprint) is considered unlikely to be genetically unique and thus not essential to the maintenance of the species overall genetic diversity.
Populations that are near the limit of the species' range	There is no known population within the Project footprint. The nearest population to the Project footprint (within 1.25 km north of the Project footprint) is near the limit of the species range and therefore may be considered an important population. Should a population exist within the footprint it would be near the western limit of the species' range therefore considered important.
Assessment as an important population	As no records exist within the Project footprint, it is considered unlikely that there is an important population within the Project footprint. The nearest important population is located 1.25 km north of the Project footprint.

TABLE 7-15 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – STREAM CLEMATIS

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Unlikely It is considered unlikely that an important population exists in the Project footprint. The clearing of 2.27 ha of potential species habitat is therefore unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Unlikely The extent of occurrence of stream clematis is approximately 34,867 km ² and the area of occupancy is not known (TSSC, 2012). The species is known from 39 sites in NSW and QLD and 16 subpopulations (DEWHA, 2008g). As no stream clematis individuals have been recorded within the Project footprint, it is considered unlikely that an important population exists. The clearing of 2.27 ha of potential species habitat is therefore unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely As no stream clematis individuals have been recorded within the Project footprint, it is considered unlikely that an important population exists. The clearing of 2.27 ha of potential species habitat is therefore unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely The Project will remove 2.27 ha of potential habitat by clearing. This habitat consists of 1.08 ha of remnant and 1.19 ha of immature regrowth vegetation. As per the species conservation advice (DEWHA, 2008g), there is no official definition for habitat critical to the survival of stream clematis, and the Significant Impact Guidelines definition of habitat critical to survival will be used. As the species was not recorded within the Project footprint, it is unlikely that potential stream clematis habitat within the Project footprint is necessary for dispersal or long-term maintenance of the species or to maintain genetic diversity. While potential habitat within the Project footprint may possibly provide for the reintroduction of the species it is overall considered unlikely that the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely As no stream clematis individuals have been recorded within the Project footprint and no important population exists within the Project footprint, it is considered unlikely that the Project will disrupt the breeding cycles of stream clematis.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on stream clematis. See Section 5.2.10 for further details. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed to prevent impacts to individuals that may occur within the Project footprint. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the

Criterion	Assessment against significance criteria
	community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. The Project footprint contains 2.27 ha of potential stream clematis habitat, which will be cleared by the Project. The species was not recorded within the Project footprint during field surveys. The majority of all species records occur more than 60 km north-west and 80 km south-east of the Project footprint, and as such, the Project is considered unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DEWHA, 2008g), stream clematis is currently threatened by the introduction of exotic grasses, including mist flower (<i>Ageratina riparia</i>), Crofton Weed (<i>Ageratina adenophora</i>), Lantana (<i>Lantana camara</i>). Lantana is present within the Project footprint and will be managed by the Project. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008g), there are no known, identified diseases associated with stream clematis. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no adopted or made recovery plan for stream clematis. The species conservation advice (DEWHA 2008g) identifies (but not limited to) the following research priorities and regional priority actions that may be relevant to the Project: • Ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where stream clematis occurs do not adversely impact on known populations; • Develop and implement a management plan for the control of major weeds such as Lantana in the region; • Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on stream clematis; and • Identify information and resource needs required to ensure land managers and stakeholders are aware of populations of stream clematis and habitat. There are no records of the species within the Project footprint despite targeted surveys. The Project has the potential to reduce known threats to the species including weed infestation through the implementation of appropriate management measures within the Project's Biosecurity Management Plans. The Project is unlikely to interfere with the recovery / priority actions as listed in the conservation advice (DEWHA, 2008g), and therefore, it is considered unlikely the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on stream clematis.

Pre-clearance surveys will target stream clematis, and should individuals be discovered within the Project footprint, the individuals will be considered in the refinement of the revised reference design during detailed design and, if necessary, the SIA will be reassessed. Should residual significant impacts to the species subsequently be determined, a requirement for offsets will be triggered.

7.2.2.4 BLUEGRASS (*DICHANTHIUM SETOSUM*)

Bluegrass (*Dichanthium setosum*) is listed as Vulnerable under the EPBC Act and has the potential to occur within the Project footprint, due to the presence of habitat and one record within the locality (10 km buffer). The species was not recorded within the Project footprint during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. Important populations of bluegrass have not been formally defined within the species conservation advice (DEWHA, 2008h) so an assessment against the important population criterion is shown in Table 7-16. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-17.

TABLE 7-16 IMPORTANT POPULATION ASSESSMENT – BLUEGRASS

Criterion	Assessment against criteria
Key source population for breeding or dispersal	The species was not recorded within the Project footprint during field surveys. The nearest desktop record is approximately 10 km south of the southernmost point of the Project, with another three occurring as scattered records approximately 15 km east of the northernmost point of the Project footprint.
Populations that are necessary for maintaining genetic diversity	There is no known population within the Project footprint and the species was not recorded despite targeted surveys. The nearest desktop record is located along an existing rail corridor between North Star Road and the Bruxner Way in NSW, approximately 10 km south of the Project footprint. Three other scattered records occur around Toowoomba, approximately 15 km east of the Project footprint. This population may be considered necessary for maintaining genetic diversity due to its relative separation from the larger occurrences in NSW and those in and around Carnarvon National Park in QLD. Should a population exist within the Project footprint it may be considered important.
Populations that are near the limit of the species' range	The nearest records to the Project footprint are not located toward the limit of the species range.
Assessment as an important population	As no records exist within the Project footprint, it is considered unlikely that there is an important population within the Project footprint. The nearest important population is located 15 km east of the Project footprint.

TABLE 7-17 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – BLUEGRASS

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size	Unlikely

Criterion	Assessment against significance criteria
of an important population	The Project footprint contains 260.52 ha of potential bluegrass habitat which has the potential to be impacted by the Project. The species was not recorded within the Project footprint despite targeted surveys. No important population exists for bluegrass within the Project footprint, as such, it is considered unlikely the Project will lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Unlikely The area of occupancy and extent of occurrence of bluegrass is not known. As no bluegrass individuals have been recorded within the Project footprint, it is considered unlikely that an important population exists. The clearing of 260.52 ha of species habitat is therefore unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely As no bluegrass individuals have been recorded within the Project footprint, it is considered unlikely that an important population exists. The clearing of 260.52 ha of species habitat is therefore unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely As per the species conservation advice (DEWHA, 2008h), there is no official definition for habitat critical to the survival of bluegrass, and as such, the Significant Impact Guidelines definition of habitat critical to survival will be used. As the species was not recorded within the Project footprint, it is unlikely that potential bluegrass habitat within the Project footprint is necessary for dispersal or long-term maintenance of the species or to maintain genetic diversity. While potential habitat within the Project footprint may possibly provide for the reintroduction of the species, it is overall considered unlikely that the Project will adversely affect habitat critical to the survival of the species. Of the 260.52 ha of potential bluegrass habitat within the Project footprint, 0.04 ha is non-remnant, 77.15 ha is immature regrowth, 5.28 ha is mature regrowth, and 178.06 ha is remnant vegetation. As such, it is unlikely the project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely No bluegrass individuals have been recorded within the Project footprint and no important population exists within the Project footprint. Bluegrass disperses through wind-based pollination and seed dispersal. The Project is not likely to impact the processes associated with wind dispersal and seed dispersal. It is considered unlikely that the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions outside of the Project footprint due to the Project are considered to have low impacts on bluegrass. See Section 5.2.10 for further details. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed to prevent impacts to individuals that may occur within the Project footprint. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the

Criterion	Assessment against significance criteria
	extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. The Project footprint contains 260.52 ha of potential bluegrass habitat which has the potential to be impacted by the Project. The species was not recorded within the Project footprint despite targeted surveys. The majority of all species records occur more than 100 km south of the Project footprint, and as such, the Project is considered unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DEWHA, 2008h), bluegrass is currently threatened by the introduction of exotic grasses, including coolatai grass (<i>Hyparrhenia hirta</i>), lippia (<i>Phyla canescens</i>) and African lovegrass (<i>Eragrostis curvula</i>). African lovegrass is known to occur within the Project footprint, and grasslands are already subject to significant invasion by introduced pastoral grass species. The Project will adopt a Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008h), there are no known, identified diseases associated with bluegrass. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no adopted or made recovery plan for bluegrass. The species conservation advice (DEWHA, 2008h) identifies (but not limited to) the following regional priority actions: • Identify populations of high conservation priority; • Manage threats to areas of vegetation that contain populations / occurrences / remnants of <i>D. setosum</i>; • Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on <i>D. setosum</i>; • Ensure road widening and maintenance activities (or other infrastructure or development activities as appropriate) in areas where <i>D. setosum</i> occurs do not adversely impact on known populations; • Investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure; • Develop and implement a management plan for the control of introduced grasses, such as Coolatai, African Lovegrass and Lippia, in the local region; • Develop and implement a stock management plan for roadside verges and travelling stock routes; and • Develop and implement a suitable fire management strategy for <i>D. setosum</i>. The actions focus on areas where the species occurs and as there are no records of the species within the Project footprint despite targeted surveys, the Project is unlikely to interfere with its recovery.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on bluegrass.

Pre-clearance surveys will target bluegrass, and should individuals be discovered within the Project footprint, the individuals will be considered in the refinement of the revised reference design during detailed design and, if necessary, the SIA will be reassessed. Should residual significant impacts to the species subsequently be determined, a requirement for offsets will be triggered.

7.2.2.5 BELSON'S PANIC (*HOMOPHOLIS BELSONII*)

Belson's panic (*Homopholis belsonii*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to the direct records during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the important population criterion is shown in Table 7-18. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-19.

TABLE 7-18 IMPORTANT POPULATION ASSESSMENT – BELSON'S PANIC

Criterion	Assessment against criteria
Key source population for breeding or dispersal	Important populations of Belson's panic have not been formally defined within the species conservation advice (DEWHA, 2008j). The species was recorded between Bringalily and Millmerran within the Project footprint during field surveys. One of the species records was observed along Millmerran-Inglewood Road, between Paton and Nicol Creek Road, at which more than 100 individuals were recorded growing in large clumps. Numerous records exist around Millmerran, Pittsworth and Oakey, as well as three historical records are 1.5 km south-west of Yelarbon. The individuals within the Project footprint are likely part of a substantial population in the broader area that is likely a key source for breeding and/or dispersal.
Populations that are necessary for maintaining genetic diversity	This population effectively exists within the species' distribution and is not considered to be isolated from other adjacent populations. As such, this population is not considered likely to be genetically unique and not essential to the maintenance of the species' overall genetic diversity.
Populations that are near the limit of the species' range	The population identified within the Project footprint is not near the limit of the species range.
Assessment as an important population	It is considered likely that there is an important population of Belson's panic within the Project footprint.

TABLE 7-19 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – BELSON'S PANIC

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Likely The Project footprint contains 242.25 ha of Belson's panic habitat which has the potential to be impacted by the Project. The species was recorded at multiple locations within the Project footprint, particularly near Yelarbon, Inglewood, Tummaville, Millmerran and Yandilla.

Criterion	Assessment against significance criteria
	Although Belson's panic can persist in disturbed area, such as roadsides, it may be shade-dependent and therefore is unlikely to recolonise temporarily disturbed areas of the Project footprint where there are no trees or shrubs. The removal of approximately 100 individuals from the population is therefore likely to lead to a long-term decrease in an important population.
Reduce the area of occupancy of an important population	Unlikely The area of occupancy of Belson's panic is unknown. Whilst the species was recorded within the Project footprint at multiple locations, and numerous records exist around Millmerran, Pittsworth and Oakey, outside of the Project footprint. Therefore, clearing of 242.25 ha within the Project footprint is unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely Whilst the Project will remove individuals from an important population, the species is likely to still be able to cross-pollinate and disperse seeds across the rail alignment. As wind-facilitated pollination and seed dispersal mechanisms are likely to maintain gene flow across the Project footprint, the existing population is likely to continue to function as a single population. Therefore, the Project is considered unlikely to fragment an existing important population into two populations.
Adversely affect habitat critical to the survival of the species	Unlikely Habitat critical to the survival of the species has not been formally defined within the conservation advice (DEWHA, 2008j), and as such, the Significant Impact Guidelines definition of habitat critical to survival will be used. The Project footprint contains 242.25 ha of suitable habitat however the species distribution in the area, with multiple records outside the Project footprint, indicates the habitat is not necessary for dispersal or long-term maintenance for the species. The Project is considered unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely Belson's panic is known to reproduce through wind dispersal and has the ability to recolonise in cleared or a highly disturbed areas, with records occurring in regenerating vegetation along roadsides (DoE, 2024b). Wind dispersal is unlikely to be impacted by the presence of such linear infrastructure, and as such, the Project is considered unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions outside of the Project footprint due to the Project are likely to have low impacts on Belson's panic. See Section 5.2.10 for further details. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including Belson's panic. Implementation of the Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known occurrences. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be

Criterion	Assessment against significance criteria
	packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. The Project footprint contains 242.25 ha of Belson's panic habitat, which has the will be cleared by the Project. This consists of 161.44 ha of non-remnant, 28.93 ha of immature regrowth, 1.61 ha of mature regrowth, and 50.27 ha of remnant vegetation. However, as numerous records exist outside of the Project footprint and the species regularly occupies highly modified habitats (provided there is a woody canopy), the Project is considered unlikely to decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species SPRAT profile (DoE, 2024b), Belson's panic is threatened by the introduction of exotic grasses, including green panic grass (<i>Panicum maximum</i> var. <i>trichoglume</i>) and tiger pear (<i>Opuntia aurantiaca</i>) in Queensland. Both green panic grass and tiger pear are known to occur within the Project footprint, albeit minimal records exist. The Project footprint is subject to significant invasion by introduced pastoral grass species. The Project will adopt the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008j), there are no known, identified diseases associated with Belson's panic. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no adopted or made recovery plan for Belson's panic. The species conservation advice (DEWHA, 2008j) identifies (but is not limited to) the following regional priority actions relevant to the Project: • Ensure fertilisers used in agriculture, and chemicals or other mechanisms used to eradicate weeds, do not have a significant adverse impact on <i>Homopholis belsonii</i>; • Ensure road widening and maintenance and mining activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where <i>H. belsonii</i> occurs do not adversely impact on known populations; • Develop and implement a management plan for the control of invasive weeds such as Green Panic Grass (<i>Panicum maximum</i> var. <i>trichoglume</i>), Coolatai Grass (<i>Hyparrhenia hirta</i>) and Tiger Pear (<i>Opuntia aurantiaca</i>) in the local region; and • Develop and implement a stock management plan for roadside verges and travelling stock routes. The species was recorded at multiple locations throughout the Project footprint. Whilst the Project will require the removal of individuals and 242.25 ha of Belson's panic habitat, the Project will implement appropriate weed controls in the Biosecurity Management Plans and remove livestock grazing from the Project footprint. The Project will also assist through the management and mitigation of potential indirect impacts through development and implementation of Erosion and Sediment Control Plans and Soil Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, and management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species.

Criterion	Assessment against significance criteria
	The Project is unlikely to substantially interfere with the recovery / priority actions as listed in the conservation advice (DEWHA, 2008j), and therefore, it is considered unlikely the Project will substantially interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on Belson's panic.

7.2.2.6 HAWKWEED (*PICRIS EVAE*)

Hawkweed (*Picris evae*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to direct sightings during field surveys. A recent survey by EMM estimated the population at the northern extent of the Project footprint to have a density of 23.9 plants per square metre (EMM, 2024). This patch was estimated to be 2.10 ha, with an area of 1.9 ha within the Project footprint. It is estimated that 448,842 plants are within the Project footprint from an estimated total of 500,705 plants within the patch. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the important population criterion is shown in Table 7-20. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-21.

TABLE 7-20 IMPORTANT POPULATION ASSESSMENT – HAWKWEED

Criterion	Assessment against criteria
Key source population for breeding or dispersal	Important populations of hawkweed have not been formally defined within the species conservation advice (DEWHA, 2008I). Hawkweed was recorded at multiple locations within the Project footprint, including south of Brookstead, north of Pittsworth and at the northern extent of the footprint near Gowrie Mountain. The species was also recorded at multiple locations just outside of the Project footprint, east of Pittsworth. A large and dense population was recorded at the northern extent of the Project footprint (estimated to have 448,842 individuals within the Project footprint). The density of this population within the Project footprint likely indicates it is a key source for breeding and/or dispersal.
Populations that are necessary for maintaining genetic diversity	The species is known to occur at multiple locations in the Project footprint and records suggest the species is abundant in the broader landscape between Pittsworth and Gowrie. Given the proximity of known populations within the Project footprint to historical records, and the species persistence within non-remnant vegetation, the populations within the Project footprint would not be considered necessary for maintaining genetic diversity.
Populations that are near the limit of the species' range	The populations within the Project footprint are located within the centre of the species' distribution.
Assessment as an important population	It is considered likely that there is an important population of hawkweed within the Project footprint.

TABLE 7-21 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – HAWKWEED

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Likely The species has been recorded at numerous locations across the northern extent of the Project footprint (from Pittsworth and further north). The Project footprint contains 110.67 ha of hawkweed habitat which will be impacted by the Project, and over 400,000 individuals will be cleared. The removal of such a large number of plants is likely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Likely The Project footprint contains 110.67 ha of suitable habitat. The removal of 1.878 ha of a population covering 2.095 ha near Gowrie Mountain, is likely to reduce the area of occupancy of this important population.
Fragment an existing important population into two or more populations	Unlikely Whilst the Project will remove individuals from an important population, the species is likely to still be able to cross-pollinate and disperse seeds across the rail alignment. As wind-facilitated pollination and seed dispersal mechanisms are likely to maintain gene flow across the alignment, the existing population is likely to continue to function as a single population. Therefore, the Project is considered unlikely to fragment an existing important population into two populations.
Adversely affect habitat critical to the survival of the species	Unlikely Habitat critical to the survival of the species has not been formally defined in the conservation advice (DEWHA, 2008I), and as such the Significant Impact Guidelines definition of habitat critical to survival will be used. The Project footprint contains 110.67 ha, of which 44.39 ha is remnant, 2.76 is immature regrowth and 63.51 ha is non-remnant vegetation. The high density of plants within the northern extent of the Project footprint indicates that this habitat is likely habitat critical to the survival of the species. The species is known to grow in grassy open woodlands, roadsides and other suitable habitat types which are widespread in the broader area. The species is also known to utilise disturbed or degraded areas. Despite this, as a result of the clearing extent, the Project is likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely Hawkweed is known to reproduce through wind dispersal and has the ability to recolonise in cleared or a highly disturbed areas, with records occurring in along roadsides and in cultivated areas (DEWHA, 2008I). Despite mature individuals being removed from the breeding pool, the breeding cycle of individuals remaining outside of the footprint will not be impacted. Wind dispersal is unlikely to be impacted by the presence of such linear infrastructure, and as such, the Project is considered unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The Project footprint contains 110.67 ha of hawkweed habitat, of which 44.39 ha is remnant, 2.76 is regrowth and 63.51 ha is non-remnant vegetation. This habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions outside of the Project footprint due to the Project are likely to have negligible impacts on hawkweed. See Section 5.2.10 for further details. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including hawkweed. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components

Criterion	Assessment against significance criteria
	of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known occurrences. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. The Project is linear and relatively narrow, the species has been recorded in road reserves in the Study area and would appear tolerant of linear infrastructure impacts. The species is also known to occur in heavily degraded habitats and is likely to regenerate in the temporary footprint and parts of the permanent footprint. The species is widespread in the broader area. As such, the extent of clearing is unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DEWHA, 2008I), hawkweed is threatened by the introduction of exotic grasses. The Project footprint is subjected to significant invasion by introduced pastoral grass species including WoNS. The Project will adopt the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008I), there are no known, identified diseases associated with hawkweed. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for the species and a recovery plan is not required. The approved conservation advice for the species (DEWHA, 2008I) identifies several regional and local priority actions. Key regional priority actions include but are not limited to: • Identify significant vulnerable populations of high conservation priority; focus recovery actions and adaptive management at these sites; • Ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where Hawkweed occurs do not adversely impact on known populations; • Investigate further formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible; and • Develop and implement a suitable fire management strategy for Hawkweed. The Project will clear suitable habitat for hawkweed and a large, dense known population will be impacted. The Project will implement appropriate weed control measures in the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) and remove livestock grazing in the Project footprint unless it overlays a stock route. This will reduce the extent of livestock grazing in the broader area. The Project will assist through the management and mitigation of potential indirect impacts through development and implementation of Erosion and Sediment Control Plans and

Criterion	Assessment against significance criteria
	Soil Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, and management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species. While the Project may be a potential point source of ignition for fires this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. Although some habitat loss will occur as a result of the Project, this is offset by several benefits to the species that align with regional and local priority actions identified for the species. Therefore, it is considered unlikely that the Project will substantially interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on hawkweed.

7.2.2.7 AUSTRAL CORNFLOWER (*RHAPONTICUM AUSTRALE*)

Austral cornflower (*Rhaponticum australe*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to direct sightings during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-22. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-23.

TABLE 7-22 IMPORTANT POPULATION ASSESSMENT – AUSTRAL CORNFLOWER

Criterion	Assessment against criteria
Key source population for breeding or dispersal	A known population of the Austral cornflower is present within the Project footprint. While open grassy woodland habitat is common throughout the Project footprint, the species was surveyed to have a highly isolated, patchy occurrence. Numerous records exist outside of the Project footprint and it is therefore considered that populations of Austral cornflower within the Project footprint are unlikely to be key source populations for breeding and/or seed dispersal.
Populations that are necessary for maintaining genetic diversity	This species' distribution historically extended through NSW and Victoria however is now presumed extinct in these two States. The Project footprint is located within an area where the species or species habitat is mapped as 'known or likely to occur' DoE (2024e) and numerous records exist outside of the Project footprint. It is therefore considered that while the species' distribution has greatly reduced at a national scale, locally the populations within the Project footprint are not necessary for maintaining genetic diversity.
Populations that are near the limit of the species' range	Known populations of Austral cornflower within the Project footprint are not near the limit of the species' range.
Assessment as an important population	It is considered unlikely that the population of Austral cornflower identified within the Project footprint is an important population.

TABLE 7-23 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – AUSTRAL CORNFLOWER

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Unlikely Austral cornflower is known to occur within the Project footprint as a result of direct sightings during field surveys, however the population is unlikely to be an important population. During surveys, 164 individuals were recorded, with only 18 plants within the Project footprint. As the species will utilise disturbed habitats, including verges along linear infrastructure, there is potential for the species to utilise areas within the Project footprint post construction. Although 18 individuals will be removed from the population, it is likely that the impacted population will recover and not sustain a long-term decrease in its size.
Reduce the area of occupancy of an important population	Unlikely Direct impacts to individuals and their associated habitat is considered unlikely to reduce the occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely A total of 83.49 ha of Austral cornflower habitat and 18 individuals will be impacted by the Project, however, a further 128 individuals were identified within the Study area however the population is unlikely to be an important population. The species is wind-dispersed, and the Project is not considered to create a barrier to dispersal. The species has been recorded in road and rail reserves in the surrounding area and would appear tolerant of linear infrastructure impacts. The species is also known to occur in heavily degraded habitats. The Project is considered unlikely to fragment an existing important population.

Criterion	Assessment against significance criteria
Adversely affect habitat critical to the survival of the species	Unlikely Habitat critical to the survival of the species has not been formally defined in the conservation advice (DEWHA, 2008i), however the species is known to grow in grassy open woodlands, roadsides and other suitable habitat types which are widespread in the broader area. The species is also known to utilise disturbed or degraded areas. As a result of the clearing extent, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely Austral cornflower is known to occur within the Project footprint as a result of direct sightings during field surveys, however the population is unlikely to be an important population. Whilst not documented, it is likely the species reproduces through wind dispersal methods. The species is known to occur in grassy open woodlands including road and rail reserves and disturbed environments. Of the population identified, only 18 individuals occur within the Project footprint, with most of the population occurring outside of the Project footprint. The Project is unlikely to disrupt the breeding cycle of an important population as a whole.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The Project footprint contains 83.49 ha of Austral cornflower habitat, of which 2.69 ha is remnant, 11.38 is immature regrowth and 69.41 ha is non-remnant vegetation. This habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions outside the Project footprint due to the Project are likely to have negligible impacts on Austral cornflower. See Section 5.2.10 for further details. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including Austral cornflower. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known occurrences. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. The species is known to occur in grassy open woodlands including road and rail reserves and disturbed environments and may recolonise areas on completion of construction. Mitigation measures will be implemented to reduce indirect impacts (e.g. dust, weeds) to individuals which were identified within the Study area but which will not be directly impacted within the Project footprint. Therefore, clearing of 83.49 ha of species habitat is not anticipated to impact the availability or quality of habitat to the extent that the species is likely to decline.

Criterion	Assessment against significance criteria
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DEWHA, 2008i), Austral cornflower is threatened by the introduction of exotic grasses. The Project footprint is subjected to significant invasion by introduced pastoral grass species including WoNS. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008i), there are no known, identified diseases associated with Austral cornflower. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for the species and a recovery plan is not required. The approved conservation advice for the species (DEWHA, 2008i) identifies several regional and local priority actions. Key regional priority actions include but are not limited to: • Identify populations of high conservation priority; • Ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where Austral cornflower occurs do not adversely impact on known populations; • Control access routes to suitably constrain public access to known sites on public land; • Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible; • Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on Austral cornflower; • Identify and remove weeds in the local area, which could become a threat to Austral Cornflower, using appropriate methods; • Manage sites to prevent introduction of invasive weeds, which could become a threat to Austral Cornflower, using appropriate methods; and • Manage total grazing pressure from stock and rabbits at important sites through exclusion fencing or other barriers. The Project will implement appropriate weed controls in the CEMP and Operational EMP Biosecurity Management Plans and remove livestock grazing from the Project footprint unless it overlays a stock route. The Project will also assist through the management and mitigation of potential indirect impacts through development and implementation of Erosion and Sediment Control Plans and Soil Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, and management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species. Although some habitat loss will occur as a result of the Project, this is offset by several benefits to the species that align with regional and local priority actions identified for the species. Therefore, it is considered unlikely that the Project will substantially interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on Austral cornflower.

7.2.2.8 AUSTRAL TOADFLAX (*THESIUM AUSTRALE*)

Austral toadflax (*Thesium australe*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to the direct sightings near Pittsworth during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-24. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-25.

TABLE 7-24 IMPORTANT POPULATION ASSESSMENT – AUSTRAL TOADFLAX

Criterion	Assessment against criteria
Key source population for breeding or dispersal	The species is known to occur from a single location where 474 individuals were located within the Project footprint, approximately 2 km north-east of Pittsworth. Additionally, multiple historical records are scattered directly east of the Project footprint near Westbrook. The population within the Project footprint is considered unlikely to be a key source population for breeding and/or seed dispersal.
Populations that are necessary for maintaining genetic diversity	Multiple historical records are scattered directly east of the Project footprint near Westbrook. Given the above, the population of Austral Toadflax within the Project footprint is considered unlikely to be necessary for the maintenance of genetic diversity across the species' range.
Populations that are near the limit of the species' range	Austral toadflax is distributed between the Bunya Mountains (Queensland) to north-east Victoria, and as far inland as the NSW southern, central and northern tablelands and the Toowoomba region (Queensland) (DoE, 2013b). Within this widespread distribution, this species has been recorded to maintain sporadic populations. As such, the population documented within the Project footprint is not considered near the limit of the species' range.
Assessment as an important population	It is considered unlikely that the population of Austral toadflax identified within the Project footprint is an important population.

TABLE 7-25 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – AUSTRAL TOADFLAX

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Unlikely Numerous individuals of Austral toadflax have been recorded within the Project footprint, approximately 2 km north-east of Pittsworth; however, this population is not considered to be an important population for the species. The Project footprint contains 46.44 ha of potential Austral toadflax habitat, which will be impacted by the Project. However, as no important population exists for Austral toadflax within the Project footprint, it is considered unlikely the Project will lead to a long-term decrease in the size of an important population.

Criterion	Assessment against significance criteria
Reduce the area of occupancy of an important population	Unlikely Numerous individuals of Austral toadflax have been recorded within the Project footprint, approximately 2 km north-east of Pittsworth; however, this population is not considered to be an important population for the species. Therefore, the clearing of 46.44 ha of Austral toadflax habitat is unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely As no important population exists within the Project footprint, the Project is unlikely to fragment an existing important population into two or more populations
Adversely affect habitat critical to the survival of the species	Unlikely As per the species SPRAT profile (DoE, 2024f), there is no official definition for habitat critical to the survival of austral toadflax, and as such, the species' definition of preferred habitat, 'shrubland, grassland or woodland, often on damp sites dominated by swamp myrtle (<i>Leptospermum myrtifolium</i>), small-fruit hakea (<i>Hakea microcarpa</i>), alpine bottlebrush (<i>Callistemon sieberi</i>), woolly grevillea (<i>Grevillea lanigera</i>), coral heath (<i>Epacris microphylla</i>) and <i>Poa</i> spp.; kangaroo grass grassland surrounded by eucalyptus woodland; and grassland dominated by barbed-wire grass (<i>Cymbopogon refractus</i>)'. The Project footprint is located within an area where the species or species habitat is mapped as 'known or likely to occur' by DoE (2024f) and numerous records exist outside of the Project footprint. The Project will result in clearing of 46.44 ha of species habitat, however, the species has the ability to resprout following direct disturbance due to buds near the soil surface, and may recolonise areas on completion of construction. Mitigation measures will be implemented to reduce ongoing indirect impacts (e.g. dust, changes in surface water and groundwater hydrology and weeds). Therefore, clearing of 46.44 ha of species habitat is not anticipated to adversely affect habitat critical to the survival.
Disrupt the breeding cycle of an important population	Unlikely No important populations of austral toadflax exist within the Project footprint, despite the species being recorded to occur during field surveys. The Project is considered unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Species habitat is described as 'shrublands, grasslands or woodlands, often on damp sites', however the species is also known to occur in disturbed habitats and can withstand disturbance (DoE, 2024f). The Project footprint contains 46.44 ha of Austral toadflax habitat, of which 17.58 ha is remnant and 28.86 ha is non-remnant vegetation. This habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Changes to flood water distribution and other flood conditions outside the Project due to the Project are likely to have negligible impacts on Austral toadflax. See Section 5.2.10 for further details. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including Austral toadflax. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known occurrences. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management

Criterion	Assessment against significance criteria
	Plans as components of both the CEMP and Operational EMP. The use of herbicides will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. Numerous records exist to the east of the Project footprint, suggesting habitat is available within the region. As such, it is considered unlikely that the Project will decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DoE, 2013f), Austral toadflax is threatened by the introduction of exotic weeds including blackberry (<i>Rubus</i> spp.). There are no database records of <i>Rubus</i> spp. within the Project footprint, however the Project footprint is subjected to significant invasion by introduced pastoral grass species including WoNS. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DoE, 2013f), there are no known, identified diseases associated with Austral toadflax. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for the species and a recovery plan is not required. The approved conservation advice for the species (DoE, 2013f) identifies several regional and local priority actions. Key regional priority actions include but are not limited to: • Identify populations of high conservation priority; • Ensure there is no disturbance in areas where the austral toadflax occurs, excluding necessary actions to manage the conservation of the species; • Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate and/or secure inclusion in reserve tenure if possible; • Develop and implement a stock management plan for roadside verges and travelling stock routes; • Develop and implement a suitable fire management strategy for the habitat of the austral toadflax that inhibits canopy thickening; and • Enable recovery of additional sites and/or populations While the project will result in disturbance of habitat in which the species is known to occur, the Project will implement appropriate weed controls in the CEMP and Operational EMP Biosecurity Management Plans and remove livestock grazing from the Project footprint unless it overlays a stock route. This will reduce the extent of livestock grazing within the broader landscape. The Project will assist through the management and mitigation of potential indirect impacts through development and implementation of Erosion and Sediment Control Plans and Soil Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, and management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species. Whilst the Project may be a potential point source of ignition for fires this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape.

Criterion	Assessment against significance criteria
	Additionally, ARTC has engaged with the University of the Sunshine Coast to investigate key aspects of the species including the identification of relevant threats which will be further incorporated into mitigation management considerations. The Project is unlikely to interfere with the recovery / priority actions as listed in the conservation advice (DoE, 2013f), and therefore, it is considered unlikely the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on Austral toadflax.

7.2.2.9 SMALL-FLOWERED WESTRINGIA (*WESTRINGIA PARVIFOLIA*)

Small-flowered westringia (*Westringia parvifolia*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to direct sightings north-east of Yelarbon during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-26. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-27.

TABLE 7-26 IMPORTANT POPULATION ASSESSMENT – SMALL-FLOWERED WESTRINGIA

Criterion	Assessment against criteria
Key source population for breeding or dispersal	Small-flowered westringia is known to occur in the Project footprint as a result of multiple individuals detected north-east of Yelarbon. Given the species' limited distribution, the population is considered likely to be a key source population for breeding and/or seed dispersal.
Populations that are necessary for maintaining genetic diversity	The species is known to occur from a single concentrated population within and adjacent to the Project footprint north-east of Yelarbon. Given the species' limited distribution, the population within the Project footprint is considered likely to be necessary for the maintenance of genetic diversity across the species' range.
Populations that are near the limit of the species' range	Given the limited available information regarding population size data and the species' limited (approximately 80 km) distribution, any population would be considered important to the maintenance of the species' range. As such, the population recorded within the Project footprint is considered near the limit of the species' range.
Assessment as an important population	It is considered likely that the population of small-flowered westringia identified within the Project footprint is an important population.

TABLE 7-27 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – SMALL-FLOWERED WESTRINGIA

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an	Likely

Criterion	Assessment against significance criteria
important population	Small-flowered westringia was recorded at a single location within the Project footprint, north-east of Yelarbon. Due to the species limited range, this population is considered an important population. The Project footprint contains 27.19 ha of small-flowered westringia habitat and 214 individuals were identified during surveys. Due to the expected disturbance, it is considered unlikely that this species will utilise the Project footprint post construction. As such, the clearing extent associated with this Project will reduce the size of this population and is considered likely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Likely The population within the Project footprint is likely to be considered an important population for the species. Due to the expected disturbance, it is considered unlikely that this species will utilise the Project footprint post construction. As such, the Project is likely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely An important population has been identified as potentially occurring within the Project footprint. The species has also been recorded to occur outside of the Project footprint (east and west). The Project is linear and unlikely to represent a barrier for dispersal or cross-pollination for the species. As such, the clearing of approximately 27.19 ha is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely As per the species conservation advice (DEWHA, 2008k), there is no official definition for habitat critical to the survival of small-flowered westringia, and as such, the Significant Impact Guidelines definition of habitat critical to survival will be used. The Project footprint contains 27.19 ha of small-flowered westringia habitat, which will be impacted by the Project. Given the species' limited (approximately 80 km) distribution, it is considered likely that this habitat is necessary for dispersal and long-term maintenance of the species and to maintain genetic diversity. Habitat within the Project footprint may also provide for the reintroduction or recovery of the species and therefore the Project is likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely An important population has been identified as occurring in the Project footprint. It is unlikely that the Project will impact upon cross-pollination and seed dispersal mechanisms. Despite some mature individuals being removed from the breeding pool, the breeding cycle of individuals remaining outside of the footprint will not be impacted. Therefore, the Project is unlikely to indirectly impact on the breeding cycle of populations of this plant species.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Likely Habitat will be directly impacted by clearing. The Project also has the potential to indirectly impact the availability or quality of habitat through the generation of dust, spread of weeds and changes to surface water and groundwater hydrology. Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species, including small-flowered westringia. Implementation of the Erosion and Sediment Control Plan and Soil Management Plans as components of the CEMP and Operational EMP will ensure potential impacts from soil erosion and disturbance, sedimentation and dust will be managed adjacent to known occurrences. Land rehabilitation and management of weeds and other pest species will be implemented through the Biosecurity Management Plans and the Rehabilitation and Landscaping Management Plans as components of both the CEMP and Operational EMP. The use of herbicides

Criterion	Assessment against significance criteria
	will target control of invasive species which may enter the community. Fertilisers will be used in rehabilitation areas but only to the extent necessary and they will be packaged and stored appropriately prior to use. Risk of regular or substantial mobilisation is considered minimal. The flooding impact assessment found that some areas of small-flowered westringia habitat is likely to be impacted by increases in inundated areas and increased duration of inundation under 20% AEP, 10% AEP and 5% AEP flood scenarios. The areas and quantum of impacts were, however, determined to be insignificant (see Section 5.2.10). Variations in the time of inundation are not expected to significantly impact the species, as habitat will continue to be periodically inundated, which is a key habitat preference for the species. ARTC will refine the drainage components of the revised reference design during the detailed design process to mitigate potential impacts from changes to hydrology and flooding on MNES species habitat, such that no significant impacts will occur. The Project footprint contains 27.19 ha of small-flowered westringia habitat, which has the will be cleared by the Project. This consists of 5.30 ha of remnant, 1.34 ha of mature regrowth, 5.37 ha of immature regrowth, and 15.18 ha of non-remnant vegetation. Given the species' limit range and records, the removal of this habitat and 214 individuals, the Project is considered likely to decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DEWHA, 2008k), invasive species (including weeds) are not listed as a threatening factor to small-flowered westringia. The Project footprint is subject to significant invasion by introduced pastoral grass species including WoNS. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008k), there are no known, identified diseases associated with small-flowered westringia. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Likely There is no recovery plan for the species and a recovery plan is not required. The approved conservation advice for the species (DEWHA, 2008k) identifies several regional and local priority actions, including but not limited to: • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary; • Identify populations of high conservation priority; • Ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where <i>W. parvifolia</i> occurs do not adversely impact on known populations; • Manage any changes to hydrology that may result in changes to water table levels and/or increased run-off, salinity, sedimentation, or pollution; • Minimise adverse impacts from land use at known sites; • Control access routes to suitably constrain public access to known sites on public land; and

Criterion	Assessment against significance criteria
	Implement national translocation protocols if establishing additional populations is considered necessary and feasible. The Project will assist through the management and mitigation of potential indirect impacts through development and implementation of Erosion and Sediment Control Plans and Soil Management Plans as components of both the CEMP and Operational EMP. These plans will outline erosion and sediment controls, suppression of dust, and management of topsoil stockpiles to maintain the viability of seed banks for threatened flora species. Additionally, ARTC has engaged with the University of the Sunshine Coast to investigate key aspects of the species including the identification of relevant threats and genetic diversity which will be further incorporated into mitigation management considerations. The Project will involve substrate and vegetation disturbance in areas where the species occurs, which is inconsistent with the recovery / priority actions as listed in the conservation advice (DEWHA, 2008k), and therefore, it is considered likely the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on small-flowered westringia.

7.3 SIGNIFICANT IMPACT ASSESSMENT FOR THREATENED FAUNA

The following sections assess the potential for significant impacts to three critically endangered, five endangered and eleven vulnerable fauna species identified as known, likely or potentially occurring within or adjacent to the Project footprint. The species assessed and a reference to the respective significant impact assessment sections are presented in Table 7-28.

The ecology, life history and distribution of these species are summarised in Appendix F Species and Community Profiles. Relevant Commonwealth documents applicable to each species including threat abatement plans, Approved Conservation Advice, and recovery plans are also summarised in Appendix F Species and Community Profiles.

The assessment of significant impacts associated with the Project is based on:

- The revised reference design and incorporated mitigation measures (Section 1.6.6 and Section 6.2);
- Currently known information about the MNES affected (Appendix F Species and Community Profiles);
- Targeted threatened fauna surveys (Cardno, 2020), other associated surveys and field verified habitat mapping for each species (Appendix A);
- Information on potential impacts of Project construction and operation (Section 5.2); and
- Proposed mitigation measures (Section 6).

TABLE 7-28 THREATENED FAUNA SPECIES INCLUDED IN THE SIGNIFICANT IMPACT ASSESSMENTS

Common name	Scientific name	EPBC Act status	SIA section
Brigalow woodland snail	<i>Adclarkia cameroni</i>	E	7.3.1.1
Regent honeyeater	<i>Anthochaera phrygia</i>	CE	7.3.1.2
Australasian bittern	<i>Botaurus poiciloptilus</i>	E	7.3.1.3
Curlew sandpiper	<i>Calidris ferruginea</i>	CE	7.3.1.4
Spotted-tailed quoll	<i>Dasyurus maculatus maculatus</i>	E	7.3.1.5
Swift parrot	<i>Lathamus discolor</i>	CE	7.3.1.6
Australian painted snipe	<i>Rostratula australis</i>	E	7.3.1.7
Condamine earless dragon	<i>Tympanocryptis condaminensis</i>	E	7.3.1.8
Five-clawed worm-skink	<i>Anomalopus mackayi</i>	V	7.3.2.1
Collared delma	<i>Delma torquata</i>	V	7.3.2.2
Yakka skink	<i>Egernia rugosa</i>	V	7.3.2.3
Dunmall's snake	<i>Furina dunmali</i>	V	7.3.2.4
Squatter pigeon (southern)	<i>Geophaps scripta scripta</i>	V	7.3.2.5
Painted honeyeater	<i>Grantiella picta</i>	V	7.3.2.6
Murray cod	<i>Maccullochella peelii</i>	V	7.3.2.7
South-eastern long-eared bat	<i>Nyctophilus corbeni</i>	V	7.3.2.8
Greater glider (southern and central)	<i>Petauroides volans</i>	V	7.3.2.9
Koala	<i>Phascolarctos cinereus</i>	V	7.3.2.10
Grey-headed flying-fox	<i>Pteropus poliocephalus</i>	V	7.3.2.11

7.3.1 CRITICALLY ENDANGERED AND ENDANGERED FAUNA SPECIES

The following sections assess the potential for significant impacts on the three critically endangered and five endangered fauna species known, likely or potentially occurring within the Project footprint in accordance with the *Significant Impact Guidelines* (DoE, 2013a).

7.3.1.1 BRIGALOW WOODLAND SNAIL (*ADCLARKIA CAMERONI*)

Brigalow woodland snail (*Adclarkia cameroni*) is listed as Endangered under the EPBC Act and is known to occur within the Project footprint, due to direct observations between Brookstead and Canning Creek. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-29

TABLE 7-29 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – BRIGALOW WOODLAND SNAIL

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population of a species	Likely Brigalow woodland snail is known to occur in 11 locations across the Project footprint between Brookstead and Canning Creek. The extent or size of the population is unknown due to the cryptic nature of the species. The Project footprint contains 146.72 ha of habitat for the Brigalow woodland snail, which all will be cleared. The species distribution is restricted to the Condamine River floodplain in Queensland. Within this distribution, the species is unlikely to mobilise at great distances, and as such, clearing of habitat for the species within the Project footprint is likely to lead to a long-term decrease in the size of a population of a species.
Reduce the area of occupancy for a population	Likely The area of occupancy for brigalow woodland snail is 76 km² (7,600 ha) (TSSC, 2016a). Clearing of 146.72 ha (being 1.93% of the area of occupancy) of the species habitat will reduce the area of occupancy for a population as the species has low mobility within a restricted distribution.
Fragment an existing population into two or more populations	Unlikely The species is known to occur in the Project footprint, with records at multiple locations between Brookstead and Canning Creek, wherein the species is unlikely to mobilise at great distances. As such, it is likely there are multiple populations present along the Project alignment. Brigalow woodland snail is highly restricted to niche microhabitats within their distribution. Although the species has very limited mobility, movement between suitable microhabitat areas can occur during favourable conditions, such as rain (TSSC, 2016a). It is also possible that this species may disperse during flood events, as is likely for the boggomoss snail (<i>Adclarkia dawsonensis</i>) (DEHP, 2017b). Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for the brigalow woodland snail. Connectivity areas have been identified for brigalow woodland snail. Structures with natural substrate will be designed for the species, including provision of suitable habitat features within these crossing structures and in their approaches. The residual impact to connectivity for brigalow woodland snail after mitigation was assessed in the Fauna Connectivity Strategy as low at bridges and moderate at culverts. As such, the Project is unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species is defined in the species conservation advice (TSSC, 2016a) as: • Habitat with tree cover and ground debris is critical to survival of native land snails and increases the species' ability to disperse and recolonise. Tree cover ensures a level of environmental moisture; and • Accumulated ground debris provides important shelter for the species. Brigalow woodland snail habitat within the Project footprint meets this description. It is therefore considered likely that the Project will adversely affect 146.80 ha of habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Likely Breeding individuals of the species have not been observed and breeding information is poorly known however according to the species Conservation Advice (TSSC, 2016a), records comprised of juveniles and sub-adults indicate that the brigalow woodland snail is breeding in some locations of known populations. The species requires canopy and on-ground timber cover for egg-laying. Clearing of 146.72 ha of habitat for the species is likely to

Criterion	Assessment against significance criteria
	create a barrier in species movement and therefore, it is considered likely the Project will disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Likely Changes to flood water distribution and other flood conditions due to the Project are likely to have low impacts on brigalow woodland snail habitat outside of the Project footprint. See Section 5.2.10 for further details. Impacts relating to noise and vibration are expected to be negligible (see Section 5.2.6). Brigalow woodland snail requires on-ground timber cover for survival and egg laying. The species has limited mobility and the capacity for dispersal is therefore also very limited (TSSC, 2016a). Clearing of 146.72 ha of habitat within the Project footprint is considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that Brigalow woodland snail is likely to decline.
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	Unlikely As per the species conservation advice (TSSC, 2016a), Brigalow woodland snail is threatened by the invasion of buffel grass (<i>Cenchrus ciliaris</i>) and the predation by rats (<i>Rattus</i> spp.), mice (<i>Mus musculus</i>) and feral pigs (<i>Sus scrofa</i>). The Project footprint is subjected to significant invasion by introduced pastoral grass species including WoNS and introduced fauna have been recorded. The Project will adopt Biosecurity Management Plans (as a components of both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the endangered species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (TSSC, 2016a), there are no known, identified diseases associated with Brigalow woodland snail. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Likely There is no adopted or made recovery plan for this species, and a recovery plan is not required. The species conservation advice (TSSC, 2016a) identifies (but not limited to) the following priority actions: • Prevent land clearing and resulting habitat destruction at all known localities. Any further habitat destruction at known or potential localities will have a significant impact on the species; • Prevent clearing of all brigalow habitat within the species' range, and in other areas where the brigalow woodland snail may occur; • Retain a buffer of native vegetation and leaf litter around all occurrences of this species; and • Ensure land managers are aware of the species' occurrence and provide protection measures against key and potential threats. Clearing of 146.72 ha of Brigalow woodland snail habitat is likely to interfere with the above recovery actions, particularly regarding the prevention of clearing of habitat where the species is known to occur. Therefore, it is likely the Project will interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on brigalow woodland snail.

7.3.1.2 REGENT HONEYEATER (*ANTHOCHAERA PHRYGIA*)

Regent honeyeater (*Anthochaera phrygia*) is listed as Critically Endangered under the EPBC Act and has the potential to occur within the Project footprint, due to the presence of habitat. The species was not recorded within the Project footprint during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-30

TABLE 7-30 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – REGENT HONEYEATER

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Unlikely Regent honeyeater was not recorded during field surveys and no database records exist within the Project footprint. The nearest record is located approximately 9 km west of the Project footprint. Regent honeyeaters are widely distributed across eastern Australia (excluding central to north Queensland). Majority of the species records in SEQ occurs east of the Project footprint. No populations have been defined for this species in Queensland. The Project footprint contains 285.01 ha of potential regent honeyeater habitat. The species is considered likely to only utilise the Project footprint intermittently and opportunistically as there are more significant and suitable habitat areas in the greater landscape, outside of the Project footprint. As such, the clearing of 285.01 ha of potential regent honeyeater habitat is considered unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	Unlikely The regent honeyeater is not known to occur within the Project footprint and was not recorded during field surveys. The Project footprint contains 285.01 ha of potential regent honeyeater habitat, which will be cleared for the Project. The species has a predicted occupancy of 600,000 km² (DoE, 2015b). This potential habitat represents approximately 0.0005% of the species' predicted occupancy. Therefore, the Project is unlikely to significantly reduce the area of occupancy of the regent honeyeater.
Fragment an existing population into two or more populations	Unlikely There are no known populations of the species within the Project footprint, and the species is expected to potentially use the habitat in the area in on an occasional basis due to its nomadic and highly mobile nature. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide movement opportunities across the Project for woodland birds. Connectivity areas have been identified for woodland birds and structures will be suitably designed (i.e., bridge underpasses). Connectivity for woodland birds at some locations may also be maintained through the retention and revegetation of low shrubby vegetation and groundcover within the Project footprint, leaving a gap of no more than 100 m. This will be considered on a site-by-site basis during detailed design. The residual impact to connectivity after mitigation was assessed in the Fauna Connectivity Strategy as low for woodland birds.

Criterion	Assessment against significance criteria
	The Project is expected to clear 285.01 ha of potential regent honeyeater habitat; however this is unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely As per the species national recovery plan (DoE, 2016a), habitat critical to the survival of the regent honeyeater is defined as: - Any breeding or foraging habitat in areas where the species is likely to occur (as defined by the distribution map); and - Any newly discovered breeding or foraging locations. Additionally, the conservation advice identifies major importance to areas of areas providing reliable nectar (seasonally) in areas of creek flats, river valleys and lower slopes (DoE, 2015b). Given the lack of records in the area and the determination that the species may only potentially occur, it is considered unlikely that habitat within the Project footprint is likely to be necessary for foraging, breeding, roosting or dispersal. Especially as there are also no breeding areas mapped near to the Project. It is also unlikely to provide for the long-term maintenance of the species or for the recovery of the species. Therefore, it is considered unlikely the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Unlikely No regent honeyeater individuals or nests were identified during target field surveys within the Project Area. Although the Project footprint contains potential habitat for the species, given the lack of records in the area, it is considered unlikely that the species will breed in this habitat due to it being located on the western edge of the species' modelled distribution. Additionally, the Project footprint is not located within any known key breeding sites for the species. The nearest known breeding site is within the Cement Mills-Durakai area, approximately 42 km east of the Project footprint. Therefore, the Project is considered unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The Project footprint contains 285.01 ha of potential regent honeyeater habitat. Regent honeyeater was not recorded during field surveys within the Project footprint and are widely distributed across eastern Australia (excluding central to north Queensland). The majority of the species SEQ population occurs east of the Project footprint. Regent honeyeaters are known to forage in ironbark paddock trees (DEE, n.d.). While some ironbark paddock trees may be removed, these are not in known breeding areas, nor areas frequently visited by the species. The loss of these foraging trees will be mitigated through landscaping and revegetation works. The potential habitat within the Project represents approximately 0.0005% of the area of occupancy for the species. As such, the clearing of 285.01 ha of potential regent honeyeater habitat is considered unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically	Unlikely As per the species conservation advice (DoE, 2015b), regent honeyeater is not threatened by invasive species. Threats to the regent honeyeater include competition with other more aggressive honeyeaters and predation by native pest predators including the pied currawong (<i>Strepera graculina</i>), however invasive species are not listed. The Project will implement appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be

Criterion	Assessment against significance criteria
endangered or endangered species' habitat	through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the critically endangered species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DoE, 2015b), there are no known, identified diseases associated with regent honeyeater. This species may be susceptible to avian influenza, however, the Project is unlikely to introduce this disease, given there are no currently known cases in Queensland. The Project will adopt Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely The National Recovery Plan for the Regent Honeyeater (<i>Anthochaera phrygia</i>) (DoE, 2016a) lists the following recovery strategies as relevant for the species: • Improve the extent and quality of regent honeyeater habitat; • Bolster the wild population with captive-bred birds until the wild population becomes self-sustaining; • Increase understanding of the size, structure, trajectory and viability of the wild population; and • Maintain and increase community awareness, understanding and involvement in the recovery program. The Project is unlikely to interfere with the above listed conservation objectives, and is therefore unlikely to interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on regent honeyeater.

7.3.1.3 AUSTRALASIAN BITTERN (*BOTAURUS POICILOPTILUS*)

Australasian bittern (*Botaurus poiciloptilus*) is listed as Endangered under the EPBC Act and is considered likely to occur within the Project footprint, due to the presence of wetland habitat near the Bringalily State Forest. The species was not recorded, despite targeted searches within the Project footprint (see Section 3 for information relating to survey effort). An in-depth description of the species, its distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-31

TABLE 7-31 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – AUSTRALASIAN BITTERN

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Unlikely The Australasian bittern is a species that is occasionally irruptive after heavy rains but are a mainly sedentary species. No resident population can be attributed to the Project footprint or immediate surrounds. The species was not recorded within the Project footprint during the field surveys; and no records exist within the locality (10 km). The Project footprint contains 7.91 ha of potential Australasian bittern habitat which will be impacted by the Project. Mitigation measures will be implemented within the Fauna Management Plan (during construction) and the Operational EMP Biodiversity Management Plan to reduce the risk of impacts to the species, including pre-construction surveys following optimal (wet) conditions to re-assess wetland habitat values within the Project footprint. As the species has not been recorded within the Project footprint and it is likely the available habitat will only be used in a transient manner, it is considered unlikely that the Project will lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	Unlikely The area of occupancy for Australasian bittern is estimated to be 115,200 ha (TSSC, 2019). Habitat within the footprint represents 0.006% of the species' area of occupancy. While the Project footprint contains 7.91 ha of potentially suitable habitat for the Australasian bittern, the species was not recorded within the Project footprint during the field surveys; and no records exist within the locality (10 km). The nearest recent record is located approximately 48 km east of the Project footprint (ALA, 2024). The species is mainly sedentary, however is also considered occasionally irruptive (suddenly occurring in great numbers) following heavy rainfall; and as there are no records of the species within the Project footprint, the Australasian bittern is unlikely to use these areas in more than a transient manner (dependent on local conditions). As such, the Project is considered unlikely to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations	Unlikely Australasian bittern are highly mobile and appear to be capable of moving between areas (>100 km distance) as habitat suitability changes in response to changing wetland conditions (TSSC, 2019). The Project is therefore not considered to represent a barrier to movement for the species. As such, the clearing of 7.91 ha of habitat for the species is considered unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely As per the species conservation advice (TSSC, 2019), '<i>all natural habitat (including constructed wetlands with suitable habitat) in which the Australasian bittern is known or likely to occur is considered critical to the species survival</i>'. The Project footprint only intersects the modelled species "may occur" distribution at the northern-most and southern-most extents. Whilst the Project will clear 7.91 ha of potential habitat for the Australasian bittern, it is considered unlikely that this represents habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Unlikely The species breeds from October to February (TSSC, 2019). No individuals have been recorded within the Project footprint or within the locality. The Project will implement a Fauna Management Plan under which appropriate management measures, including, pre-construction surveys which will be carried out following optimal (wet) conditions to re-assess wetland habitat values within the Project footprint. Should nests be observed within the

Criterion	Assessment against significance criteria
	Project footprint, restricted works measures will be implemented to allow nesting to occur undisturbed. Therefore, it is unlikely the Project will disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on Australasian bittern habitat. See Section 5.2.10 for further details. While the Project will result in clearing of 7.91 ha of suitable habitat, due to the extent of suitable habitat for the species across the landscape in the form of natural and constructed wetlands with suitable habitat, the mobility of the species and the linear nature of the Project, it is considered unlikely that the Project will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Unlikely As per the species conservation advice (TSSC, 2019), specific weeds are not listed as a threatening process to the species, however changes in the abundance of plant species (native and invasive) is listed as a threat. Additionally, predation by introduced pests including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>) is listed as a threat, however, the extent of these impacts is unknown. Aquatic weed species were not recorded during the aquatic ecology surveys, however both foxes and cats are known to occur within the Project footprint. The Project will implement appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). Through implementation of the Biosecurity Management Plans, the Project is considered unlikely to result in invasive species that are harmful to the Australasian bittern becoming established in this species habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (TSSC, 2019), there are no known, identified diseases associated with Australasian bittern. This species may be susceptible to avian influenza, however, the Project is unlikely to introduce this disease, given there are no currently known cases in Queensland. The Project will adopt the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely The National Recovery Plan for the Australasian Bittern (<i>Botaurus poiciloptilus</i>) (DCCEEW, 2022a) lists the following priority objectives as relevant for the species: • Implement management actions that mitigate or reduce threats to Australasian bittern and their habitat; • Enhance the quality, extent and protection of suitable habitat for the Australasian bittern; • Undertake research and monitoring to improve knowledge of the biology, ecology and population trends of Australasian bittern; • Increase stakeholder participation in Australasian bittern conservation and management; and • Coordinate, review and report on recovery progress.

Criterion	Assessment against significance criteria
	Whilst 7.91 ha of potential Australasian bittern habitat will be impacted by the Project, management actions consistent with the objectives of the National Recovery Plan for the Australasian Bittern (<i>Botaurus poiciloptilus</i>) (DCCEEW, 2022a), will be implemented through the Fauna Management Plan and Biodiversity Management Plans, to mitigate impacts to the species and species habitat during clearing, construction and operation. Therefore, the Project is considered unlikely to interfere with the recovery of the species.
Assessment of potential for a significant impacts	The Project is unlikely to result in a significant impact on Australasian bittern.

7.3.1.4 CURLEW SANDPIPER (*CALIDRIS FERRUGINEA*)

Curlew sandpiper (*Calidris ferruginea*) is listed as Critically Endangered under the EPBC Act and has the potential to occur within the Project footprint, due to the presence of wetland habitat. The species was not recorded within the Project footprint during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-32

Habitat for the curlew sandpiper was not mapped due to the likelihood of the species only using habitat within the Project footprint during periods of flooding. This is due to inland records of the species being on large waterbodies and the Project footprint containing only small permanent waterbodies.

TABLE 7-32 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – CURLEW SANDPIPER

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Unlikely Curlew sandpiper was not recorded within the Project footprint during field surveys and no database records exist within the Project footprint. The nearest record of the species is located 11 km east of the Project footprint. Curlew sandpipers are widely distributed across Australia, with majority of the species records occurring along the coastline. The species is considered likely to only utilise the Project footprint intermittently and opportunistically as there are more significant and suitable habitat areas in the greater landscape, outside of the Project footprint. The clearing of habitat that is only likely to be used opportunistically during periods of flooding is considered unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	Unlikely Curlew sandpiper was not recorded within the Project footprint during field surveys and no database records exist within the Project footprint. The species has a global area of occupancy with a migration flyway over Australia. In Queensland the species is known to occur from the Gulf of Carpentaria to south of the New South Wales border (DCCEEW, 2023e). Due to the species global distribution and widespread distribution in Australia, the Project is considered unlikely to reduce the area of occupancy of the species.

Criterion	Assessment against significance criteria
Fragment an existing population into two or more populations	Unlikely Curlew sandpiper have not been recorded within the Project footprint, despite surveys in potential habitat. The species is highly mobile with a global distribution, and the Project footprint will not create a barrier for the species movement, and as such, the Project is considered unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely As per the species conservation advice (DCCEEW, 2023e) habitat critical to the survival of the curlew sandpiper is dependent on the presence of an internationally or nationally important site (containing 90 individuals or more). The species has not been recorded within the Project footprint, and as the Project footprint does not meet the thresholds of an internationally or nationally important site, habitat within the Project footprint is not considered habitat critical to the survival of the species. Therefore, the Project will not adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Unlikely The curlew sandpiper does not breed within Australia, rather the species breeds in Siberia between June and July. As a result, the Project will not disrupt the breeding cycle of a population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on curlew sandpiper habitat. ARTC will refine the revised reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat. Majority of the species records are located along the coastline, and the Project footprint is likely to only be used intermittently and opportunistically by the species during periods of flooding. The species is more likely to use larger permanent wetland areas in the broader area, such as Coolmunda Dam. Therefore, the Project is considered unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Unlikely As per the species conservation advice (DCCEEW, 2023e), invasive species are not listed as threatening factors to curlew sandpiper in Australia. The Project will adopt Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the construction, and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the critically endangered species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DCCEEW, 2023e), there are no known, identified diseases associated with curlew sandpiper. This species may be susceptible to avian influenza, however, the Project is unlikely to introduce this disease, given there are no currently known cases in Queensland. The Project will adopt Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely There is no adopted or made recovery plan for the species, and a recovery plan is not required. The species conservation advice (DCCEEW, 2023e) lists the following primary conservation objectives for the curlew sandpiper:

Criterion	Assessment against significance criteria
	- Minimise further loss of habitat critical to the survival of curlew sandpiper throughout Australia (including habitat predicted to become habitat critical in the future because of climate change); and - Prevent further declines in curlew sandpiper populations by working with relevant Range States to address threats in the East Asian-Australasian Flyway. The Project is unlikely to interfere with the above listed conservation objectives and is therefore unlikely to interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on curlew sandpiper.

7.3.1.5 SPOTTED-TAILED QUOLL (*DASYURUS MACULATUS MACULATUS*)

Spotted-tailed quoll (*Dasyurus maculatus maculatus*) is listed as Endangered under the EPBC Act and is likely to occur within the Project footprint, due to a nearby (4.5 km) record in Bringalily State Forest and the presence of habitat. The species was not recorded within the Project footprint during field surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-33.

TABLE 7-33 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – SPOTTED-TAILED QUOLL

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Unlikely A recent record of a spotted-tailed quoll indicates that a population of quolls is likely located in the broader Bringalily State Forest. The Project footprint contains 387.48 ha of potential spotted-tailed quoll habitat and the habitat that is to be impacted by the Project is in the south-eastern areas of Bringalily and Whetstone State Forests. Areas within these State forests are likely to be the only areas of habitat for the species, and as the Project footprint has been revised to minimise impacts within these forests, most of these areas will remain. Vehicle strikes of spotted-tailed quolls are considered a threatening process for the species. With the exception of the Condamine River floodplain, most of the rail corridor will be fenced, in part to prevent wildlife and pest access (refer to Section 1.6.6.6). While it may still be possible for occasional incursions of the fencing to be made by individuals, maintenance of the fencing and provision of alternative crossing points (via fauna culverts and bridge underpasses) are predicted to prevent train strikes having a long-term impact on the population. In the unfenced areas, four bridges have been incorporated into the Project across the Condamine River floodplain, for a total of 6 km. Large, raised bridge structures such as these are designed to allow fauna to follow the lay of the land under the rail line. There are also numerous culverts in this section and the rail line will be raised to ensure compliance with flood hydraulic design criteria and flood immunity to rail formation level during a 1% AEP flood event (see revised draft EIS Chapter 14: Flooding and Geomorphology for further details). It is

Criterion	Assessment against significance criteria
	considered likely that bridge underpasses and/or fauna culverts are the most likely path for fauna to take when crossing the rail line in these areas, and therefore, spotted-tailed quoll strikes are predicted to be low. Therefore, it is unlikely that the Project will lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	Unlikely The spotted-tailed quoll occupies home ranges of several hundred to several thousand hectares in size, having multiple dens (more than 20), and commonly moves between dens every 1-4 days (DELWP, 2016). The area of occupancy for the species is estimated at 2,512 km² (251,200 ha). There are no records of the species within the Project footprint. This species is mapped to have potential habitat within several protected areas (National Park and State Forests) and is the only habitat within the Project footprint that has potential to support the species. The disturbance will reduce denning habitat by a small amount, with micro-siting to assist in the identification and avoidance of specific denning habitat (large hollow logs, rocky outcrops, termite mounds). While most of the species' range in southern Queensland is to the east of the Project footprint, the removal of 387.48 ha (being 0.15% of the total area of occupancy) of habitat in the footprint is not expected to impact the population within Bringalily State Forest. While the species typically has large home ranges, these are not exclusive and overlap, so any changes caused by the Project will not impact local individuals. Therefore, removal of this habitat is unlikely to reduce the area of occupancy of the spotted-tailed quoll.
Fragment an existing population into two or more populations	Unlikely The Project footprint contains 387.48 ha of spotted-tailed quoll habitat. Although a population is likely located in the wider area of Bringalily State Forest and surrounding forested areas, and the Project will sever habitat areas around Canning Creek, the species is considered highly mobile and likely to use the structures and culverts implemented throughout the Project footprint. Development and implementation of the Wildlife Connectivity Plan, based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for the spotted-tailed quoll. Connectivity areas have been identified for the spotted-tailed quoll and structures will be suitably designed for the species. Provision of suitable habitat in the approaches to structures will further enhance their effectiveness. Due to the highly mobile nature of the species, and the mitigation measures that will be implemented, it is unlikely that the Project will fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely The Project footprint does not contain an important population of the species, the nearest known population being in Dalby (TSSC, 2020). However, a recent record of the species indicates that a population of quolls is likely located the broader Bringalily State Forest. Habitat critical to the survival of the spotted-tailed quoll species is defined in the National Recovery Plan as large patches of forest with adequate denning resources and relatively high densities of medium sized mammalian prey (DELWP, 2016). Although the density requirements are not specified, high-quality breeding/denning and foraging habitat would likely be consistent with this definition. The Project footprint contains 387.48 ha of spotted-tailed quoll habitat, of which 259.93 ha is high quality breeding/denning and foraging habitat and 127.55 ha is low quality breeding/denning and foraging habitat. Habitat within the Project footprint qualifies as habitat critical to the survival of the spotted-tailed quoll species. Therefore, it is considered likely that the Project will adversely affect habitat critical to the survival of the species.

Criterion	Assessment against significance criteria
Disrupt the breeding cycle of a population	Likely Although the species has not been recorded within the Project footprint, nearby records in Bringalily suggest that the species is likely to be present. A total of 387.48 ha of species breeding/denning and foraging habitat (259.93 ha of high-quality habitat and 127.55 ha of low-quality habitat) will be impacted. Additionally, the species is short lived with a generation length of 2.5 years. Breeding only occurs once per year, in winter, when females produce one litter. As a result of this, any disruption to the breeding of the spotted-tail quoll is likely to result in a significant impact. As such, the Project is likely to disrupt the breeding cycle of a population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on spotted-tailed quoll habitat outside of the Project footprint. See Section 5.2.10 for further details. The habitat that is to be impacted by the Project is located in the south-eastern areas of Bringalily and Whetstone State forests, with a population likely located in the broader Bringalily State Forest. The Project is linear and will not remove areas of habitat in the landscape that are likely to cause the species to decline. Any habitat remaining within the footprint will be cleared during the construction stage of the Project. Therefore, it is considered unlikely that the Project will modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Unlikely As per the species conservation advice (TSSC, 2020), spotted-tailed quoll is threatened by feral cats (<i>Felis catus</i>), the European red fox (<i>Vulpes vulpes</i>) and cane toads (<i>Rhinella marina</i>), which are known to occur within the Project footprint. The Project will implement appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the endangered species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (TSSC, 2020), spotted-tailed quolls are not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Likely The National Recovery Plan for the spotted-tailed quoll (<i>Dasyurus maculatus</i>) outlines the following recovery objectives for the species: • Determine the distribution and status of spotted-tailed quoll populations throughout the range and identify key threats and implement threat abatement management practices. • Investigate key aspects of the biology and ecology of the spotted-tailed quoll to acquire targeted information to aid recovery. • Reduce the rate of habitat loss and fragmentation on private land. • Evaluate and manage the risk posed by silvicultural practices. • Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on spotted-tailed quoll populations. • Determine and manage the impact of fire regimes on spotted-tailed quoll populations. • Reduce deliberate killings of spotted-tailed quoll.

Criterion	Assessment against significance criteria
	• Reduce the frequency of spotted-tailed quoll road mortality. • Assess the threat cane toads pose to spotted-tailed quolls and develop threat abatement actions if necessary. • Determine the likely impact of climate change on spotted-tailed quoll populations. • Increase community awareness of the spotted-tailed quoll and involvement in the Recovery program (DELWP, 2016). As stated above, the majority of the rail corridor will be fenced (including through the State Forests) to minimise the likelihood of collisions with trains. Bridge underpasses and culverts will provide movement pathways for quolls to maintain connectivity within the local population. These structures will also aid in preventing mortality from train strikes in the Condamine River floodplain, where the rail line will not be fenced. The Project will impact a total of 387.48 ha of species breeding/denning and foraging habitat (259.93 ha of high-quality habitat and 127.55 ha of low-quality habitat), some of which is located within private land, which directly interferes with the recovery objective of 'reduce the rate of habitat loss and fragmentation on private land'. Therefore, the Project is considered likely to interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on spotted-tailed quoll.

7.3.1.6 SWIFT PARROT (*LATHAMUS DISCOLOR*)

Swift parrot (*Lathamus discolor*) is listed as critically endangered under the EPBC Act and has the potential to occur within the Project footprint, due to the presence of habitat near Inglewood. The species was not recorded, despite targeted searches within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-34

TABLE 7-34 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – SWIFT PARROT

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Unlikely Swift parrot has not been recorded within the Project footprint during field surveys, and no desktop records exist within the Project footprint. The nearest record is located approximately 4 km east of the Project footprint (1998). The Project footprint contains 614.93 ha of potential swift parrot habitat. Swift parrot have a widespread distribution across eastern Australia, from SEQ south to Victoria, and breed in Tasmania, with an extent of occurrence estimated to be 57,000 km² (TSSC, 2016b). The species is considered to potentially utilise the Project footprint intermittently and opportunistically as there are more significant and suitable habitat areas in the greater landscape, outside of the Project footprint. As such, the clearing of 614.93 ha of potential swift parrot habitat is considered unlikely to lead to a long-term decrease in the size of a population.

Criterion	Assessment against significance criteria
Reduce the area of occupancy of the species	Unlikely There are no records of the swift parrot within the Project footprint and the species was not recorded during field surveys. The swift parrot has an average area of occupancy of 425 km² (TSSC, 2016b). The Project is a linear infrastructure within a railway corridor, allowing for the species to transverse habitat with ease. Although some individuals may disperse into areas of the Project footprint, this would likely be considered a rare and sporadic occurrence, and strongly dependent on long-term habitat resource availability cycles. Should the species utilise habitat within the Project footprint, areas outside of the footprint would continue to support the species in the area. Therefore, the clearing of 614.93 ha of potential habitat for swift parrot is unlikely to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations	Unlikely There are no known populations of the species within the Project footprint, and the species is expected to potentially use the habitat in the area in on an occasional basis due to its nomadic, highly mobile nature and widespread distribution. Therefore, it is unlikely that the Project will fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely As per the species national recovery plan, habitat critical to the survival of the swift parrot (within the context of foraging habitat on the Australian mainland) is defined as '<i>all preferred foraging species within known and likely foraging habitat on the mainland including Yellow Gum (Eucalyptus leucoxylon); Red Ironbark (E. tricarpa); Mugga Ironbark (E. sideroxylon); Grey Box (E. macrocarpa); White Box (E. albens); Yellow Box (E. melliodora); Swamp Mahogany (E. robusta); Forest Red Gum (E. tereticornis); Blackbutt (E. pilularis); and Spotted Gum (Corymbia maculata)</i>'. (DCCEEW, 2024b). The Project footprint does not contain habitat critical to the survival of the species, as the species is not known or considered likely to utilise habitat in the area regularly. Potential habitat within the Project footprint is likely poor quality for the species and generally lacks the tree species listed as preferred in the national recovery plan, with only <i>E. albens</i> and <i>E. tereticornis</i> present. As such, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Unlikely Swift parrot exclusively breeds in Tasmania from mid-September to late-January before migrating to the Australian mainland. As the species does not breed on the Australian mainland, the Project is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Swift parrot has not been recorded within the Project footprint during field surveys, and no desktop records exist within the Project footprint (all records are east of the footprint). The Project footprint contains 614.93 ha of potential swift parrot habitat, however the species has a widespread distribution across eastern Australia, from SEQ south to Victoria, including Tasmania. Swift parrots are known to forage in Tasmanian blue gum (<i>Eucalyptus globulus</i>) and black gum (<i>E. ovata</i>) paddock trees in known breeding areas (DEE, n.d.). Swift parrots only breed in Tasmania and these Eucalypt species do not grow in the region. Therefore, while some paddock trees will be removed, the loss of these paddock trees will not impact the species. Due to all habitat within the Project footprint considered potential habitat only, the Project is unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Criterion	Assessment against significance criteria
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Unlikely As per the species conservation advice and national recovery plan (TSSC, 2016b; DCCEEW, 2024b), swift parrots may be threatened by experience competition for tree hollows from the common starling (<i>Sturnus vulgaris</i>) and European honeybee (<i>Apis mellifera</i>), however this is more relevant in breeding habitat within Tasmania. Threats to the swift parrot also include competition with aggressive honeyeaters. The Project will implement appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the critically endangered species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (TSSC, 2016b), swift parrots are threatened by Psittacine Beak and Feather Disease (Pbfd), a widespread lethal parrot disease which is known to occur in swift parrots and has been recorded in swift parrot nestlings in the wild population. This species may be susceptible to avian influenza, however, the Project is unlikely to introduce this disease, given there are no currently known cases in Queensland. There is no evidence to suggest the Project will introduce a disease that would cause the species to decline. The Project will adopt the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely The species national recovery plan (DCCEEW, 2024b) lists the following recovery objectives as relevant to the swift parrot: • To prevent further decline of the swift parrot population; and • To achieve a demonstrable sustained improvement in the quality and quantity of swift parrot habitat to increase carrying capacity. Given the species has not been recorded within the Project footprint or recorded during field surveys, and all habitat within the Project footprint is considered potential habitat only, the Project is unlikely to interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on swift parrot.

7.3.1.7 AUSTRALIAN PAINTED SNIPE (*ROSTRATULA AUSTRALIS*)

Australian painted snipe (*Rostratula australis*) is listed as Endangered under the EPBC Act and is considered likely to occur within the Project footprint, due to a nearby record on an offset property 300 m from the Project footprint, and the presence of suitable habitat. The species was not recorded, despite targeted searches within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-35.

TABLE 7-35 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – AUSTRALIAN PAINTED SNIPE

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population	Unlikely The Australian painted snipe is considered to occur as a single, contiguous population. The species is not known to be permanently resident at any site, and may be nomadic, moving around areas of suitable habitat. Suitable habitat (as defined in DSEWPC, 2013b) is commonly available in the broader landscape. The Australian painted snipe was not recorded during field surveys within the Project footprint however the nearest record of the species was recorded at the Glenlovely offset site near Yelarbon, approximately 300 m from the Project footprint. The Project footprint contains 7.91 ha of suitable habitat for the species, which will be impacted by the Project. The majority of the species records in southern Queensland are located east of the Project footprint, and the species is considered likely to only utilise the area intermittently and opportunistically as there are more significant and suitable wetland areas in the greater landscape, outside of the Project footprint. As such, the clearing of 7.91 ha of Australian painted snipe habitat is considered unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	Unlikely The area of occupancy for the species was thought to be 2,000 km² (200,000 ha) in 2011 and increasing. The Project footprint contains 7.91 ha (being 0.00395% of the total area of occupancy) of habitat for the Australian painted snipe. Given the broader landscape and significant suitable wetland areas outside of the Project footprint, it is likely the species will only use habitat within the Project footprint intermittently and opportunistically. Therefore, the Project is considered unlikely to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations	Unlikely Australian painted snipe is highly mobile and the Project footprint is unlikely to create a barrier for the species movement. As such, the clearing of 7.91 ha of Australian painted snipe habitat is considered unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species is defined broadly (as habitat varies across the species range) in the species recovery plan as: - Any natural wetland habitat where the species is known or likely to occur (especially with suitable breeding habitat) within the indicative distribution map; and - Any location outside this area that may be periodically occupied by Australian painted snipe when wetland conditions are favourable. Australian painted snipe is a widespread species, with an extent of occurrence estimated to be 7,100,000km² (710,000,000 ha) globally. Although Australian painted snipe was not recorded within the footprint, it was recorded on the Glenlovely offset site (within 300 m of the footprint) and is considered likely to occur within the Project footprint. Therefore the 7.91 ha of suitable habitat identified within the Project footprint likely represents habitat critical to the survival of the species. The Project is likely to adversely impact habitat critical to the survival of the species based on this definition.

Criterion	Assessment against significance criteria
Disrupt the breeding cycle of a population	Unlikely The Australian painted snipe breeds in response to rainfall patterns and wetland conditions, breeding across all months in Australia (DCCEEW, 2022b). Australian painted snipe occurs as a single homogenous breeding population dispersed thinly across much of Australia and no resident population can be attributed to the Project footprint. The Project has the potential to disrupt the breeding cycle of individuals, should they occur within the Project footprint, however this is dependent on rainfall and wetland conditions. The Project will implement a Fauna Management Plan and Biodiversity Management Plan under which appropriate management measures including pre-construction surveys which will be carried out following optimal (wet) conditions to re-assess wetland habitat values within the Project footprint. Should nests be observed within the Project footprint, restricted works measures will be implemented to allow nesting to occur undisturbed. As no individuals or nesting areas for the species have been recorded within the Project footprint, it is unlikely the Project will disrupt the breeding cycle of a population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on Australian painted snipe habitat outside the Project footprint. See Section 5.2.10 for further details. The Project will result in the removal of 7.91 ha of habitat for the species. However, given the broader landscape and significant suitable wetland areas outside of the Project footprint, it is likely the species will only use potential habitat within the Project footprint intermittently and opportunistically. Therefore, it is considered unlikely that the Project will modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat	Unlikely The Australian painted snipe is threatened by the introduction of aquatic weed species and potentially threatened by the predation by feral animals, including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>), however there is no evidence for this. Aquatic weed species were not recorded during the aquatic ecology surveys, however both foxes and cats are known to occur within the Project footprint. The Project will implement appropriate weed and pest management measures to prevent/minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). Through implementation of weed and pest management measures, the Project is considered unlikely to result in invasive species that are harmful to Australian painted snipe becoming established in this species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DSEWPC, 2013b), there are no known, identified diseases associated with Australian painted snipe. This species may be susceptible to avian influenza, however, the Project is unlikely to introduce this disease, given there are no currently known cases in Queensland. The Project will adopt the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP) that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause the species to decline.

Criterion	Assessment against significance criteria
Interfere with the recovery of the species	Unlikely The National Recovery Plan for the Australian Painted Snipe (<i>Rostratula australis</i>) (DCCEEW, 2022b) outlines the following recovery strategies for the species: • Manage and protect known Australian painted snipe breeding habitats at the landscape scale; • Develop and apply techniques to measure changes in population trajectory in order to measure the success of recovery actions; • Reduce, or eliminate threats at breeding and non-breeding habitats; • Improve knowledge of the habitat requirements, biology and behaviour of Australian painted snipe; • Engage community stakeholders to improve awareness of the conservation of Australian painted snipe; and • Coordinate, review, and report on recovery process (DCCEEW, 2022b). Although Australian painted snipe is likely to occur and breeding habitat has been mapped within the Project footprint, the clearing of 7.91 ha of habitat is unlikely to impact breeding habitat availability at the landscape scale. It is considered unlikely that the Project has potential to interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on Australian painted snipe.

7.3.1.8 CONDAMINE EARLESS DRAGON (*TYMPANOCRYPTIS CONDAMINENSIS*)

Condamine earless dragon (*Tympanocryptis condaminensis*) is listed as Endangered under the EPBC Act and is known to occur within the Project footprint, due to reliable records between Millmerran and Brookstead. A study on the genomics of the species indicate that two populations exist, one around Pittsworth Shire and another further south-east near Nobby (Chaplin, 2018). Specimens included in the genetic analyses came from Bongeen, Evanslea, Mt Tyson, Mt Russell, north of Brookstead and Yarranlea, and Nobby. Although the specimens from just south of Brookstead were not included in the genetic analyses, it is assumed that individuals would be considered part of the Pittsworth Shire population due to the broad local distribution of specimens in the population. Despite some differentiation, the species exhibits generally little genetic separation of the populations, and it is suggested that the two populations be treated as a single management unit, however further research is required (Chaplin, 2018). An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-36.

TABLE 7-36 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – CONDAMINE EARLESS DRAGON

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a population of a species	Likely Condamine earless dragon has a restricted distribution between Warwick and Jandowae. The species may consist of two populations (Chaplin, 2018), with the Project running through the Pittsworth Shire population.

Criterion	Assessment against significance criteria
	The Project footprint contains 51.20 ha of Condamine earless dragon habitat, all of which will be cleared for the Project. There are numerous records of this species located to the north of the Project footprint, however the nearest record was located 1.5 km to the south and other records exist to the southeast. The species was also recorded within an existing rail reserve within the Project footprint between Millmerran and Brookstead. Given the restricted geographic distribution, and the contributing decline of extent and quality of habitat, clearing of species habitat within the Project footprint is considered likely to lead to a long-term decrease in the size of a population of the species.
Reduce the area of occupancy for a population	Likely The area of occupancy of the Condamine earless dragon is 76 km² (7,600 ha). The Project footprint contains 51.20 ha of Condamine earless dragon habitat (being 0.67% of the area of occupancy). Revegetation of grassland consisting of tussock forming species within the temporary Project footprint may reduce the overall impact to habitat. Additionally, parts of the permanent footprint have the potential to be regenerated with grassland that may form habitat for the species. Due to the restricted distribution of the species, clearing of 51.20 ha of species habitat is considered likely to reduce the area of occupancy for a population.
Fragment an existing population into two or more populations	Unlikely Movement and dispersal patterns of the Condamine earless dragon are unknown. The Project will run through the Pittsworth Shire population and will likely act as a barrier to dispersal. The Condamine earless dragon has been detected in an existing rail reserve and within road verges outside of the Project footprint. The species has been recorded to withstand disturbance and can persist in highly modified landscapes with extensive linear infrastructure corridors. The species has been recorded to utilise manmade structures and soil properties for shelter and movement. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for the Condamine earless dragon. Connectivity areas have been identified for the Condamine earless dragon. Structures with natural substrate will be designed for the species, including provision of suitable habitat features and fauna furniture within these crossing structures and in their approaches. The residual impact to connectivity for the Condamine earless dragon after mitigation was assessed in the Fauna Connectivity Strategy as low at bridges and moderate at culverts. As such, the Project is unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species has not been formally defined within the species conservation advice (TSSC, 2016c), however due to the species restricted distribution, it is considered likely that all habitat is habitat critical to the survival of the species. Therefore, the clearing of 51.20 ha of Condamine earless dragon habitat is considered likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	Likely Minimal information exists regarding the breeding requirements for this species, which likely breeds in summer (TSSC, 2016c). As such a conservative approach should be taken. Clearing of 51.20 ha of habitat for the species is considered likely to disrupt the breeding cycle of an important population.

Criterion	Assessment against significance criteria
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Likely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on Condamine earless dragon habitat outside of the Project footprint. See Section 5.2.10 for further details. ARTC will refine the revised reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat. Removal of 51.20 ha of Condamine earless dragon habitat as a result of the Project is considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	Unlikely As per the species conservation advice (TSSC, 2016c), Condamine earless dragon is threatened by the invasion of weeds or pasture species that change the soil structure, and the predation by feral animals, including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>). The Project footprint is subjected to significant invasion by introduced pastoral grass species including WoNS and both foxes and cats are known to occur. The Project will implement appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of the both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the endangered species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (TSSC, 2016c), there are no known, identified diseases associated with Condamine earless dragon. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Potential The National recovery plan for the grassland earless dragon (<i>Tympanocryptis pinguicollis</i>) (Robertson and Evans, 2009) is still in effect for the Condamine earless dragon and outlines the following recovery actions for the species: • Determine the distribution and abundance of Grassland Earless Dragons to define habitats critical to the survival of the species; • Maintain or increase the abundance/distribution of the species by better understanding those aspects of the biology of the Grassland Earless Dragon that will enable effective management of populations and habitat; • Identify the nature and extent of the processes that threaten Grassland Earless Dragons and their habitat, and the measures needed to abate these; • Establish a system of reserves and other areas under appropriate protection and management such that all populations are maintained or increased; • Monitor populations and habitats of Grassland Earless Dragons and the implementation and effectiveness of management prescriptions to provide a basis for adaptive management and to identify new threats; and • Determine if there is a need for salvage of individuals from doomed sites, determine the feasibility of such measures, and develop and implement a protocol. Determine if there is a need for translocation, determine its feasibility, and develop and implement a protocol.

Criterion	Assessment against significance criteria
	The Project is considered unlikely to interfere with the recovery actions outlined in the recovery plan, however as habitat critical to the survival of the species has not formally been defined, clearing of 51.20 ha of habitat has the potential to interfere with the species recovery.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on Condamine earless dragon.

7.3.2 VULNERABLE FAUNA SPECIES

The following sections assess the potential for significant impacts on eleven vulnerable fauna species identified as known, likely or potentially occurring within the Project footprint in accordance with the *Significant Impact Guidelines* (DoE, 2013a).

7.3.2.1 FIVE-CLAWED WORM-SKINK (*ANOMALOPUS MACKAYI*)

Five-clawed worm-skink (*Anomalopus mackayi*) is listed as Vulnerable under the EPBC Act and is likely to occur within the Project footprint, due to the presence of habitat and microhabitat features within the Project footprint and proximity of previous records. The species was not recorded, despite targeted searches and seasonal habitat trials in increase probability of detection. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6.

The draft referral guidelines for Brigalow Belt reptiles consider an occurrence of important habitat for the five-clawed worm-skink (*Anomalopus mackayi*) is a surrogate for an 'important population' of the species (DCCEEW, 2023a). Important habitat is defined as 'all suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands; and suitable habitat within the known / likely-to-occur distribution of the species' (DCCEEW, 2023a). The presence of important habitat is assessed under the four criteria specified in the guidelines in Table 7-37. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-38

TABLE 7-37 IMPORTANT POPULATION ASSESSMENT – FIVE-CLAWED WORM-SKINK

Criterion	Assessment against criteria
Suitable habitat for this species is considered important if it is:	
Habitat where the species has been identified during a survey	This species was not recorded during surveys and therefore habitat within the Project footprint is not considered to contain important habitat under this criterion.
Near the limit of the species' known range	The Project footprint is not located near the limit of the species' known range.
Large patches of contiguous, suitable habitat and viable landscape corridors	The Project footprint passes through large patches of vegetation that contain suitable habitat and that may be considered necessary for breeding, dispersal and maintaining genetic diversity. The species was not recorded during field surveys, however the Project footprint is

Criterion	Assessment against criteria
Suitable habitat for this species is considered important if it is:	
(necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations)	considered likely to contain important habitat for the species and as such, should a population be present within the Project footprint, it would be considered an important population. Very little is known about the genetic diversity of this species and therefore it would be difficult to assess whether any existing population is likely to be necessary for maintaining genetic diversity.
A habitat type where the species is identified during a survey, but which was previously thought not to support the species	No five-clawed worm-skink were detected during field surveys. Therefore, habitat within the Project footprint is not considered important habitat under this criterion.
Assessment of important habitat as a surrogate for important populations	Suitable habitat within Project footprint is located within the species known / likely-to-occur distribution and contains important habitat as described above and is therefore considered likely to support an important population.

TABLE 7-38 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – FIVE-CLAWED WORM-SKINK

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Likely An important population is inferred based on the presence of important habitat, which is likely to be present within the Project footprint. There are no records of the species within the Project footprint, however, the nearest record was recorded 300 m east of the Project footprint. The Project footprint contains 241.61 ha of important habitat for the species, which will be cleared for the Project. Therefore, as important habitat is present within the Project footprint, the Project is likely to lead to a long-term decrease in the size of an important population of the species.
Reduce the area of occupancy for an important population	Likely Within Queensland, the species has a restricted range, occurring from the QLD / NSW border to Chinchilla (noting that it also occurs in NSW). The Project footprint contains 241.61 ha of potential important habitat for the species which will be cleared. The <i>Draft Referral guidelines for the nationally listed Brigalow Belt reptiles</i> (DCCEW, 2023a) lists the clearing of four or more hectares of important habitat as a high-risk significant impact, and as such, the Project is likely to reduce the area of occupancy for an important population.
Fragment an existing important population into two or more populations	Unlikely An important population is likely to be present based on the presence of important habitat. No individuals were recorded within the Project footprint, however suitable habitat will be severed. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for the cracking clay reptiles. Connectivity areas have been identified for cracking clay reptiles. Structures with natural substrate will be designed for the species, including provision of suitable habitat features and fauna furniture within these crossing structures and in their approaches. The Fauna Connectivity Strategy includes recommendations to preserve cracking clay soils in areas of suitable habitat, where possible. The residual impact to connectivity for cracking clay reptiles after mitigation was assessed in the Fauna

Criterion	Assessment against significance criteria
	Connectivity Strategy as low at bridges and moderate at culverts. As such, the Project is likely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely As per the species conservation advice (DEWHA, 2008b), there is no official definition for habitat critical to the survival of five-clawed worm-skink, and as such, the Significant Impact Guidelines definition of habitat critical to the survival will be used in lieu. Whilst no records of the species exist within the Project footprint, the Project footprint contains 241.61 ha of important habitat for the species will be cleared. The <i>Draft Referral guidelines for the nationally listed Brigalow Belt reptiles</i> (DCCEEW, 2023a) lists the clearing of four or more hectares of important habitat as a high-risk significant impact, and as such, the Project is considered likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Potential Minimal information exists regarding the breeding requirements for this species and as such a conservative approach should be taken. Clearing of 241.61 ha of important habitat for the species is considered to have the potential to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Potential Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on five-clawed worm-skink habitat. See Section 5.2.10 for further details. ARTC will refine the revised reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat. The Project will result in the removal of 241.61 ha of important habitat. By modifying or removing the areas of important habitat, the availability and quality of habitat will decrease and may potentially lead to decline in the species population.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DEWHA, 2008b), five-clawed worm-skink are currently threatened by the predation by feral animals. Feral animals, including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>) are known to occur within the Project footprint. The Project will adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008b), five-clawed worm-skink are not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for this species and a recovery plan is not required. The species' conservation advice (DEWHA 2008b) outlines the following priority actions relevant to the species: • Monitor known populations to identify key threats; • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary; • Identify populations of high conservation priority; • Manage threats to areas of vegetation that contain populations of the five-clawed worm-skink;

Criterion	Assessment against significance criteria
	- Investigate formal conservation arrangements, such as, the use of covenants, conservation agreements or inclusion in reserve tenure; - Develop and implement a stock management plan for roadside verges and travelling stock routes; - Develop and implement a management plan for the control and eradication of foxes and feral cats in the local region; and - Investigate options for linking, enhancing or establishing additional populations. Whilst the Project will clear 241.61 ha of important habitat for the species, the Project will not directly interfere with the priority actions outlined above. The Project will implement appropriate pest and weed controls during construction and operation and remove livestock grazing from the Project footprint apart from where it overlays a stock route. As the Project does not interfere with the recovery actions for the species, the Project is unlikely to interfere substantially with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on five-clawed worm-skink.

7.3.2.2 COLLARED DELMA (*DELMA TORQUATA*)

Collared delma (*Delma torquata*) is listed as Vulnerable under the EPBC Act and has the potential to occur, due to the presence of habitat within the Project footprint. The species was not recorded, despite targeted searches including seasonal habitat trials to increase probability of detection. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6.

The draft referral guidelines for Brigalow Belt reptiles consider an occurrence of important habitat for the collared delma (*Delma torquata*) as a surrogate for an 'important population' of the species (DCCEEW, 2023a). Important habitat is defined as 'suitable habitat within the known / likely-to-occur distribution of the species and the Toowoomba Range; and suitable habitat between grazed or cropped areas, along road reserves, and travelling stock routes, especially the Donnybrook Stock Route region' (DCCEEW, 2023a). The presence of important habitat is assessed under the four criteria specified in the guidelines in Table 7-39. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-40

TABLE 7-39 IMPORTANT POPULATION ASSESSMENT – COLLARED DELMA

Criterion	Assessment against criteria
Suitable habitat for this species is considered important if it is:	
Habitat where the species has been identified during a survey	The species was not recorded within the Project Footprint and no historical records exist.
Near the limits of the species known range	The Project footprint is not located near the limit of the species' range.

Criterion	Assessment against criteria
Suitable habitat for this species is considered important if it is:	
Large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations)	The species was not recorded within the Project footprint and no historical records exist. The Project footprint is not located within the species known or likely distribution (only within the 'species or species habitat may occur'), and as key microhabitat features are generally absent across the Project footprint, it is considered unlikely this habitat is important habitat for the species or a key source for breeding, dispersal, or maintaining genetic diversity.
A habitat type where the species is identified during a survey, but which was previously thought not to support the species	No collared delma were detected during field surveys and no historical records exist. Therefore, habitat within the Project footprint is not considered important habitat under this criterion.
Assessment of important habitat as a surrogate for important populations	It is considered unlikely that the Project footprint contains important habitat. Therefore, should a population of collared delma be present within the Project footprint, it is unlikely this would be an important population.

TABLE 7-40 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – COLLARED DELMA

Criterion	Assessment against significance criteria ¹
Lead to a long-term decrease in the size of an important population of a species	Unlikely There are no records of the species within the Project footprint and the species was not recorded during field surveys and broader seasonal habitat trials. Important habitat as per the above assessment does not occur within the Project footprint and as such, there are no important populations of the species within the Project footprint. The Project footprint contains 36.83 ha of potential habitat for the species, albeit microhabitat features are largely absent. The clearing of 36.83 ha of potential species habitat is considered unlikely to lead to a long-term decrease in the size of an important population of a species.
Reduce the area of occupancy for an important population	Unlikely The species was not recorded during the field surveys within the Project footprint and the Project footprint does not contain any important habitat for the species. The nearest record of the species was recorded in Withcott, 12 km east of the eastern-most section of the Project footprint. As no important populations / important habitat exists within the Project footprint, it is unlikely the clearing of 36.83 ha of potential habitat will reduce the area of occupancy for an important population.
Fragment an existing important population into two or more populations	Unlikely As no important populations / important habitat exists within the Project footprint, it is unlikely the clearing of 36.83 ha of potential habitat will fragment an existing important population into two or more populations. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy

Criterion	Assessment against significance criteria ¹
	will provide opportunities for movement across the Project footprint for woodland reptiles. Connectivity areas have been identified for woodland reptiles. Structures with natural substrate will be designed for the species, including provision of suitable habitat features and fauna furniture within these crossing structures and in their approaches. The residual impact to connectivity for woodland reptiles after mitigation was assessed in the Fauna Connectivity Strategy as low at bridges and moderate at culverts. Therefore, an important population will not be fragmented into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely As per the species conservation advice (DEWHA, 2008f), there is no official definition for habitat critical to the survival of collared delma, and as such, the Significant Impact Guidelines definition of habitat critical to survival will be used. As the species was not recorded within the Project footprint, and the nearest record was recorded in Withcott, 12 km east of the Project footprint in Withcott, it is unlikely that potential collared delma habitat within the Project footprint is necessary for dispersal or long-term maintenance of the species or to maintain genetic diversity. While the potential habitat within the Project footprint may possibly provide for the reintroduction or recovery of the species, suitable micro habitat features were generally absent and it is considered unlikely the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely The species was not recorded during the field surveys within the Project footprint and the Project footprint does not contain any important habitat for the species. The Project footprint contains 36.83 ha of potential habitat for the species, albeit microhabitat features are largely absent. Mitigation measures will be implemented to minimise the risk of impacts to species and potential habitat. As no important populations or important habitat exist within the Project footprint, it is considered unlikely that the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have low impacts on collared delma habitat outside of the Project footprint. See Section 5.2.10 for further details. ARTC will refine the revised reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat. The species was not recorded during the field surveys within the Project footprint and the Project footprint does not contain any important habitat for the species. The Project footprint contains 36.83 ha of potential habitat for the species, albeit microhabitat features are largely absent. As such, it is unlikely the Project will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DEWHA, 2008f), collared delma are currently threatened by the invasion of dwarf lantana (<i>Lantana montevidensis</i>) and the predation by foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>). Both foxes and cats are known to occur within the Project footprint, however dwarf lantana was not recorded during field surveys. The Project will adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation

Criterion	Assessment against significance criteria ¹
	measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DEWHA, 2008f), collared delma are not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no adopted or made recovery plan for this species, and a recovery plan is not required. The species conservation advice (DEWHA, 2008f) outlines the following priority actions relevant to the species: • Monitor known populations to identify key threats; • Identify sites of high conservation priority; • Protect areas of habitat that contain populations/occurrences of the collared delma; • Ensure road widening and maintenance activities in areas where the collared delma occurs do not adversely impact on known populations; • Investigate formal conservation arrangements, such as covenants or inclusion in reserve tenure; • Develop and implement a suitable fire management strategy for the collared delma; • Provide for a 50 m buffer during prescribed burns in known species habitat; • Encourage mosaic burns outside the buffer zone to prevent high intensity wildfire in species habitat; • Provide maps of known occurrences to local and state rural fire services and seek inclusion of mitigative measures in bush fire risk management plans, risk register and/or operation maps. • Investigate options for linking, enhancing or establishing additional populations; and • Raise awareness of the collared delma within the local community. The Project considered unlikely to interfere with these recovery actions and therefore is unlikely to interfere substantially with the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on collared delma.

7.3.2.3 YAKKA SKINK (*EGERNIA RUGOSA*)

Yakka skink (*Egernia rugosa*) is listed as Vulnerable under the EPBC Act and has the potential to occur within the Project footprint. Part of the Project footprint is located within the modelled distribution habitat for the Yakka skink (*Egernia rugosa*) showing that the species or species habitat may occur (DCCEEW 2023). Yakka skink (*Egernia rugosa*) was not found during surveys and no burrow systems or communal defecation sites were recorded, despite targeted searches in and around the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 6.

Yakka skink (*Egernia rugosa*) occurs in a wide variety of vegetation types and is difficult to detect. The draft referral guidelines for Brigalow Belt reptiles consider an occurrence of important habitat for the yakka skink (*Egernia rugosa*) is a surrogate for an 'important population' of the species (DCCEEW, 2023a). Important habitat is defined as 'any contiguous patch of suitable habitat, particularly remnant vegetation, where a colony is known or identified; and any microhabitat where colonies are likely to be found' (DCCEEW, 2023a). The presence of important habitat is also assessed under the four criteria specified in the guidelines in Table 7-41. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-42.

TABLE 7-41 IMPORTANT POPULATION ASSESSMENT – YAKKA SKINK

Criterion	Assessment against criteria
Suitable habitat for this species is considered important if it is:	
Habitat where the species has been identified during a survey	No yakka skink (<i>Egernia rugosa</i>) or evidence of burrow systems and communal defecation sites were detected during field surveys and the species has not been detected within 70 km of the Project. Therefore, habitat within the Project footprint is not considered important habitat under this criterion.
Near the limits of the species known range	The Project footprint intersects the species modelled distribution of species habitat may occur. The Project is not located near the limit of the species' known range, therefore habitat within the Project footprint is not considered important habitat under this criterion.
Large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations)	The Project footprint is not impacting on large patches of contiguous, suitable habitat and viable landscape corridors where the species is known or likely to occur. The Project footprint has not been determined to be necessary for breeding, dispersal or maintaining the genetic diversity of the species over successive generations given no evidence of yakka skink (<i>Egernia rugosa</i>) was detected during field surveys, including microhabitat, or subsequent reptile surveys in adjacent areas. There are no records of the species in any of the vegetation communities or state forest areas adjacent to the footprint. No records are located within 70 km of the Project footprint and the impacted area is outside of the modelled 'known or likely to occur' habitat areas (DCCEEW, 2023a). The species occurs in a wide variety of vegetation types and therefore potential habitat does exist and was found during surveys to be predominantly in areas of 11.3.2 and 11.5.4 in the Project footprint however there was an absence of suitable microhabitat features in the form of burrows and log piles due to the past and current forestry and agricultural practices in the landscape.
A habitat type where the species is identified during a survey, but which was previously thought not to support the species:	No yakka skink (<i>Egernia rugosa</i>) or evidence of burrow systems and communal defecation sites were detected during field surveys and the species has not been detected within 70 km of the Project. Therefore, habitat within the Project footprint is not considered important habitat under this criterion.
Assessment of important habitat as a surrogate for important populations	There is no important habitat for the species within the Project footprint, and therefore no important populations may occur.

TABLE 7-42 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – YAKKA SKINK

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Unlikely The species was not recorded within the Project footprint during field surveys. The nearest records of the species are located approximately 70 km north-west of the Project footprint. Potential habitat in the Project footprint is not considered important habitat for the species, as assessed against the important habitat criteria defined in the draft referral guidelines for Brigalow Belt reptiles (DCCEEW, 2023a). Therefore, the Project is considered unlikely to lead to a long-term decrease in the size of an important population of a species.
Reduce the area of occupancy for an important population	Unlikely The field surveys did not identify the species within the Project footprint, including microhabitat, and there are no known populations in the surrounding area. In addition, no important habitat as assessed in Table 7-55 was found with the Project footprint, and therefore, removal of potential habitat would not reduce the area of occupancy for an important population.
Fragment an existing important population into two or more populations	Unlikely The species or evidence of the species was not recorded within the Project footprint during field surveys. The Project footprint contains 241.13 ha of potential yakka skink habitat, which is not considered important habitat for the species, as defined in the draft referral guidelines for Brigalow Belt reptiles (DCCEEW, 2023a). Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for woodland reptiles. Connectivity areas have been identified for woodland reptiles. Structures with natural substrate will be designed for the species, including provision of suitable habitat features and fauna furniture within these crossing structures and in their approaches. The residual impact to connectivity for woodland reptiles after mitigation was assessed in the Fauna Connectivity Strategy as low at bridges and moderate at culverts. Therefore an important population will not be fragmented into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely The species or evidence of the species was not recorded within the Project footprint during field surveys and there is no important habitat assessed as present in the Project footprint. As such, it is considered unlikely that the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely The species and important habitat for the species was not recorded during field surveys and given this, the clearing of potential habitat is unlikely to disrupt the breeding cycle of an important population
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on yakka skink habitat. See Section 5.2.10 for further details. The Project footprint contains 241.13 ha of potential yakka skink habitat, which will be cleared for the Project. There are no records of the species within or close to the Project footprint and no individuals or important habitat was recorded during field surveys. The nearest record is located approximately 70 km north-west of the Project footprint. Therefore, it is considered unlikely that the Project will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Criterion	Assessment against significance criteria
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DoE, 2014a), yakka skink is currently threatened by feral animals including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>). Both foxes and cats are known to occur within the Project footprint. The Project will adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DoE, 2014a), yakka skink is not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for this species and a recovery plan is not required. The species' conservation advice (DoE, 2014b) notes the following priority actions applicable to the species: • Protect and monitor known populations and identify threats; • Encourage the retention of habitat structure elements (logs and surface rocks) in known and potential habitat; • Develop a fire management strategy for known populations and habitat; • Minimise adverse impacts from land use including road widening and maintenance; and • Develop and implement a feral predator management plan to control feral cat and red fox in the region. The clearing of 241.13 ha of potential yakka skink habitat will not directly interfere with the recovery of the species. The species was not recorded during field surveys within the Project footprint, and important habitat, as per the DCCEEW (2023a) definition, has not been identified. Therefore, it is considered unlikely that the Project will interfere substantially with the recovery of the yakka skink.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on yakka skink.

7.3.2.4 DUNMALL'S SNAKE (*FURINA DUNMALLI*)

Dunmall's snake (*Furina dunmalli*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to a direct sighting in Bringalily State Forest. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6.

The draft referral guidelines for Brigalow Belt reptiles consider an occurrence of important habitat for the Dunmall's snake (*Furina dunmalli*) is a surrogate for an 'important population' of the species (DCCEEW, 2023a). Important habitat is defined as 'suitable habitat within the known / likely-to-occur distribution of the species and any habitat corridors in between'

(DCCEEW, 2023a). The presence of important habitat is assessed under the four criteria specified in the guidelines in Table 7-43 An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-44

TABLE 7-43 IMPORTANT POPULATION ASSESSMENT – DUNMALL’S SNAKE

Criterion	Assessment against criteria
Suitable habitat for this species is considered important if it is:	
Habitat where the species has been identified during a survey	Given the suitable habitat has been mapped within the Project footprint and the species is known to occur, suitable habitat within the footprint could be considered important habitat. Additionally, the Project footprint is located within a corridor joining two areas within the known/likely distribution of the species. As such, it is considered likely this habitat is important habitat for the species or a key source for breeding or dispersal.
Near the limits of the species known range	The Project footprint is not located near the limit of the species’ range.
Large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations)	The Project footprint is located within a corridor joining two areas within the known/likely distribution of the species. As such, it is considered likely this habitat is important habitat for the species and necessary for breeding, dispersal or maintaining genetic diversity.
A habitat type where the species is identified during a survey, but which was previously thought not to support the species	A single Dunmall’s snake was recorded incidentally beside a drainage line in bull-oak forest. This species is known to occur in bull-oak open forest, and therefore, habitat within the Project footprint is not considered important habitat under this criterion
Assessment of important habitat as a surrogate for important populations	As the Project footprint contains suitable habitat and the species is known to occur, mapped habitat for this species is considered important habitat. Additionally, the Project is located within a corridor joining two areas within the known / likely-to-occur distribution of the species. Therefore, an important population of the species is likely to occur within the Project footprint.

TABLE 7-44 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – DUNMALL'S SNAKE

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Potential An important population is inferred based on the presence of important habitat for the species. A single Dunmall’s snake was recorded within the Project footprint, and 262.69 ha of important habitat is expected to be cleared. Therefore, the Project has the potential to lead to a long-term decrease in the size of an important population of the species.
Reduce the area of occupancy for an important population	Likely The <i>Draft Referral guidelines for the nationally listed Brigalow Belt reptiles</i> (DCCEEW, 2023a) lists the clearing of four or more hectares of important

Criterion	Assessment against significance criteria
	habitat as a high-risk significant impact, and as such, the Project is likely to reduce the area of occupancy for an important population.
Fragment an existing important population into two or more populations	Unlikely Clearing of 262.69 ha of important habitat for the species has the potential to fragment an existing important population. Only a single individual was recorded within the Project footprint, and the extent and size of the population is unknown. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for woodland reptiles. Connectivity areas have been identified for woodland reptiles. Structures with natural substrate will be designed for the species, including provision of suitable habitat features and fauna furniture within these crossing structures and in their approaches. The residual impact to connectivity for woodland reptiles after mitigation was assessed in the Fauna Connectivity Strategy as low at bridges and moderate at culverts. As such, the Project is likely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely As per the species conservation advice (DoE, 2014b), there is no official definition for habitat critical to the survival of Dunmall's snake, and as such, the Significant Impact Guidelines definition of habitat critical to the survival will be used. The Draft Referral guidelines for the nationally listed Brigalow Belt reptiles state that '<i>all suitable habitat within the known / likely to occur distribution of the species and any habitat corridors in between</i>' is considered important habitat for the species (DCCEEW, 2023a). As per the Significant Impact Guidelines definition, habitat within the Project footprint is considered critical as the species has been recorded and is likely to use habitat for foraging, breeding and dispersal. Therefore, the clearing of all Dunmall's snake habitat within the Project footprint (being 262.69 ha) is likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Potential Minimal information exists regarding the breeding requirements for this species and as such a conservative approach should be taken. Clearing of 262.69 ha of important habitat for the species is considered to have the potential to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Likely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on Dunmall's snake habitat. See Section 5.2.10 for further details. ARTC have committed to further refinement of the final reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat. There is a single record of the species within the Project footprint and the status and extent of the population is not known. The loss of 262.69 ha of important habitat will likely decrease the availability of habitat to the extent that the species has the potential to decline. Although the Project footprint follows existing linear corridors in some parts of the species' habitat, this is not the case for all habitat. As such, the Project has the potential to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the	Unlikely As per the species conservation advice (DoE, 2014b), Dunmall's snake are currently threatened by the predation by feral animals. Feral animals, including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>) are known to occur within the Project footprint. The Project will adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will

Criterion	Assessment against significance criteria
vulnerable species' habitat	outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DoE, 2014b), Dunmall's snake are not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for this species and a recovery plan is not required. The approved conservation advice for Dunmall's snake (DoE, 2014b) notes the following priority actions applicable to the species: • Manage any disruptions to water flows and any modification of wetlands; • Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible; • Raise awareness of Dunmall's snake and other reptiles within the local community; • Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions; • Minimise adverse impacts from land use at known sites; • If livestock grazing occurs in the area, ensure landowners / managers use an appropriate management regime and stocking density that does not detrimentally affect this species; and • Continue baiting to control population numbers of feral animals. Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on Dunmall's snake habitat. Additionally, ARTC have committed to further refinement of the final reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat outside the Project footprint. Based on the species' recovery actions, the project is unlikely to substantially interfere with the recovery of the species due to the extent of alternative habitat of similar quality remaining in the surrounding landscape and the implementation of mitigation measures.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on Dunmall's snake.

7.3.2.5 SQUATTER PIGEON (SOUTHERN) (*GEOPHAPS SCRIPTA SCRIPTA*)

Squatter pigeon (southern) (*Geophaps scripta scripta*) is listed as Vulnerable under the EPBC Act and is likely to occur within the Project footprint, due to the presence of habitat within the Project footprint, nearby records and sightings on the Canning Creek offset property subsequent to original surveys. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion specific to the squatter pigeon (southern) is shown in Table 7-45. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-46.

TABLE 7-45 IMPORTANT POPULATION ASSESSMENT – SQUATTER PIGEON (SOUTHERN)

Criterion	Assessment against criteria
Populations occurring in the Condamine River catchment and Darling Downs of southern Queensland	The Project is partially located in the Condamine River catchment and Darling Downs region and therefore any populations utilising habitat within or surrounding the Project area are considered important.
Populations known to occur in the Warwick-Inglewood-Texas region of southern Queensland	The Project traverses past Inglewood (approximately 3 km away), and any populations utilising habitat within or surrounding this area are considered important.
Any populations potentially occurring in northern NSW	The Project is located entirely within Queensland.
Assessment as an important population	An important population is likely to be present and utilising habitat within and surrounding the Project footprint.

TABLE 7-46 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – SQUATTER PIGEON (SOUTHERN)

Criterion	Assessment against significance criteria ¹
Lead to a long-term decrease in the size of an important population of a species	Unlikely Squatter pigeon (southern) was not recorded within the Project footprint during field surveys, however it was observed in the Canning Creek potential offset property. The Project footprint contains 421.42 ha of squatter pigeon (southern) habitat, of which 166.89 ha is breeding habitat and 254.53 ha is foraging habitat. Due to the proximity of records, an important population is likely to exist. However, the surrounding landscape provides suitable habitat for the species, where species records are abundant. The Project will implement mitigation measures to minimise the risk of impacts on the species, including pre-clearance surveys and revegetation within the temporary construction footprint that may represent potential foraging habitat for the squatter pigeon (subject to landholder agreements). Therefore, the Project is considered unlikely to result in a long-term decrease in the size of an important population.
Reduce the area of occupancy for an	Unlikely

Criterion	Assessment against significance criteria ¹
important population	An important population is likely to exist within the Project footprint. The Project footprint generally intersects already disturbed (cleared) habitat along an existing linear infrastructure corridor. Squatter pigeon (southern) have been recorded utilising disturbed areas, roadsides, and tracks, and it is considered likely that the species will persist in the area following construction. As such, the Project is unlikely to reduce the occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely Much of the potential habitat in and surrounding the Project footprint is already fragmented due to the disturbed nature of the landscape. Squatter pigeon (southern) have been recorded utilising disturbed areas, roadsides, and tracks, and it is considered likely that the species will persist in the area following construction and may be able to freely move across the Project. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide movement opportunities across the Project for woodland birds. Connectivity areas have been identified for woodland birds and structures will be suitably designed (i.e., bridge underpasses). Connectivity for woodland birds at some locations may also be maintained through the retention and revegetation of low shrubby vegetation and groundcover within the Project footprint, leaving a gap of no more than 100 m. This will be considered on a site-by-site basis during detailed design. The residual impact to connectivity after mitigation was assessed in the Fauna Connectivity Strategy as low for woodland birds. Therefore, the Project is considered unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species in Queensland has not been formally defined within the conservation advice (TSSC, 2015a), therefore, the Significant Impact Guidelines definition of habitat critical to survival will be used. The Project footprint contains 421.42 ha of squatter pigeon (southern) habitat, of which 166.89 ha is breeding habitat and 254.53 ha is foraging habitat, primarily between Yelarbon and Canning Creek. Revegetation of grass species within the Project temporary footprint (largely used for access and laydown areas) may mitigate impacts to squatter pigeon foraging habitat (subject to landholder agreement). Additionally, it is likely that regeneration of grassland within the permanent footprint may also constitute foraging habitat for squatter pigeon. Although the habitat being removed for the Project is small relative to what is available in the broader landscape, the habitat still constitutes habitat critical to the survival of the species. As such, the Project is likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely The species breeds throughout the year, depending on conditions and food resources. The Project footprint contains 166.89 ha of squatter pigeon (southern) breeding habitat. However, the species is high mobility and the abundance of records in the landscape surrounding the Project suggests a prevalence of habitat in the broader landscape. Although the Project will remove 166.89 ha of breeding habitat, this habitat is not isolated from habitat areas in the broader landscape and therefore it is considered unlikely that the breeding cycle of squatter pigeons (southern) will be disrupted.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the	Unlikely Squatter pigeon (southern) is widespread from northern central Queensland, south to the Warwick/Inglewood area and west to Charleville (TSSC, 2015a). The Project footprint contains 421.42 ha of squatter pigeon (southern) habitat which is expected to be cleared for the Project.

Criterion	Assessment against significance criteria ¹
species is likely to decline	The Project follows an existing cleared linear corridor through the areas of State Forest and for much of the Project, therefore, potential habitat in these areas is already fragmented. Additionally, the Project is considered unlikely to create a barrier for the species movement. Squatter pigeon (southern) have been recorded utilising disturbed areas, roadsides, and tracks, and it is considered likely that the species will persist in the area following construction. Moreso, abundant suitable habitat remains outside of the Project footprint, where the species has been recorded. Therefore, the Project is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (TSSC, 2015a), squatter pigeon (southern) are currently threatened by feral herbivores including rabbits (<i>Oryctolagus cuniculus</i>), the introduction of weeds, and the predation by feral animals including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>). Both foxes and cats are known to occur within the Project footprint. Additionally, the Project footprint is subjected to significant invasion by introduced pastoral grass species. The Project will implement appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (TSSC, 2015a), squatter pigeon (southern) is not currently threatened by diseases. This species may be susceptible to avian influenza, however, the Project is unlikely to introduce this disease, given there are no currently known cases in Queensland. The Project will adopt the Biosecurity Management Plans that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for this species and a recovery plan is not required. The approved conservation advice (TSSC, 2015a) outlines the following priority actions: • Identify sub-populations of high conservation priority, especially in the southern part of the squatter pigeon's (southern) range; • Protect and rehabilitate areas of vegetation that support important sub-populations; • Protect sub-populations of the listed subspecies through the development of covenants, conservation agreements or inclusion in reserve tenure; • Develop and implement a stock management plan for key sites; • Develop and implement a management plan, or nominate an existing plan to be implemented, for the control and eradication of feral herbivores in areas inhabited by the squatter pigeon (southern); and • Raise awareness of the squatter pigeon (southern) within the local community, particularly among land managers. Clearing of 421.42 ha of squatter pigeon (southern) habitat will not directly interfere with the recovery of the species, as listed in the priority actions above, therefore the Project is considered unlikely to interfere with the recovery of the species.

Criterion	Assessment against significance criteria ¹
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on squatter pigeon (southern).

7.3.2.6 PAINTED HONEYEATER (*GRANTIELLA PICTA*)

Painted honeyeater (*Grantiella picta*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to direct sightings within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-47. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-48.

TABLE 7-47 IMPORTANT POPULATION ASSESSMENT – PAINTED HONEYEATER

Criterion	Assessment against criteria
Key source population for breeding or dispersal	The species conservation advice (DoE, 2015a) mentions the species is considered to occur as a single, sparsely distributed breeding population, and as such, the population of painted honeyeater within the Project footprint is considered to be an important population and a key source population for breeding or dispersal.
Populations that are necessary for maintaining genetic diversity	The species conservation advice (DoE, 2015a) mentions the species is considered to occur as a single, sparsely distributed breeding population, and as such, the population of painted honeyeater within the Project footprint is considered to be an important population and necessary for maintaining genetic diversity.
Populations that are near the limit of the species' range	The Project footprint is not located near the limit of the species range.
Assessment as an important population	It is likely the Project footprint contains an important population.

TABLE 7-48 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – PAINTED HONEYEATER

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Unlikely Painted honeyeater is known to occur within the Project footprint, as a result of direct sightings during field surveys. The Project footprint contains 330.66 ha of painted honeyeater habitat which is expected to be cleared for the Project. This habitat constitutes both breeding and foraging habitat for the species. The species is highly mobile and nomadic occurring as a sparsely and widely distributed single interbreeding population dispersed across inland eastern Australia. Given the large home range of this species and the adjacent habitat outside of the Project footprint that will remain intact, it is unlikely that the Project will lead to a long-term decrease in the size of an important population.

Criterion	Assessment against significance criteria
Reduce the area of occupancy for an important population	Unlikely Painted honeyeaters were recorded within the Project footprint during field surveys and an important population is known to occur. The Project footprint contains 330.66 ha of painted honeyeater habitat which is expected to be cleared for the Project. Suitable habitat for the species is abundant in the wider region of the Project, particularly associated with Bringalily State Forest and Whetstone State Forest. Painted honeyeater travels between flowering mistletoe throughout eastern Australia and its area of occupancy is unlikely to be affected by this scale of clearing. Therefore, the Project is considered unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely Painted honeyeaters occur as a single, sparsely distributed breeding population (DoE, 2015a). The species is known to be highly mobile, moving between habitats where mistletoe is most abundant. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide movement opportunities across the Project for woodland birds. Connectivity areas have been identified for woodland birds and structures will be suitably designed (i.e., bridge underpasses). Connectivity for woodland birds at some locations may also be maintained through the retention and revegetation of low shrubby vegetation and groundcover within the Project footprint, leaving a gap of no more than 100 m. This will be considered on a site-by-site basis during detailed design. The residual impact to connectivity after mitigation was assessed in the Fauna Connectivity Strategy as low for woodland birds. Therefore, the Project is considered unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the painted honeyeater is described in the species recovery plan (DAWE, 2021b) includes, but is not limited to: - Known or likely breeding habitat in Boree/Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) woodlands, box-gum woodlands and box-ironbark forests on the inland slopes of the Great Dividing Range in New South Wales, Victoria and southern Queensland, and - All preferred foraging species within known and likely foraging habitat particularly mistletoes of the genus <i>Amyema</i> growing on forest and woodland eucalypts and acacias. The Project footprint contains 330.66 ha of painted honeyeater habitat, which is considered to be habitat critical to the survival of the species. Of this, 113.45 ha is remnant, 5.40 is mature regrowth and 211.81 is immature regrowth vegetation. Impacts to the species preferred habitat are expected to be permanent, and therefore, the Project is likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely Painted honeyeaters breed from October to March, building a cup shaped nest in the outer foliage of trees (DoE, 2015a). Painted honeyeater was recorded within the Project footprint, and a single important population exists. The species is highly mobile, occurring sporadically and unpredictably. The Project footprint is within the generally accepted, broad breeding range (south of 26°S and west of the Great Dividing Range), however, it is not within the inland slopes of the Great Dividing Range, where the majority of breeding is known to occur (Higgins et al., 2001). Given the size and range of the population as a whole, the species' sporadic nature, and with the Project footprint being outside of the key breeding habitat, it is considered unlikely that the Project will disrupt the breeding cycle of an important population.

Criterion	Assessment against significance criteria
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The painted honeyeater population is sparsely dispersed across eastern Australia, particularly in remnant and non-remnant areas where flowering mistletoes are present. Numerous records of the species exist outside of the Project footprint, suggesting the broader region supports species habitat. Painted honeyeaters are known to forage in old growth eucalypt paddock trees that contain mistletoe (DEE, n.d.). While some paddock trees containing mistletoe may be removed, this is unlikely to significantly impact the species locally or nationally, due to likely abundant suitable habitat outside of the Project footprint (inferred from species records). Therefore, the Project is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely As per the species conservation advice (DoE, 2015a), painted honeyeater is currently threatened by the black rat (<i>Rattus rattus</i>). Additionally, whilst not invasive, the painted honeyeater is threatened by the competition with other more aggressive honeyeaters and predation by native pest predators including the pied currawong (<i>Strepera graculina</i>), pied and grey butcherbirds (<i>Cracticus nigrogularis</i> and <i>Cracticus torquatus</i>), and crows and ravens (<i>Corvidae</i>). The Project will adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DoE, 2015a), there are no known, identified diseases associated with regent honeyeater. This species may be susceptible to avian influenza, however, the Project is unlikely to introduce this disease, given there are no currently known cases in Queensland. The Project will adopt the Biosecurity Management Plans that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Likely The national recovery plan for the painted honeyeater (<i>Grantiella picta</i>) (DAWE, 2021b) outlines a strategy for the species recovery, being: • Protect, manage and restore Painted Honeyeater breeding and foraging habitats at the local, regional and landscape scales; • Monitor, reduce and manage threats and sources of mortality; • Develop and apply techniques to measure changes in population trajectory in order to measure the success of recovery actions; • Improve understanding of habitat use at a landscape scale in order to better target protection and restoration measures; • Engage local communities and stakeholders in Painted Honeyeater conservation; and • Coordinate, review and report on recovery progress. The Project will clear 330.66 ha of painted honeyeater breeding and foraging habitat. Therefore, the Project will substantially interfere with the recovery objectives outlined in the national recovery plan.

Criterion	Assessment against significance criteria
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on painted honeyeater.

7.3.2.7 MURRAY COD (*MACCULLOCHELLA PEELII*)

Murray cod (*Maccullochella peelii*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to direct detections during eDNA surveys within the Project footprint. These detections were in the MacIntyre River, MacIntyre Brook and Canning Creek, although the Project does not intersect the section of Canning Creek where Murray cod was detected, it does intersect a small ephemeral unnamed tributary. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-49. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-50

TABLE 7-49 IMPORTANT POPULATION ASSESSMENT – MURRAY COD

Criterion	Assessment against criteria
Key source population for breeding or dispersal	Currently, broad scale, systematic surveys of Murray cod populations have not been undertaken. Murray cod is known to occur within the Project footprint, with individuals recorded via eDNA surveys at Macintyre River and Canning Creek. Macintyre Brook downstream of Inglewood is listed in the draft referral guidelines as containing an important population of Murray Cod (DoE, 2016b). Therefore, the population is considered a key source for breeding and/or dispersal.
Populations that are necessary for maintaining genetic diversity	As per species national recovery plan (National Murray Cod Recovery Team, 2010), 'Murray cod populations are fragmented and patchy'. As such, any population of this species would be deemed as fragmented from another. Subsequently, the population is considered likely to be genetically unique and thus essential to the maintenance of the species overall genetic diversity.
Populations that are near the limit of the species' range	The Project footprint is located near the limit of the species range.
Assessment as an important population	It is likely the Project footprint contains an important population.

TABLE 7-50 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – MURRAY COD

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Unlikely Murray cod was recorded in the Macintyre River, Macintyre Brook and Canning Creek during field surveys. These waterways are considered as supporting an 'important population' under the draft referral guidelines for the species (DoE, 2016b).

Criterion	Assessment against significance criteria
	The Project footprint contains 60.50 ha of Murray cod habitat which is expected to be disturbed by the Project. The revised reference design incorporates culverts, bridges, and viaducts to allow fish passage, including crossings at the Macintyre River and floodplain, Macintyre Brook, and Condamine River channels (refer to section 6.2). The Project's construction phase may require temporary stream impoundments at waterway crossing points, along with the removal of instream habitat, however this is expected to be temporary and localised. Dewatering activities of impounded areas will be carried out with consideration of the DAF Guidelines for fish salvage in impounded areas. Overall, the Project is considered unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy for an important population	Unlikely The species was recorded in the Macintyre River, Macintyre Brook and Canning Creek during field surveys and these waterways are considered to support important populations. The Project footprint contains 60.50 ha of Murray cod habitat, which is expected to be disturbed by the Project. Disturbance of these habitat areas are expected to be temporary only and localised. The revised reference design has incorporated culverts, bridges, and viaducts to allow fish passage, including crossings at the Macintyre River and floodplain, Macintyre Brook, and Condamine River channels. Stream impoundments may be required temporarily, only during the construction phase. Therefore, as impacts are temporary only, the Project is considered unlikely to reduce the area of occupancy of the species.
Fragment an existing important population into two or more populations	Unlikely The Project will facilitate fish passages at the Macintyre River and floodplain, Macintyre Brook, and Condamine River channels, via the Wildlife Connectivity Plan which will be based on revised draft EIS Appendix P: Fauna Connectivity Strategy. All structures in key connectivity areas for Murray cod are bridges that are elevated above the floodplain. Bridges have been designed so that they do not significantly alter water flow and allow for Murray cod movement. The Fauna Connectivity Strategy includes recommendations to provide bank and in-stream habitat in connectivity locations for the Murray cod. The residual impact to connectivity after mitigation was assessed in the Fauna Connectivity Strategy as negligible for the Murray cod. Impacts to movement as a result of the Project are likely to be temporary during the construction phase only, and as such it is considered unlikely that the Project will fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely The Project footprint contains 60.50 ha of Murray cod habitat, intersecting 'critical habitat' at the Macintyre River, Macintyre Brook and Condamine River floodplain. However, field assessments indicate the Condamine River floodplain provides poor habitat values for the species. Murray cod was recorded in the Macintyre River and Macintyre Brook during field surveys. Impacts from the Project are likely to be temporary during the construction phase only, and as such it is considered unlikely that the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely Murray cod is restricted to permanent waterways and is known to complete their lifecycle entirely within freshwater habitats (i.e., potamodromous). The species generally breeds during spring, with warmer temperatures and increased day length. The species is known to make significant upstream migrations prior to spawning. Temporary construction works at Macintyre River and floodplain, Macintyre Brook, and Condamine River channels may impact the species, however these impacts are expected to be temporary only. High-risk construction activities will be timed to occur outside of the species' spawning season (September to November (inclusive)). As impacts are temporary only and will occur outside of the breeding season, it is

Criterion	Assessment against significance criteria
	considered unlikely that the Project will disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on Murray cod habitat. See Section 5.2.10 for further details. ARTC will refine the revised reference design to reduce significant impacts of changes to hydrology and flooding on MNES species habitat. Aquatic habitat degradation is a contributing factor to the decline in Murray cod populations. The degradation generally occurs at a catchment scale such as land clearing, broad-scale fires and river regulation which influence water quality. The Project will include works within instream habitats, which may result in the localised removal of important habitat features such as woody debris and changes to the local geomorphology. Provision of beneficial habitat (including snags) for the Murray cod within the MacIntyre River, one kilometre north of the bridge crossing will increase the quality of habitat within this system. The majority of the water crossing points along the Project footprint are ephemeral and instream habitat complexity is limited. Disturbances to waterways are expected to be localised and temporary, only during the construction phase of the Project. Changes to water quality may also occur if not appropriately managed during construction (e.g., erosion and sediment controls) or operations (accidental spills and maintenance of waterway barriers). However, the risk of impact is likely to be low and localised. The Project will implement appropriate mitigation measures to ensure surface water quality is not impacted (e.g. erosion and sediment controls and water quality monitoring program). Therefore, as the impacts are likely to be temporary only, the Project is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely The species' national recovery plan (Murray Cod Recovery Team, 2010) states Murray cod are currently threatened by eleven alien fish species, including but not limited to, carp (<i>Cyprinus carpio</i>), redfin perch (<i>Perca fluviatilis</i>), goldfish (<i>Carassius auratus</i>) and eastern gambusia (<i>Gambusia holbrooki</i>). European carp, goldfish and mosquito fish were identified in Macintyre Brook during field surveys. Goldfish and Mosquito fish were also recorded in the Macintyre River. The Project will adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species national recovery plan (Murray Cod Recovery Team, 2010), Murray cod are not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely The <i>National Recovery Plan for the Murray Cod Maccullochella peelii</i> (Murray Cod Recovery Team, 2010) outlines the following recovery objectives for the species: Determine the distribution, structure and dynamics of Murray cod populations across the Murray-Darling Basin;

Criterion	Assessment against significance criteria
	• Manage river flows to enhance recruitment to Murray cod populations; • Evaluate the risks of threats and benefits of recovery options on Murray cod populations for each management unit; • Determine the habitat requirements of Murray cod life stages and populations; • Manage the recreational fishery for Murray cod in a sustainable manner while recognising the social, economic, and recreational value of the fishery; • Encourage community ownership for Murray cod conservation. Project impacts to the species habitats are expected to be localised and temporary during the construction phase only. As such, the Project is unlikely to interfere the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on Murray cod.

7.3.2.8 SOUTH-EASTERN LONG-EARED BAT (*NYCTOPHILUS CORBENI*)

South-eastern long-eared bat (*Nyctophilus corbeni*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to direct sightings within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-51. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-52

TABLE 7-51 IMPORTANT POPULATION ASSESSMENT – SOUTH-EASTERN LONG-EARED BAT

Criterion	Assessment against criteria
Key source population for breeding or dispersal	There is limited information currently available regarding population numbers and structure for the south-eastern long-eared bat. South-eastern long-eared bat is known to occur within the Project footprint. Habitat within the Project footprint is connected to an extensive area of potential habitat north of Inglewood, associated with several protected areas (National Park and State forests) and is situated more broadly within a highly fragmented landscape. Within such fragmented surrounds, the habitat is likely to contain important populations for both breeding and dispersal.
Populations that are necessary for maintaining genetic diversity	Habitat within the Project footprint is connected to an extensive area of potential habitat north of Inglewood, associated with several protected areas (National Park and State forests) and is situated more broadly within a highly fragmented landscape. Within such fragmented surrounds, the habitat is likely to contain important populations necessary for maintaining genetic diversity.
Populations that are near the limit of the species' range	The Project footprint is located towards the eastern limit of the species' range.
Assessment as an important population	It is likely the Project footprint contains an important population.

TABLE 7-52 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – SOUTH-EASTERN LONG-EARED BAT

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Unlikely South-eastern long-eared bat is known to occur within the Project footprint and an important population has been identified. The Project footprint contains 696.25 ha of south-eastern long-eared bat habitat which is expected to be cleared by the Project. This consists of 301.28 ha of roosting habitat and 394.97 ha of foraging habitat. Habitat within the Project footprint is connected to an extensive area of potential habitat north of Inglewood, associated with several protected areas (National Park and State forests) and is situated more broadly within a highly fragmented landscape. The Project will implement mitigation measures to reduce the risk of impacts on the species, including but not limited to pre-clearance surveys (in accordance with the guidelines) and relocation of individuals if observed during construction. The Project is linear and largely follows an existing linear infrastructure corridor, particularly through large areas of contiguous habitat. There is abundant similar habitat in the region surrounding the Project footprint to the north and south where the species is known to occur, including foraging and roosting habitat on the Canning Creek offset site. Given this, it is considered unlikely the Project will lead to a long-term decrease in the size of an important population of the species.
Reduce the area of occupancy for an important population	Unlikely South-eastern long-eared bat is known to occur within the Project footprint and an important population has been identified. The Project footprint contains 696.25 ha of south-eastern long-eared bat habitat which is expected to be cleared by the Project. Habitat within the Project footprint is connected to an extensive area of potential habitat north of Inglewood, associated with several protected areas (National Park and State forests) and is situated more broadly within a highly fragmented landscape. The south-eastern long-eared bat will persist across the broad area that will be impacted by the Project, including in areas of Bringalily State Forest and the Canning Creek offset site. The Canning Creek offset site contains 1,183 ha of roosting habitat and 746 ha of suitable foraging habitat for the species (Williams, 2023). With consideration of the scale of impacts in the context of the habitat in the region and implementation of mitigation measures, the Project is unlikely to reduce the area of occupancy for an important population.
Fragment an existing important population into two or more populations	Unlikely An important population has been identified within the Project footprint, and the species was recorded during field surveys. South-eastern long-eared bat was recorded along an access track located within eucalypt woodland forest and a secondary tree layer of <i>Allocasuarina luehmannii</i> in Bringalily State Forest, and within the Canning Creek offset site. The Project footprint intersects a small portion of Bringalily State Forest, which will be impacted during clearing and construction. Despite the species preferring forested habitat, tracking of individuals around northern Bringalily State Forest and Canning Creek indicate that the species is capable of travelling across cleared and fragmented land (Williams, 2023). As the species is highly mobile and extensive preferable habitat remains outside of the Project footprint, the Project is considered unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species in Queensland has not been formally defined within the conservation advice, therefore the Significant Impact Guidelines definition of habitat critical to survival will be used. The Project footprint contains 696.25 ha of south-eastern long-eared bat habitat

Criterion	Assessment against significance criteria
	which is expected to be cleared by the Project. This disturbance has the ability to impact preferable habitat for the species within the Project footprint. Therefore, the Project is considered likely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Likely An important population exists within the Project footprint, and individuals were recorded during field surveys. The species breeds seasonally in woodland habitats, hollows within dead trees or limbs preferred as maternity roosts (TSSC, 2015b). In Queensland, pregnant and lactating females have been observed in November. The Project will implement mitigation measures to minimise the risk of impacts to the species, including but not limited to, pre-clearance surveys and retrieval of tree hollows, where safe to do so, during vegetation clearing allowing for inspections for roosting individuals. The surrounding National Park and State forests are likely to contain suitable breeding habitat for the species. However, impacts to breeding habitat within the Project footprint are likely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The Project is linear and largely follows an existing linear infrastructure corridor, particularly through large areas of contiguous habitat. The surrounding landscape, particularly the National Park and State forests support suitable habitat for the species and the species has been recorded during surveys. South-eastern long-eared bats are known to utilise paddock trees, likely for foraging within 12 km of large, connected habitat patches. Paddock trees with decorticated bark, tree fissures and/or hollows within these areas may also be used roosting and breeding (TSSC, 2015b; DEE, n.d.). Although there is also potential for south-eastern long-eared bat to use paddock trees with dead tree trunk hollows as maternity roosts, this is considered unlikely given the extensive habitat in the form of large contiguous patches in the broader landscape. As the species is highly mobile and is known to occur within the surrounding landscape, the Project is considered unlikely to impact on habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	Unlikely As per the species conservation advice (TSSC, 2015b), it is currently unknown whether the invasion of weeds and predation by feral animals are threats to south-eastern long-eared bat. Feral animals, including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>) are known to occur within the Project footprint. The Project will adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (TSSC, 2015b), south-eastern long-eared bats are not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no recovery plan for this species, however a recovery plan is required. The species' conservation advice (TSSC, 2015b) outlines the following priority actions:

Criterion	Assessment against significance criteria
	- Protect known and potential habitat of key populations, including within conservation reserves, from habitat loss and fragmentation; - Retain hollow-bearing trees and provide for hollow tree recruitment where possible; - Incorporate key population locations into the planning and decision-making process for major infrastructure projects, such as the development of new roads and pipeline routes, and extractive industries; and - Where feasible, undertake habitat renewal actions to link habitat supporting known populations or potential habitat. 'Key populations' of the species have not been identified within the Project footprint, however an important population is known to occur. Whilst the Project will clear 696.25 ha of south-eastern long-eared bat habitat, impacts will be linear and abundant habitat remains within the surrounding landscape where the species is known to occur. The Project is not expected to substantially interfere with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on south-eastern long-eared bat.

7.3.2.9 GREATER GLIDER (SOUTHERN AND CENTRAL) (*PETAUROIDES VOLANS*)

Greater glider (southern and central) (*Petauroides volans*) is listed as Endangered under the EPBC Act, however it is assessed as Vulnerable due to the date of the controlled action decision being made at Vulnerable listing status. Nonetheless and in accordance with Section 139 of the EPBC Act the currently approved conservation advice for greater glider (southern and central) has been used. Greater glider (southern and central) has the potential to occur within the Project footprint, due to the presence of habitat within the Project footprint. The species was not recorded during surveys, despite targeted searches. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-53. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-54

TABLE 7-53 IMPORTANT POPULATION ASSESSMENT – GREATER GLIDER (SOUTHERN AND CENTRAL)

Criterion	Assessment against criteria
Key source population for breeding or dispersal	The species conservation advice lists all populations of greater glider (southern and central) as important (DCCEEW, 2022), however there are no known populations of the species within the Project footprint, and the species was not recorded despite targeted surveys. The nearest record is located 9 km north-east of the Project footprint. Therefore, it is unlikely the Project footprint contains a key source population for breeding or dispersal.
Populations that are necessary for	Majority of the species' records occur along the coastline east of the Project footprint, suggesting inland populations of the species may become fragmented from other populations. However, there are no

Criterion	Assessment against criteria
maintaining genetic diversity	known populations or individuals within the Project footprint despite targeted surveys.
Populations that are near the limit of the species' range	Records within the locality of the Project footprint are near a patchy western limit of the species range. In a broader form, the species distribution extends further north, south, east and west in an irregular form, albeit patchy areas do occur.
Assessment as an important population	As no records or populations of the species occur, it is unlikely the Project footprint contains an important population.

TABLE 7-54 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – GREATER GLIDER (SOUTHERN AND CENTRAL)

Criteria	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Unlikely There are no important populations within the Project footprint and the species was not recorded within or near the Project footprint, despite targeted surveys. The nearest record is located 9 km north-east of the northern extent of the Project footprint. The Project footprint contains 15.97 ha of potential habitat which is expected to be cleared for the Project. This consists of 1.60 ha of potential breeding and denning habitat and 14.37 ha of potential foraging habitat. The Project will implement appropriate mitigation measures to minimise the risks to the species, including providing safe movement opportunities across the Project in the form of glider poles through tall bridge underpasses. Therefore, as no important populations exist within the Project footprint, the Project is unlikely to lead to a long-term decrease in the size of an important population of the species.
Reduce the area of occupancy for an important population	Unlikely There are no known important populations of the species within the Project footprint, and the species was not recorded despite targeted surveys. Majority of the species records occur along the coastline, east of the Project footprint, where habitat is more preferable. As there are no known important populations of the species within the Project footprint, the expected clearing of 15.97 ha of potential habitat is unlikely to reduce the area of occupancy for an important population.
Fragment an existing important population into two or more populations	Unlikely There are no known important populations of the species within the Project footprint, and the species was not recorded despite targeted surveys. The broader landscape has been subject to clearing (with the exception of State forests near Inglewood). Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide for movement across the Project footprint should an undetected greater glider (southern and central) population be present. Connectivity areas have been identified for gliders and opportunities for movement will be facilitated by provision of over rail canopy bridges and/or suitably high glider poles. These will likely be located over low bridge structures. Reducing the width of the rail corridor will enhance connectivity outcomes for gliders and is likely to be possible at waterway crossings. Where feasible, suitably high bridge structures may incorporate under-bridge canopy bridges and/or glider poles. The Fauna Connectivity Strategy includes recommendations to remove barbed wire from fencing and revegetate approaches to bridges to ensure connectivity outcomes for gliders. These measures will be incorporated into the detailed design for the Project. The residual impact to

Criteria	Assessment against significance criteria
	connectivity after mitigation was assessed in the Fauna Connectivity Strategy as low for gliders. Therefore, it is unlikely that an important population of greater gliders (southern and central) will be fragmented into two or more populations.
Adversely affect habitat critical to the survival of the species	Unlikely As per the species conservation advice (DCCEEW, 2022c), habitat meeting any of the following criteria is considered habitat critical to survival for the greater glider (southern and central): • <i>'Large contiguous areas of eucalypt forest, which contain mature hollow-bearing trees and a diverse range of the species' preferred food species in a particular region;</i> • <i>Smaller or fragmented habitat patches connected to larger patches of habitat, that can facilitate dispersal of the species and/or that enable recolonisation;</i> • <i>Cool microclimate forest/woodland areas (e.g. protected gullies, sheltered high elevation areas, coastal lowland areas, southern slopes);</i> • <i>Areas identified as refuges under future climate changes scenarios; and</i> • <i>Short-term or long-term post-fire refuges (i.e. unburnt habitat within or adjacent to recently burnt landscapes) that allow the species to persist, recover and recolonise burnt areas'.</i> Habitat critical to the survival of the species was not recorded within the Project footprint (as assessed through target habitat assessments). The Project footprint contains 15.97 ha of potential habitat for the species, which is expected to be cleared. However, all habitat patches were small and either too isolated or very tenuously connected to other areas of potential habitat outside of the Project footprint to be considered habitat critical to the survival of the species. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely Greater glider (southern and central) requires hollow entrances of >10 cm in diameter in old large trees (live and dead; with DB >50 cm), and at least 2-4 live den trees per 2 ha for denning habitat (DCCEEW, 2022c; Eyre et al., 2022). Only one small patch (1.60 ha) of potential habitat within the Project footprint met these criteria. The Project will implement mitigation measures to reduce the risk of direct and indirect impacts should the species be present, including pre-construction and pre-clearance surveys in potential habitat. As there are no known important populations of the species within the Project footprint, the Project is considered unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely There are no known populations of the species within the Project footprint, and the species was not recorded despite targeted surveys. The Project footprint contains 15.97 ha of potential habitat which is expected to be cleared for the Project. The Project footprint is largely located along existing linear infrastructure corridors within a highly modified landscape. The development and implementation of the Wildlife Connectivity Plan based revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunity for movement across the Project footprint in areas identified as key for the connectivity of gliders. As such, it is considered unlikely the Project will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the	Unlikely As per the species conservation advice (DCCEEW, 2022c), greater glider (southern and central) are currently threatened by the predation by feral animals. Feral animals, including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>) are known to occur within the Project footprint. The Project will implement appropriate weed and pest management measures to prevent

Criteria	Assessment against significance criteria
vulnerable species' habitat	and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species conservation advice (DCCEEW, 2022c), greater gliders (southern and central) are not currently threatened by diseases. It is considered unlikely the Project will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely There is no adopted or made recovery plan for the species, however a recovery plan is required. The species conservation advice (DCCEEW, 2022c) outlines a range of priority actions relevant to the species, including but not limited to: • Protect and maintain sufficient areas of suitable habitat, including denning and foraging resources and habitat connectivity, to sustain viable subpopulations throughout the species' range; • Protect any unburnt habitat and assess the impacts of fire management strategies on habitat values and Greater glider (southern and central) populations; • Implement and enforce measures to reduce direct mortality and loss of hollow-bearing trees during site preparation and execution of prescribed burns, including rake hoeing around the base of trees; • Avoid fragmentation and habitat loss from developments and upgrades of transport corridors; • High priority monitoring actions include designing an integrated monitoring program across major subpopulations and monitor the abundance/size structure of critical tree species and their responses to management actions; and • Assess the abundance, density and types of hollow-bearing trees required to support viable populations. The Project is expected to clear 15.97 ha of potential greater glider (southern and central). The Project may be a potential point source of ignition for fires (a potential threat to the species habitat) this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. Given the species is not known to occur and higher quality habitat exists outside of the Project footprint, it is unlikely the Project will interfere substantially with the management actions identified above or the recovery of the species.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on greater glider (southern and central).

7.3.2.10 KOALA (PHASCOLARCTOS CINEREUS)

Koala (*Phascolarctos cinereus*) is listed as Endangered under the EPBC Act, however, is assessed as Vulnerable due to the date of the controlled action decision being made at Vulnerable listing status. Nonetheless and in accordance with Section 139 of the EPBC Act the currently approved conservation advice for koala has been used. Koala is known to occur within the Project footprint due to direct sightings, and detailed studies of the koala

populations have been commissioned by the Inland Rail Program. These studies include koala detection dog surveys, a koala tracking program, and a koala genetics study.

The koalas inhabiting the areas surrounding the Border to Gowrie and Gowrie to Helidon (G2H) sections of the Inland Rail Program were analysed as a group to bolster sample size. Overall this group showed little differentiation with the group analysed from the Calvert to Kagaru (C2K) section and the former Kagaru to Acacia Ridge section. This group showed higher levels of heterozygosity and low levels of inbreeding, indicating high evolutionary potential and population health. There is also evidence of gene flow with koalas in the areas of Logan, Ipswich, the Scenic Rim, Lockyer Valley, Toowoomba, and Tenterfield (NSW) (ERM, 2024b). Both the koala genetics study and the koala tracking program showed almost parity in sex ratios; however, the prevalence of chlamydia was moderate (Allen, 2024; ERM, 2024b). Over 40% of individuals either tested positive, borderline, or showed clinical signs of disease (Allen, 2024; ERM, 2024b). The population size of this group is estimated to be relatively small, and therefore living at low densities in the landscape. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-55. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-56.

TABLE 7-55 IMPORTANT POPULATION ASSESSMENT – KOALA

Criterion	Assessment against criteria
Key source population for breeding or dispersal	Genetically important populations are defined in the species conservation advice (DAWE, 2022a). Any 'Queensland and New South Wales koala populations north of the Clarence River valley (New South Wales)' is documented to be an important genetic population. Koalas are known to occur within the Project footprint, with 26 individuals directly recorded and 62 indirect records (via scat and tracks). The Koala Genetics Study Project conducted for the Inland Rail Program indicates that there is gene flow occurring between the koalas in Logan, Ipswich, the Scenic Rim, Lockyer Valley, Toowoomba, and Tenterfield (NSW) (ERM, 2024b). Additionally, tracking of koalas conducted by UniSQ shows that koalas currently move and disperse across the proposed Project. The population is therefore considered a key source for breeding and/or dispersal.
Populations that are necessary for maintaining genetic diversity	As stated above, QLD and NSW populations north of the Calarence River valley are identified as being important genetic populations. This is supported by the results of the Koala Genetics Study Project, which indicate that heterozygosity is high and inbreeding levels are low in koalas that inhabit areas along B2G and G2H sections of the Inland Rail Program (ERM, 2024b). The high genetic diversity of individuals sampled within the Project footprint is considered important for maintaining high genetic diversity across the broader landscape.
Populations that are near the limit of the species' range	The Project footprint is not located near the limit of the species' range.
Assessment as an important population	As the Project footprint contains individuals considered to occur within an important population (Any 'Queensland and New South Wales koala populations north of the Clarence River valley (New South Wales)') which is considered a key source for breeding and/or dispersal it is likely the individuals within the Project footprint contributes to this important population.

TABLE 7-56 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – KOALA

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of a species	Likely Koalas are known to occur within the Project footprint, with direct and indirect records observed during field surveys. Twenty-six (26) koalas were directly recorded during field surveys, and a further 62 indirect observations (via scats and scratches) were recorded. The Project footprint contains a total of 1,362.53 ha of koala habitat which is expected to be cleared for the Project. This consists of 769.40 ha of koala breeding and foraging habitat and 593.13 ha of koala dispersal habitat. Vehicle strikes of koalas are considered a threatening process for the species, however most of the rail line will be fenced, in part to prevent wildlife access. While it may still be possible for occasional incursions of the fencing to be made by individuals, maintenance of the fencing and provision of alternative crossing points (via fauna culverts and bridge underpasses) are predicted to prevent train strikes having a long-term impact on the population. In the unfenced areas, four bridges have been incorporated into the Project across the Condamine River floodplain, for a total of 6 km. Large, raised bridge structures such as these are designed to allow fauna to follow the lay of the land under the rail line. There are also numerous culverts in this section and the rail line will be raised to ensure compliance with flood hydraulic design criteria and flood immunity to rail formation level during a 1% AEP flood event (see revised draft EIS Chapter 14: Flooding and Geomorphology for further details). Embankment slopes in the Condamine River floodplain will be determined during detailed design, however, will be a maximum of 1V:3H (0.3 gradient). This gradient is also the maximum koalas are likely to traverse, dependent upon the substrate that is used as specified in revised draft EIS Appendix M: Draft Koala Management Plan. It is considered likely that bridge underpasses and/or fauna culverts are the most likely path for fauna to take when crossing the rail line in these areas, and therefore, koala strikes are predicted to be low. The Project will implement mitigation measures to minimise the risk of impacts on koalas, including but not limited to pre-clearance surveys and implementing fauna crossing structures. The broader surrounding area contains abundant habitat suitable for koala foraging and breeding. However, the direct and permanent loss of eucalypt forest and woodland may result in a long-term decrease in the size of an important population of the species due to reduced carrying capacity of the area.
Reduce the area of occupancy for an important population	Likely As direct impacts and the permanent loss of eucalypt forest and woodland is expected to occur as a result of the Project, the Project is considered likely to reduce the area of occupancy for an important population.
Fragment an existing important population into two or more populations	Unlikely Individuals sampled within the Project footprint contribute to an important genetic population of the species, and the broader surrounding area contains abundant habitat suitable for koala foraging, breeding and dispersal. Koalas are known to traverse cleared lands (containing paddock trees) adjacent to higher quality habitats. Much of the Project footprint largely lies adjacent to an existing rail line (Southwestern System) and passes through heavily disturbed agricultural and urban lands that already fragment the landscape. The Project will bisect remnant habitat within Bringalily and Whetstone State forests. Tracking of koalas living in the vicinity of the Project revealed that koalas regularly cross the area of the proposed Project. During the study period, 11 individual koalas have been recorded crossing the proposed Project an estimated 132 times (Allen et al., 2024). Additionally, the Koala Genetics Study revealed that gene flow occurs across the broad landscape and region which likely contributes highly to the genetic heterozygosity of the koala population (ERM, 2024b).

Criterion	Assessment against significance criteria
	Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide dispersal opportunities for koalas. Connectivity areas have been identified for the koala and structures will be suitably designed for the species (including bridges, culverts, and crossing opportunities built into noise walls). Structures will be included in locations to maintain current movement pathways of koalas across the Project (based on tracking conducted by UniSQ; Allen et al., 2024). Provision of suitable habitat in the approaches to structures will further enhance their effectiveness. The implementation of these structures will ensure that the functionality of dispersal habitat across the Project is maintained and any long-term impacts that may be caused by fragmentation after the removal of 593.13 ha of dispersal habitat can be avoided. Therefore, the Project is unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	Likely Habitat critical to the survival of the species is defined as <i>'the areas that the species relies on to avoid or halt decline and promote the recovery of the species'</i> (DAWE, 2022a). Habitat present within the Project footprint is utilised by an important population, may be used to meet essential life cycle requirements, may be necessary to maintain genetic diversity and is likely to be utilised as a corridor to allow the species to move freely between sites and the three identified koala hotspots (ERM, 2024b). These 'hotspots' were determined based on historical and anecdotal information (e.g. community consultation), sightings as per the available online databases, sightings in line with the ecological investigations undertaken for the Project and mapped habitat known to be utilised by koalas (see the revised draft EIS Appendix M: Draft Koala Management Plan). This includes 769.40 ha of breeding and foraging habitat and 593.13 ha of dispersal habitat to be cleared by the Project. Through the development and implementation of the Wildlife Connectivity Plan, the function of dispersal habitat will be maintained across the Project. Habitat surrounding the Project footprint, particularly habitats in Bringalily State Forest and Whetstone State Forest may be important refugia for mitigating the impacts of climate change on the species or as a connective path between viable patches of habitat. The 769.40 ha of breeding and foraging habitat to be impacted by the Project consists of: • 499.40 ha of remnant woodland, • 15.81 ha of mature regrowth woodland, • 250.01 ha of immature regrowth woodland, and • 4.18 ha of non-remnant areas. The direct and permanent loss of breeding and foraging habitat will result in an adverse impact to habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Likely The Project will implement mitigation measures including, but not limited to, clearing outside the breeding season for koala (October-May), where possible. However, the loss of 769.40 ha of koala breeding and foraging habitat is likely to disrupt the breeding cycle of an important population, albeit temporarily during the construction period.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely Changes to flood water distribution and other flood conditions due to the Project are likely to have negligible impacts on koala habitat outside the Project footprint. See Section 5.2.10 for further details. ARTC will refine the revised reference design to mitigate significant impacts of changes to hydrology and flooding on MNES species habitat. The Project has the potential to fragment habitat of the koala population (combined populations of Queensland, New South Wales and the Australian Capital Territory). The ERM genetics study shows evidence of gene flow

Criterion	Assessment against significance criteria
	between koalas in the areas of Logan, Ipswich, the Scenic Rim, Lockyer Valley, Toowoomba, and Tenterfield (NSW) (ERM, 2024b). Disruption of this gene flow could have long-term repercussions on the future gene flow and genetic mixing of koalas in these areas. The Project aims to mitigate this by maintaining connectivity across the rail line and therefore maintain the vital function of dispersal habitat and gene flow across the area. Koalas are known to utilise paddock trees, particularly as 'stepping stones' during dispersal and movements between patches of breeding and foraging habitat (DEE, n.d.). Paddock trees that are koala feed tree species may also be used for foraging during these dispersal movements (DEE, n.d.). While some paddock trees will be removed, the function of those trees will be mitigated through the provision of fauna crossing structures in koala habitat along the Project and landscaping and revegetation works. The broader surrounding area contains abundant habitat suitable for koala foraging and breeding. Koalas are distributed across eastern Australia and are widespread in Queensland. While the loss of koala habitat as a result of the Project has the potential to result in the species decline at a local scale, it is considered unlikely to lead to the decline of the species population as a whole.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely The species' conservation advice does not list invasive species as a threatening factor to the koala (DAWE, 2022a). However, domesticated dogs are listed as a current threat to the species through attacks, this is likely to be restricted to areas within and adjacent to peri-urban and residential areas. The Project will adopt Biosecurity Management Plans (as a component of both the CEMP and Operational EMP) that will outline appropriate weed and pest management measures to prevent and minimise the spread of invasive species within the Project footprint throughout the clearing, construction and operational phase of the Project. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely Koalas are known to be impacted by diseases, including koala retrovirus (KoRV), chlamydia (<i>Chlamydia pecorum</i>) and myrtle rust which affects koala feed trees. Chlamydia has been detected in koalas across the Inland Rail Program, including the B2G section (50% prevalence in B2G and G2H sections combined), however presence of the pathogen does not always equate to clinical disease and the sample size was small (N = 14; ERM, 2024b). Detection of chlamydia in the koalas captured during the ongoing UniSQ koala monitoring program for the B2G section detected chlamydia in 12 koalas, with four koalas returning borderline results and an additional three showing overt signs of chlamydia infection (19 in total; 44.2%) (Allen et al., 2024). The severity of infection of these individuals was low and overall health assessments indicate that the population is healthy. The Project's Fauna Management Plan will incorporate precautionary measures (e.g., proper personal protection equipment (PPE) worn by fauna spotter catcher workers) throughout construction of the Project. As appropriate mitigation measures will be implemented, the Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Likely The <i>National Recovery Plan for the Koala Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territory)</i> (DAWE, 2022b) outlines the following priority objectives for the koala: • The area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased;

Criterion	Assessment against significance criteria
	- The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased; - Metapopulation processes are maintained or improved; and - Partners, communities, and individuals have a greater role and capability in listed koala monitoring, conservation, and management. Of the identified objectives, the Project may decrease the area of occupancy and estimated size of a population that may be declining or stable. The Project is not considered likely to interfere with the stability of the population. Additionally, the direct and permanent loss of breeding and foraging habitat will result in an adverse impact to habitat critical to the survival of the species. The Project will implement a range of mitigation measures (refer to Section 6) to minimise these impacts, including fencing the majority of the rail corridor to minimise the likelihood of collisions with trains and providing regular suitable crossing structures to maintain connectivity and metapopulation dynamics. Despite this, the Project is considered likely to interfere substantially with the recovery of the species.
Assessment of potential for significant impacts	The Project is likely to result in a significant impact on 769.40 ha of koala breeding and foraging habitat.

7.3.2.11 GREY-HEADED FLYING-FOX (*PTEROPUS POLIOCEPHALUS*)

Grey-headed flying-fox (*Pteropus poliocephalus*) is listed as Vulnerable under the EPBC Act and is known to occur within the Project footprint, due to a direct sighting within the Project footprint. An in-depth description of the species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans can be found in Appendix F Species and Community Profiles.

Impacts and mitigation measures associated with this species are identified within Sections 5 and 6. An assessment against the important population criterion is shown in Table 7-57. An assessment against the significant impact criteria (DoE, 2013a) for the species is presented in Table 7-58

TABLE 7-57 IMPORTANT POPULATION ASSESSMENT – GREY-HEADED FLYING-FOX

Criterion	Assessment against criteria
Key source population for breeding or dispersal	Grey-headed flying-fox is a highly mobile species. There are no separate or distinct populations due to the constant genetic exchange and movement between camps throughout the species' entire geographic range suggesting there is one single interbreeding population (DoE, 2024g). The species is known to occur within the Project footprint, with the species directly recorded at a roost site in Inglewood (3 km from the Project) and within the Project footprint. Additionally, numerous records both recent and historic have been documented adjacent to the Project footprint. Although the species population occurs in a single widespread population, the Project will not directly impact known camps, and the Project footprint contains only a small portion of a very widespread population that is unlikely to be a key source for breeding or dispersal.
Populations that are necessary for maintaining genetic diversity	Due to the mobility of this species, there are no separate and distinct populations of the species, suggesting there is only one single interbreeding population. The Project will not directly impact known camps for the species. The single population is not deemed to be fragmented, and as a result, the population is not considered likely to be

Criterion	Assessment against criteria
	genetically unique and not essential to the maintenance of the species overall genetic diversity.
Populations that are near the limit of the species' range	The Project footprint is located near the western extent of the species' range.
Assessment as an important population	As the Project footprint is located near the western extent of the species' range, it is likely the Project footprint contains an important population.

TABLE 7-58 ASSESSMENT AGAINST THE SIGNIFICANT IMPACT CRITERIA – GREY-HEADED FLYING-FOX

Criteria	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population of the species	Unlikely Grey-headed flying-fox was recorded foraging within the Project footprint during field surveys. Additionally, despite the nearest regularly used grey-headed flying-fox camp being located in Toowoomba, a camp of 500-1,000 individuals was observed in Inglewood, 3 km outside of the Project footprint. An important population has been observed as occurring within the Project footprint. The Project footprint contains 788.39 ha of grey-headed flying-fox foraging habitat, most of which is located within the southern half of the alignment, between from Bringalily State Forest to west of Yelarbon. An additional substantial area of habitat is mapped between Brookstead and Pittsworth. No breeding or roosting habitat (camps) are located within the Project footprint. The Project will clear 788.39 ha of grey-headed flying-fox foraging habitat, however the species is highly mobile and Project impacts are linear in nature, largely following existing linear infrastructure corridors. Large areas of suitable habitat will remain in the surrounding area where the species has also been recorded to occur. The Project will implement mitigation measures to minimise the risk of impacts on the species, including pre-clearance surveys. Additionally, habitat described in the draft recovery plan includes an association with winter flowering tree species located largely in the coastal lowlands of northern NSW and SEQ (i.e., outside the Project footprint, which is in the Brigalow Belt Bioregion). These areas are of particular importance for the species, whereas the Project footprint is likely irregularly utilised. Therefore, it is considered unlikely the Project will lead to a long-term decrease in the size of an important population of grey-headed flying-fox.
Reduce the area of occupancy of an important population	Unlikely The species has a widespread distribution from Rockhampton (QLD) to Melbourne (Vic). The Project footprint contains 788.39 ha of grey-headed flying-fox foraging habitat which will be cleared for the Project. Whilst the Project will clear 788.39 ha, this is within a species range of ~65,000,000 ha, being a 0.001% reduction. Given the species high mobility, widespread distribution and abundant habitat/camps occurring outside of the Project footprint, the Project is considered unlikely to reduce the area of occupancy for an important population of the species.
Fragment an existing important population into two or more populations	Unlikely The species is highly mobile and abundant habitat in the form of foraging habitat and camps occurs outside of the Project footprint. Although the Project infrastructure is linear, it will not prevent movement of individuals throughout the landscape. Therefore, the Project is considered unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to	Unlikely Habitat critical to the survival of the species in Queensland is defined as habitat containing important winter and spring flowering vegetation

Criteria	Assessment against significance criteria
the survival of the species	communities (DAWE, 2021a). Spring foraging resources are critical as these are relied upon during late gestation, birth and early lactation to avoid rapid weight loss in the adults and poor reproductive success (Eby, 1999; Collins, 2000; Parry-Jones & Augee, 2001). Spring food shortages have been reported over large portions of the range in six of the past 20 years, and more frequently in some local areas (Parry-Jones & Augee, 2001; Teagle 2002). The Project footprint contains 788.39 ha of grey-headed flying-fox habitat, including areas of habitat which has potential to contain winter and spring flowering vegetation communities. Whilst the Project will clear 788.39 ha, this is within a species range of ~65,000,000 ha, being a 0.001% reduction. Clearing as a result of the Project is unlikely to result in a spring shortage over a 'large portion of the range'. Therefore, the Project is considered unlikely to adversely affect habitat critical to the survival of the grey-headed flying-fox.
Disrupt the breeding cycle of an important population	Unlikely The grey-headed flying-fox population is considered one single interbreeding population. In Queensland, breeding is largely limited to SEQ (outside of the Project footprint) and there are no known camps within the Project footprint. The nearest camp of 500-1,000 individuals was observed in Inglewood, 3 km outside of the Project footprint. Nationally important camps are defined as those with ' <i>more than 10,000 individuals in more than one year in the last 10 years, or have been occupied by more than 2,500 Grey-headed Flying-foxes permanently or seasonally every year for the last 10 years</i> ' (DAWE, 2021a). The identified camps in surrounding areas do not sustain the required numbers of a 'nationally important' camp. The Project will implement mitigation measures to minimise the risk of impacts on the species, including pre-clearance surveys. Therefore, it is considered unlikely the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The Project footprint contains 788.39 ha of grey-headed flying-fox habitat, including substantial areas of habitat within the southern half of the alignment. The Project is expected to clear all this habitat, however, there is abundant suitable habitat for the species in the area surrounding the Project and the wider region. Additionally, the species is highly mobile and has a widespread distribution from Rockhampton (QLD) to Melbourne (Vic). Project infrastructure is linear and will not prevent the species movement throughout the landscape. Given the species high mobility, widespread distribution and abundant habitat/camps occurring outside of the Project footprint, the Project is considered unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Unlikely As per the species national recovery plan (DAWE, 2021a), grey-headed flying-fox are currently threatened by the predation by feral animals. Feral animals, including foxes (<i>Vulpes vulpes</i>) and cats (<i>Felis catus</i>) are known to occur within the Project footprint. The Project will implement appropriate weed and pest management measures to prevent and minimise the spread of invasive weeds within the Project footprint throughout the clearing, construction and operation phase of the Project. This will be through the implementation of the Biosecurity Management Plans (as components of both the CEMP and Operational EMP). With the appropriate management and mitigation measures applied, it is considered unlikely the Project will result in invasive species that are harmful to the species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely As per the species national recovery plan (DAWE, 2021a), grey-headed flying-fox are known to be natural reservoirs for Australian Bat Lyssavirus, a rabies-like disease, and two paramyxoviruses – Hendra virus and Menangle virus. There is no evidence to suggest that these pathogens are introduced

Criteria	Assessment against significance criteria
	as a result of human / project developments. The Project will incorporate precautionary measures throughout the project lifecycle (e.g., appropriate personal protection equipment (PPE) worn by fauna spotter catcher workers and maintain hygiene protocols to avoid spreading disease between individuals). The Project will also adopt Biosecurity Management Plans (as a components of the both the CEMP and Operational EMP) that will outline appropriate disease management measures to prevent the introduction and spread of diseases as a result of Project activities. As appropriate mitigation measures will be implemented, the Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely The <i>National recovery plan for the Grey-headed flying-fox (Pteropus poliocephalus)</i> (DAWE, 2021a) identifies the following nine recovery objectives for the species: • Identify, protect, and increase native foraging habitat that is critical to the survival of the grey-headed flying-fox; • Identify, protect, and increase roosting habitat of grey-headed flying-fox camps; • Determine trends in the grey-headed flying-fox population so as to monitor the species' national distribution, habitat use and conservation status; • Build community capacity to coexist with flying-foxes and minimise the impacts on urban settlements from new and existing camps while avoiding interventions to move on or relocate entire camps; • Increase public awareness and understanding of grey-headed flying-foxes, the recovery program, and involve the community in the recovery program where appropriate; • Improve the management of grey-headed flying-fox camps in areas where interaction with humans is likely; • Significantly reduce levels of licensed harm to grey-headed flying-foxes associated with commercial horticulture; • Support research activities that will improve the conservation status and management of grey-headed flying-foxes; and • Reduce the impact on grey-headed flying-foxes of electrocution on power lines, and entanglement in netting and on barbed-wire. The Project is expected to clear all 788.39 ha of grey-headed flying-fox foraging habitat within the footprint. This habitat has been considered habitat critical to the survival of the species, however, these areas are not within conservation reserves or areas protected for the species and do not contain camps. Given that these areas have not been protected under the recovery plan, the linear nature of the impact and remaining habitat within the region, these impacts are not considered to substantially interfere with the recovery objectives.
Assessment of potential for significant impacts	The Project is unlikely to result in a significant impact on grey-headed flying-fox.

8. ENVIRONMENTAL OFFSETS

The EPBC Act Offsets Policy states: "Offsets provide environmental benefits to counterbalance the impacts that remain after avoidance and mitigation measures. These remaining, unavoidable impacts are termed 'residual impacts'. For assessments under the EPBC Act, offsets are only required if residual impacts are significant."

An assessment of MNES relevant to the Project has been undertaken in accordance with the significant impact criteria (Section 7) and determined that significant residual impacts are likely to occur for MNES. The significant residual impact to each MNES is presented in Table 8-1.

TABLE 8-1 RESIDUAL SIGNIFICANT IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

MNES	Significant impact determination	Residual significant impact area
Threatened Ecological Communities		
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	Likely	104.50 ha
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	Likely	66.07 ha
White box-yellow box-Blakely's red gum grassy woodland and derived native grassland	Likely	2.54 ha
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions	Unlikely	-
Threatened flora species		
Austral cornflower (<i>Rhaponticum australe</i>)	Unlikely	-
Austral toadflax (<i>Thesium australe</i>)	Unlikely	-
Belson's panic (<i>Homopholis belsonii</i>)	Likely	242.25 ha
Bluegrass (<i>Dichanthium setosum</i>)	Unlikely	-
Hairy-joint grass (<i>Arthraxon hispidus</i>)	Unlikely	-
Hawkweed (<i>Picris evae</i>)	Likely	110.67 ha
King bluegrass (<i>Dichanthium queenslandicum</i>)	Unlikely	-
Small-flowered westringia (<i>Westringia parvifolia</i>)	Likely	27.19 ha
Stream clematis (<i>Clematis fawcettii</i>)	Unlikely	-
Tara wattle (<i>Acacia lauta</i>)	Unlikely	-

MNES	Significant impact determination	Residual significant impact area
Winged peppercress (<i>Lepidium monoplacoides</i>)	Likely	79.86 ha
<i>Xerothamnella herbacea</i>	Likely	11.99 ha
Threatened fauna species		
Australasian bittern (<i>Botaurus poiciloptilus</i>)	Unlikely	-
Australian painted snipe (<i>Rostratula australis</i>)	Likely	7.91 ha
Brigalow woodland snail (<i>Adclarkia cameroni</i>)	Likely	146.72 ha
Collared delma (<i>Delma torquata</i>)	Unlikely	-
Condamine earless dragon (<i>Tympanocryptis condaminensis</i>)	Likely	51.20 ha
Curlew sandpiper (<i>Calidris ferruginea</i>)	Unlikely	-
Dunmall's snake (<i>Furina dunmalli</i>)	Likely	262.69 ha
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	Likely	241.61 ha
Greater glider (southern and central) (<i>Petauroides volans</i>)	Unlikely	-
Grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	Unlikely	-
Koala (<i>Phascolarctos cinereus</i>)	Likely	769.40 ha of breeding and foraging habitat
Murray cod (<i>Maccullochella peelii</i>)	Unlikely	-
Painted honeyeater (<i>Grantiella picta</i>)	Likely	330.66 ha
Regent honeyeater (<i>Anthochaera phrygia</i>)	Unlikely	-
South-eastern long-eared bat (<i>Nyctophilus corbeni</i>)	Likely	301.28 ha of roosting habitat and 394.97 ha of foraging habitat, totalling 696.25 ha
Spotted-tailed quoll (<i>Dasyurus maculatus maculatus</i>)	Likely	259.93 ha of high-quality denning/breeding and foraging habitat and 127.55 ha of low-quality denning/breeding and foraging habitat, totalling 387.48 ha
Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>)	Likely	166.89 ha of breeding habitat and 254.53 ha of foraging habitat, totalling 421.42 ha
Swift parrot (<i>Lathamus discolor</i>)	Unlikely	-
Yakka skink (<i>Egernia rugosa</i>)	Unlikely	-

ARTC's Environmental Offset Delivery Strategy informs the development of offset delivery components for B2G including specific management intent to drive matter specific conservation outcomes across currently secured properties and properties to be secured. Property specific Offset Area Management Plans (OAMPs) will be developed and submitted by ARTC prior to construction commencement subject to approval under the EPBC Act.

The Environmental Offset Delivery Strategy provides the following information:

- An overview of the environmental offset compliance framework, principles and objectives at a Commonwealth and State level;
- An outline of the Project and details the SRIs the Project is predicted to have on MNES matters;
- A summary the offset property selection process, including desktop assessments and the methodology of rapid and detailed field surveys;
- Identification of the offset property portfolio selected for the offset portfolio based on the predicted MNES SRIs and assessment through OAG;
- Specific matters management intent to drive matter specific conservation outcomes across each relevant offset property;
- An outline of the content that will be contained within the property specific OAMPs;
- The options for legally securing additional offset areas; and
- Identification and assessment of the risks associated with delivering environmental offsets and what controls will be put in place to manage these risks.

9. CUMULATIVE IMPACT ASSESSMENT

Cumulative impacts have been assessed using the methodology identified in Section 3.5.4. The assessment was undertaken for all MNES identified as known or likely to occur within the Project footprint.

A number of projects were initially identified as having potential to contribute to ecological cumulative impacts in combination with the Project. These projects are either currently operational, may undergo future expansion or are currently going through an approval process. A full list of projects, with a description of each, is presented in revised draft EIS Chapter 23: Cumulative Impacts. A summary of the projects used for this CIA is presented in Table 9-1 and shown in Figure 9-1.

Cumulative impacts are appropriately considered at a biologically relevant scale. A distance of 50 km from the Project was selected as many of the MNES of relevance to the Project do not occur beyond this area, and if they do occur, any cumulative impacts associated with the Project are not considered to be relevant beyond this extent. Twenty-one projects have been identified for preliminary consideration for their potential to contribute to cumulative impacts, in combination with the Project. Operational projects have been included in the assessment of ecological cumulative impacts due to the potential for such developments to continue to have an ongoing impact on ecological values and processes, for example, through the degradation of adjoining habitats or disturbance of species through noise, operational emissions, light, weed incursion.

The cumulative impacts of multiple projects occurring in the vicinity of the Project will likely include the continued loss of biodiversity in the SEQ and Brigalow Belt Regions and other impacts described in Section 5.

The total impact area of MNES habitat contained within the combined footprint of the 23 projects occurring within the area of influence (AOI) has been quantified and is provided in Table 9-2. The quantitative method of assessment that has been applied establishes a percentage of impact to each MNES as a combined consequence of all projects identified for the cumulative impact assessment. The results of the significance assessment of these cumulative impacts are presented in aggregated form in Table 9-3 (i.e. a level of cumulative impact significance is not attributed for each project).

Unmitigated, the cumulative impacts resulting from existing and proposed developments within the CIA area include some that can be considered irreversible and permanent. Without targeted mitigation measures, the potential cumulative impacts upon MNES within CIA area have been assessed to be low to moderate significance. The potential for cumulative impacts to MNES will be managed through implementation of mitigation measures specified in Sections 6.2 and 6.3 including the following:

- Development and implementation of the following, as components of the CEMP:
 - Biodiversity Management Plan, which will outline the management strategies, actions and controls to be implemented to avoid or minimise potential impacts of the Project during construction.
 - Biosecurity Management Plan, which will outline biosecurity risks associated with the construction of the Project and the processes that are to be used to manage those risks.

- Soil Management Plan, which provides procedures and protocols for the management of potential impacts on land resources during construction. The Soil Management Plan will include soil conservation measures and erosion and sediment controls with specific reference to identified habitat for threatened flora (where they are found to occur).
- Waste Management Plan, which will outline the management strategies, actions and controls to be implemented to avoid or minimise the waste created by the Project during construction. This Plan will be underpinned by the *2018 National Waste Policy* and *Waste Reduction and Recycling Act 2011* (Qld) waste and resource management hierarchy, and
- Rehabilitation and Landscaping Management Plan, which will be based on the Inland Rail Landscape and Rehabilitation Strategy, Inland Rail Landscape and Rehabilitation Framework and location-specific reinstatement commitments and will outline the requirements for rehabilitate the areas within the temporary Project footprint that are for use during construction phase only. This Plan will be developed in consultation with local councils and affected communities, including Traditional Owners.
- Finalisation and implementation of the Draft Koala Management Plan and Draft Threatened Species Fauna Management Plan which provide detailed management direction for koala and listed threatened fauna.
- Consultation with owners/operators of adjoining projects regarding the compatibility/comprehensiveness of management measures for the Project with their developments to achieve positive ecological outcomes.
- Refinement of the Project footprint through detailed design to reduce the extent of disturbance to MNES to that required to enable safe and efficient construction, operation, and maintenance of the Project.
 - Detailed surveys will be undertaken during the detailed design phase to inform modifications to the Project footprint that may be required to reduce impacts to MNES (or their habitat). Where MNES are found to occur, condition assessment will be undertaken (using BioCondition assessment).
- Should MNES (or their habitat) be retained within the Project footprint, annual monitoring will be undertaken against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified.
- Delivery of offsets for significant residual impacts to MNES due to the Project in accordance with the EPBC Act.

TABLE 9-1 PROJECTS TO BE INCLUDED IN CUMULATIVE IMPACT ASSESSMENT

Projects	Location	Description	Status	Construction dates	Operational years
Wetalla Water Pipeline	From the Wetalla Wastewater Reclamation Facility in Toowoomba to the New Acland coal mine, 35 km northwest of the city. Adjacent to Ch 210.48 km of the Project	A 45 km underground water pipeline to supply up to 5,500 megalitres of treated wastewater to the New Acland coal mine.	EIS approved with conditions in 2008. The Wetalla Water Pipeline is completed and operational.	2010 to 2013	Ongoing
Wagners Intermodal Terminal	Wellcamp Airport, Queensland East of Ch 196.00 km of the Project	Major freight terminal, designed to benefit the freight network and future Inland Rail. The terminal will be 24/7 facility, designed to operate 78,000 containers for almost 400 freight customers. Utilising approximately 150 locomotives and 1,500 wagons. Unique features of Wagners Intermodal terminal are a 2.7 km frontage for 1,800 m freight trains, a daily-use fully licensed and bonded international air cargo terminal and reach up to 500,000 containers capacity by 2040.	Construction	Unknown	Ongoing Karara, Queensland 40 km east of Ch 80.00 km of the Project, 10 km south of Karara
New Acland Coal Mine Stage 3	35 km northwest of Toowoomba	Expansion of the existing New Acland open-cut coal mine to up to 7.5 Mtpa.	EIS approved with conditions. Q4 2021, QLD Court recommends environmental	The mine is operational. Potential for Stage 3 expansion works.	Sequential development of resource areas expected to extend

Projects	Location	Description	Status	Construction dates	Operational years
	18 km north of Ch 210.48 km of the Project.		conditions be reassessed.		coal production until 2042.
Australia Pacific LNG Project	Walloons gas fields (approximately 20 km west of Millmerran) 13 km west of the Project footprint	Integrated liquefied natural gas (LNG) project. The Walloons gas fields, located to the west of the Project, supplies Coal Seam Gas to support the LNG Facility on Curtis Island.	EIS approved with conditions in 2011. Operational but subject to continued expansion.	Project started operation in 2015, but subject to continual gas field development	Expected project life of 30 years.
Toowoomba Bypass (formerly the Toowoomba Second Range Crossing)	The 41 km-long bypass route extends from the Warrego Highway at Helidon Spa in the east to the Gore Highway at Athol in the west, via Charlton. 1 km to south and east of Ch 126.00 km of the Project.	This bypass takes heavy vehicle through-traffic around the north of Toowoomba	Operational	2015 to 2019	Ongoing
InterLinkSQ	13 km west of Toowoomba Adjacent to south of Ch 210.48 km of the Project.	A 200 ha transport, logistics and business hub. Located on the narrow gauge regional rail network and interstate network. Located at the junction of the Gore, Warrego, and New England Highways.	Under construction	Commenced May 2022 and will continue development until Inland Rail is operation in 2028	Ongoing
Toowoomba Wellcamp Airport	Wellcamp, Queensland 1 km east of the Project footprint	Airport servicing Toowoomba, promoting interstate, intrastate and international connection for the Darling Downs, Granite Belt, Surat Basin and Southern Downs regions.	Operational	2013 to 2014	Ongoing

Projects	Location	Description	Status	Construction dates	Operational years
Wellcamp Business Park	Wellcamp, Queensland 1.5 km east of Ch 196.00 km of the Project.	A 500 ha industrial and commercial park that forms part of the Toowoomba Enterprise Hub. The Business Park is located in close proximity to the Toowoomba Wellcamp Airport and other major transportation infrastructure.	Operational	2016 to 2018	Ongoing
Witmack Industry Park and Charlton Logistics Park	Wellcamp, Queensland 3 km southeast of Ch 200.00 km of the Project (Witmack Industry Park) Charlton, Queensland 3 km south of Ch 200.00 km of the Project (Charlton Logistics Park)	The Witmack Industry Park is a large industrial land development that offers large size industrial land parcels. Businesses situated within the Witmack Industrial Park include the Toowoomba Pulse Data Centre. The Charlton Logistics Park is part of the Toowoomba Enterprise Hub and provides fully serviced 2 ha sites and is well situated for potential transport and logistics operators due to its proximity to transport infrastructure.	Operational	2016 to 2018	Ongoing
Asterion Medicinal Cannabis Project	Wellcamp, Queensland Adjoins the Project footprint 1 km south of Toowoomba-Cecil Plains Road, east of Ch 196.00 km of the Project	A high-tech medicinal cannabis cultivation, research, and manufacturing facility. The project involves construction of a 40 ha glasshouse to produce 20,000 plants per day at full capacity. Medicinal grade cannabis grown at the facility will be manufactured into a range of medicinal products,	Approved	Unknown	Ongoing

Projects	Location	Description	Status	Construction dates	Operational years
		including single patient packs, cannabis oils, gels, salts and related products, destined solely for the medicinal market. This facility is anticipated to be the largest facility of its kind in the world. Major Project status granted 14 July 2020			
Commodore Mine and Millmerran Power Station	Domville, Queensland Intersects the Project, located at approximately Ch 122.00 km, primarily to the east.	The Commodore Mine is an open cut coal mine which provides coal for the 850 Mega Watts Millmerran Power Station (Mininglink, 2018). The Millmerran Power Station is a coal-fired power station that supplies enough electricity to power approximately 1.1 million homes (Power Technology, 2018)	Operational	Ongoing to 2056	Ongoing
Pittsworth Industrial Precinct and Enabling Project	Pittsworth, Queensland 500 m to south of the Project footprint, west of Ch 160.00 km of the Project.	Road and sewerage infrastructure upgrades at the Pittsworth Industrial Precinct to allow for industrial land for industries servicing agriculture and the wider region.	Operational	2017 to 2019	Ongoing
Doug Hall Poultry	Millmerran, Queensland Intersects the Project footprint, located primarily to north-west of Ch 138.00 km of the Project.	Poultry farming operation with capacity of approximately 20,000 chickens. Operations include egg grading, a feedmill with output of 1,500 tonnes per week, piggery, cropping and solar farm.	Operational	N/A	Ongoing

Projects	Location	Description	Status	Construction dates	Operational years
Yarranbrook Feedlot	Whetstone, Queensland Intersects the Project footprint, located predominantly to north	Cattle feedlot licenced for 25,000 head.	Operational	N/A	Ongoing
Sapphire Feedlot	Kildonan, Queensland Adjacent to south of the Project at Ch 10.00 km.	Cattle feedlot which currently has a 6,000 head capacity, which expanded to 20,000 head in 2020.	Operational	2018 to 2020	Ongoing
Wyemo Piggery	Glenarbon, Queensland 8 km south of Ch 30.00 km of the Project footprint	Piggery with approval for 55,000 pig units.	Approved with conditions by GRC	Not yet publicly released	Ongoing once complete
Yarranlea Solar	Yarranlea, Queensland Intersects the Project footprint, located Ch 163.5 km at Yarranlea Road, Yarranlea	Solar Farm Stage 1 will span over 250 ha area consisting of 360,000 solar panels. Projected to have a generation capacity of up to 100 Mega Watts once completed.	Operational	2018 to 2019	Ongoing
MacIntyre Wind Farm	Karara, Queensland 40 km east of Ch 80.00 km of the Project, 10 km south of Karara	The Wind Farm Precinct will span approximately 40,000 hectares (ha), predominantly built on sheep farming land. The MacIntyre Wind Farm is expected to generate 1,026 megawatts (MW), using up to 120 turbines.	Construction	2022 to 2024	>30 years
Goondiwindi Abattoir	Goondiwindi, Queensland 19 km northwest of Ch 1 km of the Project.	A new beef Abattoir located on the outskirts of Goondiwindi with beef processing of up to 72,000 tonnes per year.	Approved with conditions by GRC	Not yet publicly released	Unknown

Projects	Location	Description	Status	Construction dates	Operational years
Narribri to North Star Project (Inland Rail)	Rail alignment from Narribri to North Star, NSW. Adjoins the North Star to NSW/QLD Border (Inland Rail).	Upgrade of 189 km of existing rail corridor and construct 2 km of new track to connect Narribri to North Star (NSW).	Phase 1- Commissioning and Operations Phase 2 – Environmental Approvals	Phase 1 2021 to 2023 ¹ Phase 2 2024 to 2027 ¹	>100 years
North Star to NSW/QLD Border (Inland Rail)	Rail alignment from North Star, NSW to the NSW/QLD border Adjoins the Project footprint at the southern end of the Project, located at the NSW/QLD border.	New 37 km rail corridor to connect North Star (NSW) to the QR South West Rail Line just over the NSW/QLD border.	Reference design and EIS	2024 to 2028 ¹	>100 years
Gowrie to Helidon Project (Inland Rail)	Rail alignment from Gowrie to Helidon, Queensland Adjoins the Project footprint at the northern point of the Project, located at Ch 210.48 km.	New 26 km dual gauge track between Gowrie (north-west of Toowoomba) and Helidon (east of Toowoomba), extending through the Local Government Areas of Toowoomba and Lockyer Valley. The project includes a 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.	Reference design and EIS	2024 to 2028 ¹	>100 years
Helidon to Calvert (Inland Rail)	Rail alignment from Helidon to Calvert, Queensland 26 km east of the Project footprint	New 47 km dual gauge rail line connecting Helidon (east of Toowoomba) with Calvert (near Ipswich), via Placid Hills, Gatton, Forest Hill, Laidley, and Grandchester, extending through the Local Government Areas of Lockyer Valley and Ipswich City. The project includes a	Reference design and EIS	2024 to 2028 ¹	>100 years

Projects	Location	Description	Status	Construction dates	Operational years
		1.1 km tunnel to create an efficient route through the steep terrain of the Little Liverpool Range.			

Note: 1 Construction dates for Inland Rail projects have been assumed for the purposes of the assessment

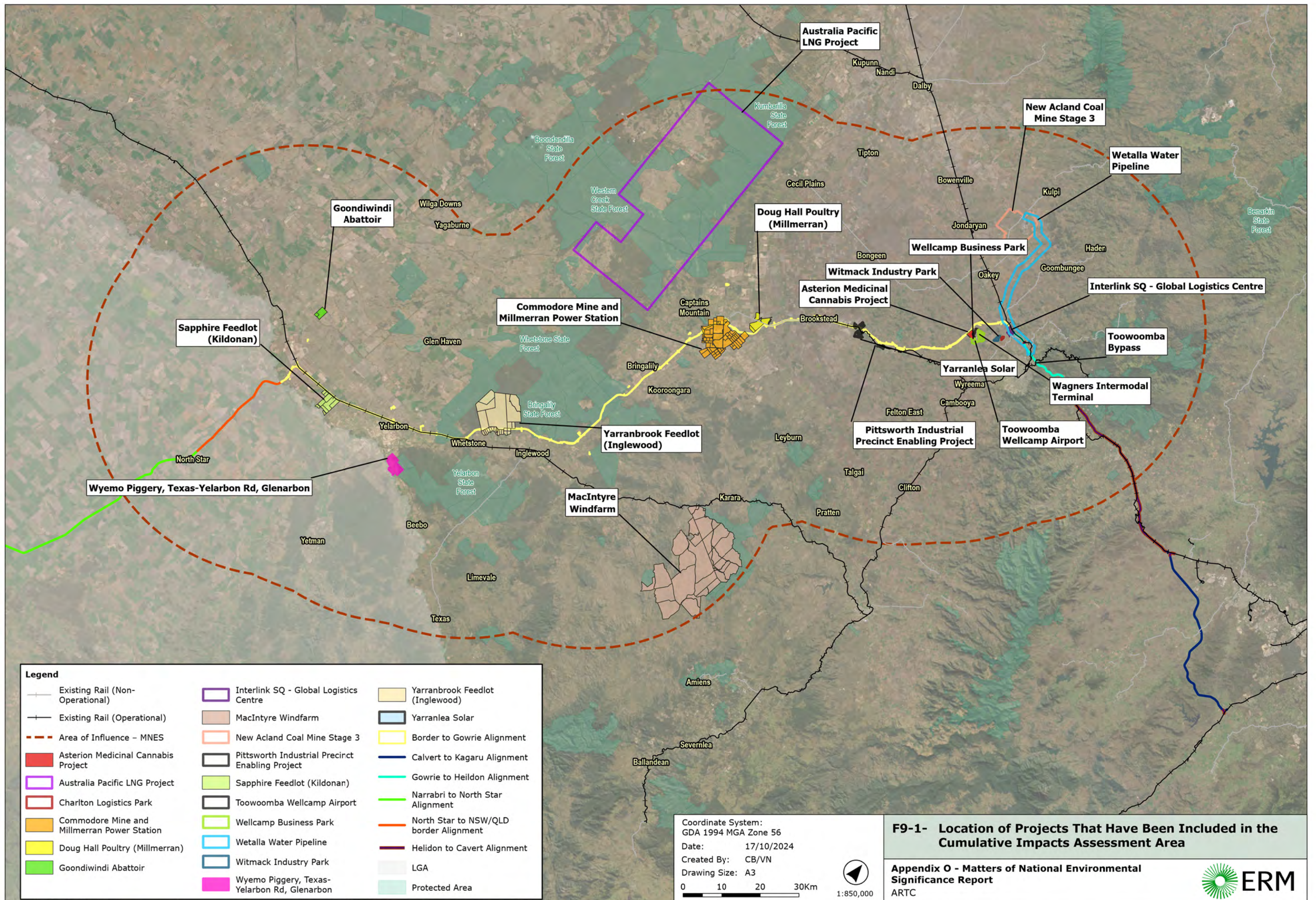


TABLE 9-2 CUMMULATIVE IMPACTS AS CALCULATED WITHIN THE FLORA AND FAUNA AREA OF INFLUENCE

MNES	Occurrence in the AOI area (50 km) (ha) ¹	Occurrence in the footprint of all projects in AOI area (excluding the Project footprint) (ha)	Occurrence in the Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
TECs							
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	21,457.68	729.23	103.69	832.92	3.88	0.48	Low
Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	2,721.27	308.45	66.07	374.52	13.76	2.43	Low
Semi-evergreen vine thicket within the Brigalow Belt (north and south) and Nandewar bioregions (SEVT)	2,073.39	73.08	0.00	73.08	3.52	0.00	Low
White box-yellow box-Blakely's red gum grassy woodland and derived native grassland	115,393.38	26.66	2.54	29.20	0.03	0.00	Low
Threatened flora habitat							
King bluegrass (<i>Dichanthium queenslandicum</i>)	40,161.13	908.71	50.31	959.02	2.39	0.13	Low
Belson's panic (<i>Homopholis belsonii</i>)	76,372.56	7,593.34	260.52	7,853.86	10.28	0.34	Low
Winged peppercress (<i>Lepidium monoplacoides</i>)	224,744.96	59,510.29	79.86	59,590.15	26.51	0.04	Low
Hawkweed (<i>Picris evae</i>)	231,977.32	35,564.49	110.67	35,675.16	15.38	0.05	Low
Austral cornflower (<i>Rhaponticum australe</i>)	51,370.32	2,244.33	83.49	2,327.82	4.53	0.16	Low
Austral toadflax (<i>Thesium australe</i>)	49,881.87	1,091.90	46.44	1,138.34	2.28	0.09	Low
Small-flowered westringia (<i>Westringia parvifolia</i>)	960.91	0.00	27.19	27.19	2.83	2.83	Low
<i>Xerothamnella herbacea</i>	17,272.17	654.69	11.99	666.68	3.86	0.07	Low
Threatened fauna habitat							
Birds							
Australasian bittern (<i>Botaurus poiciloptilus</i>)	47,239.09	547.46	7.91	555.37	1.18	0.02	Low
Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>)	19,832.41	1,026.00	421.42	1,447.42	7.30	2.12	Low
Painted honeyeater (<i>Grantiella picta</i>)	30,624.83	178.93	330.66	509.59	1.66	1.08	Low
Australian painted snipe (<i>Rostratula australis</i>)	47,386.54	547.46	7.91	555.37	1.17	0.02	Low
Fish							
Murray cod (<i>Maccullochella peelii</i>)	20,899.39	101.47	60.50	161.97	0.77	0.29	Low
Mammals							

MNES	Occurrence in the AOI area (50 km) (ha) ¹	Occurrence in the footprint of all projects in AOI area (excluding the Project footprint) (ha)	Occurrence in the Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
South-eastern long-eared bat (<i>Nyctophilus corbeni</i>)	386,856.92	88,063.03	696.25	88,759.28	22.94	0.18	Low
Koala (<i>Phascolarctos cinereus</i>)	284,426.65	33,849.54	1,362.53	35,212.07	12.38	0.48	Low
Grey-headed flying-fox (<i>Pteropus poliocephalus</i>)	804,185.50	17,672.78	788.39	18,461.17	2.30	0.10	Low
Reptiles							
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	40,247.30	2048.44	241.61	2,290.05	5.69	0.60	Low
Collared delma (<i>Delma torquata</i>)	273,942.02	8,243.10	36.83	8,279.93	3.02	0.01	Low
Dunmall's snake (<i>Furina dunmalli</i>)	57,552.21	7,921.64	262.69	8,184.33	14.22	0.46	Low
Condamine earless dragon (<i>Tympanocryptis condaminensis</i>)	58,139.65	2,419.50	51.20	2,470.70	4.25	0.09	Low
Invertebrates							
Brigalow woodland snail (<i>Adclarkia cameroni</i>)	150,415.22	2,218.55	146.72	2,365.27	1.57	0.10	Low

Table notes:

Low magnitude = if either project contribution of less than 2 per cent OR an overall cumulative impact of <10 per cent.

Medium magnitude = if either project contribution of 2 - 20 per cent OR an overall cumulative impact of 10-20 per cent.

High magnitude = if either project contribution of >20 per cent OR an overall cumulative impact of >20 per cent.

TABLE 9-3 SIGNIFICANCE ASSESSMENT OF IMPACTS WITHIN THE AREA OF INFLUENCE

MNES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
TECs							
• Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) • Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland • Semi-evergreen vine thicket within the Brigalow Belt (north and south) and Nandewar bioregions (SEVT) • White box-yellow box-Blakely's red gum grassy woodland and derived native grassland	• Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium
	• Edge effects • Habitat fragmentation • Barrier effects • Reduction in connectivity of biodiversity corridors	1	2	1	3	7	Medium
	• Fauna species injury or mortality	1	1	1	3	6	Low
	• Dust and light and contaminant disturbance	1	1	1	3	6	Low
	• Increase in litter (waste)	1	1	1	3	6	Low
	• Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium
	• Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low

MNES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
Threatened flora and fauna species							
Flora - King bluegrass (<i>Dichanthium queenslandicum</i>) - Belson’s panic (<i>Homopholis belsonii</i>) - Winged peppergrass (<i>Lepidium monoplocoides</i>) - Hawkweed (<i>Picris evae</i>) - Austral cornflower (<i>Rhaponticum australe</i>) - Austral toadflax (<i>Thesium australe</i>) - Small-flowered westringia (<i>Westringia parvifolia</i>) <i>Xerothamnella herbacea</i>	Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium
	- Edge effects - Habitat fragmentation - Barrier effects - Reduction in connectivity of biodiversity corridors	2	2	1	3	8	Medium
	Fauna species injury or mortality	1	1	1	3	6	Low
	Dust and light and contaminant disturbance	1	1	1	3	6	Low
	Increase in litter (waste)	1	1	1	3	6	Low
	Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium
	Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low
Fauna - Australasian bittern (<i>Botaurus poiciloptilus</i>) - Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>) - Painted honeyeater (<i>Grantiella picta</i>) - Australian painted snipe (<i>Rostratula australis</i>) - Murray cod (<i>Maccullochella peelii</i>) - South-eastern long-eared bat (<i>Nyctophilus corbeni</i>) - Koala (<i>Phascolarctos cinereus</i>) - Grey-headed flying-fox (<i>Pteropus poliocephalus</i>) - Five-clawed worm-skink (<i>Anomalopus mackayi</i>) - Collared delma (<i>Delma torquata</i>) - Dunmall's snake (<i>Furina dunmalli</i>) - Condamine earless dragon (<i>Tympanocryptis condaminensis</i>) - Brigalow woodland snail (<i>Adclarkia cameroni</i>)							

Table notes:

- Table 3-8 defines the consequences of the impact significance ratings, as follows:

Low (sum of relevance factors = 1 to 5): Negative impacts need to be managed by standard environmental management practices. Special approval conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program.

Medium (sum of relevance factors = 6 to 9): Mitigation measure likely to be necessary and specific management practices to be applied. Specific approval conditions are likely. Targeted monitoring program required.

High (sum of relevance factors = 10 to 12): Alternative actions would be considered and/or mitigation measures applied to demonstrate improvement. Specific approval conditions required. Targeted monitoring program necessary.

Following the cumulative impact assessment, all MNES were assessed as having a 'low' magnitude of disturbance (refer to Table 9-2), with impacts to be managed by standard environmental management practices, and monitoring to be part of the general Project monitoring program. No MNES were assessed as having a 'medium' or 'high' magnitude of disturbance.

Impacts with the potential to cause a 'medium' significant impact, as per Table 9-3, include:

- Habitat loss from vegetation clearing/removal;
- Habitat fragmentation;
 - Edge effects;
 - Barrier effects; and
 - Reduction in connectivity of biodiversity corridors.
- Reduction in biological viability of soil to support growth due to soil compaction;

These impacts will be managed through implementation of mitigation measures outlined in Section 6.2 and 6.3

No MSES were assessed as having a 'high' significant impact.

10. CONCLUSION

In February 2018, the Project was referred to the Australian Minister for the Environment (EPBC 2018/8165) for a controlled action decision under the EPBC Act. On 9 April 2018, the Australian Minister for the Environment declared the Project a controlled action requiring the preparation of an EIS under the bilateral agreement with the Queensland Government. The controlling provisions for the Project are listed threatened species and communities.

This MNES assessment has been prepared in accordance with Sections 11.1 to 11.35 of the *Terms of Reference for an environmental impact statement: Inland Rail - Border to Gowrie project* issued in November 2018 by the Queensland Coordinator-General. It has been prepared as a stand-alone document that assesses potential significant impacts on threatened species and communities listed under the EPBC Act during construction and operation of the Project.

Field surveys of the Project footprint have confirmed the presence of four TECs and habitat for eight threatened flora and 11 threatened fauna species. These matters are either known or likely to occur within the Project footprint. Habitat was also confirmed for an additional four threatened flora and six threatened fauna species that have the potential to occur within the Project footprint.

The construction and operation of the Project has the potential to impact on MNES due to the following activities and processes:

- Habitat loss and degradation from vegetation clearing/removal;
- Fauna species injury or mortality;
- Reduction in biological viability of soil to support growth due to soil compaction;
- Introduction and spread of weeds, pathogens and pest species;
- Habitat fragmentation;
 - Loss of connectivity in biodiversity corridors;
 - Barrier effects;
 - Edge effects;
- Noise, dust, and light;
- Waste management;
- Aquatic habitat degradation;
- Altered hydrology and flooding;
- Erosion and sedimentation;
- Changes to groundwater resources;
- Clearing of riparian vegetation;
- Modification of aquatic habitats;
- Waterway barrier effects;
- Altered hydrology; and
- Water quality degradation.

Development of the revised reference design has progressed in parallel with the impact assessment process. Consequently, design solutions for avoiding, minimising or mitigating

impacts have been incorporated into the revised reference design as appropriate and where possible. Understanding of the mitigations and controls incorporated into the revised reference design process was combined with the sensitivity of ecological values and the magnitude of the potential impact to determine the significance of potential impacts from the Project.

The proposed mitigation measures for future stages of the Project were considered to reduce the significance of the potential impacts upon the listed threatened species and communities. Project mitigation measures include:

- Refining the Project footprint to reduce MNES impacts as far as reasonably practical during detailed design;
- Development and implementation of the following plans and sub-plans:
 - Construction Environmental Management Plan (CEMP) in accordance with the Australian Government's Environmental Management Plan Guidelines (DCCEEW, 2024c) to detail how the performance, commitments and mitigation measures for the Project will be implemented and achieved during all stages of construction, including the following relevant Plans:
 - CEMP Biodiversity Management Plan which outlines the management strategies, actions and controls to be used to avoid or minimise potential impacts of the Project during construction;
 - Wildlife Connectivity Plan which includes fauna movement features to reduce barrier effects associated with the Project and enable fauna passage across the Project footprint;
 - CEMP Rehabilitation and Landscaping Management Plan which will detail actions needed to rehabilitate the areas within the temporary Project footprint that are for use during construction phase only;
 - CEMP Soil Management Plan which provides procedures and protocols for the management of potential impacts on land resources during construction;
- Finalisation and implementation of the Draft Koala Management Plan and Draft Fauna Management Plan which provide detailed management direction for koala and listed threatened fauna.

Following the implementation of a range of measures including avoidance, minimisation and mitigation, the significance of potential residual impacts was determined in accordance with the *Significant Impact Guidelines* (DoE, 2013a). As a result of this assessment, it is predicted that significant residual impacts are likely to occur to:

- Brigalow (Acacia dominant and co-dominant) TEC;
- Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland TEC;
- White box-yellow box-Blakely's red gum grassy woodland and derived native grassland TEC;
- Winged peppergrass;
- *Xerothamnella herbacea*;
- Belson's panic;
- Hawkweed;
- Small-flowered westringia;

- Australian painted snipe;
- Condamine earless dragon;
- Brigalow woodland snail;
- Spotted-tailed quoll;
- Squatter pigeon (southern);
- Painted honeyeater;
- Koala;
- South-eastern long-eared bat;
- Dunmall's snake; and
- Five-clawed worm-skink.

The primary reason for these significant residual impacts is the loss of habitat as a result of the Project.

Predicted cumulative impacts within 50 km of the Project may potentially include habitat loss from vegetation clearing/removal, fauna species injury or mortality, reduction in biological viability of soil to support growth due to soil compaction, displacement of flora and fauna species due to invasion of weeds and pest species, reduction in connectivity of biodiversity corridors, edge effects, habitat fragmentation, barrier effects, noise, dust, and light impacts and increase in litter (waste) and aquatic habitat degradation. The significance of the predicted cumulative impact as a result of the Project and other similar projects has been found to be medium for:

- Reduction in biological viability of soil to support growth due to soil compaction;
- Habitat loss from vegetation clearing/removal;
- Edge effects;
- Habitat fragmentation;
- Barrier effects; and
- Reduction in connectivity of biodiversity corridors.

Whilst all other potential impacts were assessed as having a 'low' significant impact.

The MNES identified to be impacted by the Project will be subject to further investigations and surveys during the detailed design phase to more accurately determine the magnitude of the significant impacts on the listed threatened species and communities. Specific mitigation measures will then be applied to reduce the significance ratings of any potential impacts as much as is reasonably practicable.

The Project will result in significant residual impacts on MNES, even after the implementation of all mitigation measures, including rehabilitation. Therefore, environmental offsets will be required for the Project. Offsets will be provided in accordance with requirements of the EPBC Act and relevant policies.

A Project specific Environmental Offset Delivery Strategy has been developed which informs the development of offset delivery components for the Project including specific management intent to drive matter specific conservation outcomes across currently secured offset properties and additional properties to be secured. Property specific OAMPs will be prepared and submitted for approval prior to construction works commencing.

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APPENDIX

O

Matters of National Environmental Significance Report

Appendix A Additional ecological investigations post submission of the draft EIS

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

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Glossary of Terms

Acronym	Description
ALA	Atlas of Living Australia
ARTC	Australia Rail Track Corporation
AU	Assessment Unit
B2G	Border to Gowrie
BC	BioCondition
Bonn	Bonn Convention. The convention on the conservation of migratory species
Brigalow TEC	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) Threatened Ecological Community
BS Act	<i>Biosecurity Act 2014</i> (Qld)
CAMBA	China-Australia Migratory Bird Agreement
cm	Centimetres
CR	Critically endangered
CWD	Coarse woody debris
DA	Desktop assessment
DAWE	Department of Agriculture, Water and the Environment (Commonwealth) (Former now DCCEEW)
DBH	Diameter at breast height
DCCEEW	Department of Climate Change,
DES	Department of Environment and Science (Qld)
DEE	Department of Environmental and Energy (Commonwealth)
DoR	Department of Resources (Qld)
E	Endangered
EIS	Environmental Impact Statement
EP Act	<i>Environmental Protection Act 1994</i> (Qld)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
FFJV	Future Freight Joint Venture
GIS	Geographic Information System
GTDTHQ	Guide to Determining Terrestrial Habitat Quality (Version 1.3; DES 2020)
HVR	High Value Regrowth
JAMBA	Japan-Australia Migratory Bird Agreement
km	Kilometres
KRAM	Koala Rapid Assessment Method
LC	Least concern
m	Metres
MLES	Matter of Local Environmental Significance
MNES	Matter of National Environmental Significance
MSES	Matter of State Environmental Significance

Acronym	Description
Natural grasslands TEC	Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland Threatened Ecological Community
NC Act	<i>Nature Conservation Act 1992</i> (Qld)
NJKHT	Non-juvenile Koala Habitat Tree
PKADA	Priority Koala Assessable Development Area
Planning Act	<i>Planning Act 2016</i> (Qld)
PMST	Protected Matters Search Tool (Commonwealth)
Poplar box TEC	Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community
QA	quaternary
RE	Regional Ecosystem
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SEVT TEC	Semi Evergreen Vine Thicket Threatened Ecological Community
SLC	Special Least Concern
sp.	Species (singular)
spp.	Species (plural)
SPP	State Planning Policy
SPRAT	Species Profile and Threats Database (Commonwealth)
sub sp.	Sub species
TEC	Threatened Ecological Community
ToR	Terms of Reference
V	Vulnerable
VM Act	<i>Vegetation Management Act 1999</i> (Qld)
White box TEC	White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands Threatened Ecological Community

1 Executive summary

This ecology report for the Border to Gowrie (B2G) section of the Inland Rail Project, details the additional terrestrial ecological surveys undertaken by Ausecology to map Regional Ecosystems and record habitat assessment data. All of survey work was undertaken in consideration of Matters of National Environmental Significance (MNES) under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Matters of State Environmental Significance (MSES) outlined under the *Queensland Environmental Offsets Regulation 2014* and Matters of Local Environmental Significance (MLES). It should be noted that MLES were covered under both MNES and MSES and have not been considered further in this report.

Desktop assessments researched information from available environmental databases, literature reviews and previous studies and reports to evaluate the terrestrial ecological values within and surrounding the B2G Project footprint. Desktop assessments were verified with field surveys undertaken by Ausecology in accordance with relevant Commonwealth and State guidelines. These field surveys were primarily focused on detailed Regional Ecosystem (RE) mapping and collecting habitat assessment data across the B2G Project footprint, an area of approximately 3,139 ha spanning 218 km.

In total, 23 REs were ground-truthed within the B2G Project footprint, comprising four 'Endangered' REs and eight 'of concern' REs under the *Queensland Vegetation Management Act 1999*.

Five Threatened Ecological Communities (TECs) listed under the EPBC Act were ground-truthed within the B2G Project footprint, namely:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC (Brigalow TEC)
- Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland (Natural Grasslands TEC)
- Poplar Box Grassy Woodland on Alluvial Plains TEC (Poplar Box TEC)
- Semi-Evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC)
- White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands TEC

2 Introduction

2.1 Project overview

The Australian Government selected the Australian Rail Track Corporation (ARTC) to deliver the Inland Rail Project. ARTC is currently seeking project approval for the Inland Rail Border to Gowrie (B2G) section of the Inland Rail Project. This section comprises approximately 176 km of new dual gauge track and 78 km of upgraded track from the New South Wales/Queensland border to Gowrie - northwest of Toowoomba. In March 2018, the Queensland Coordinator-General declared the B2G section a 'coordinated project', under the *State Development and Public Works Organisation Act 1971* triggering the requirement for an Environmental Impact Statement (EIS) to be prepared. As part of this approvals process, impacts to Matters of National, State and Local Environmental Significance (MNES, MSES and MLES) require assessment. The Minister for the Environment determined the Project a 'controlled action' on 9 April 2018, requiring assessment and approval under the EPBC Act. The controlling provision for the controlled action is 'Listed threatened species and communities.'

2.2 Project location and description

The B2G section runs from the NSW/QLD border through to Gowrie, north of Toowoomba (Figure 2-1). The area is situated in the Brigalow Belt South bioregion and includes extensive areas of agricultural land historically cleared for pastures and cropping. The eastern section of the alignment crosses through the Condamine River floodplain and the western section runs along the edge of the Whetstone and Bringalily State Forests.

2.3 Objectives

Ausecology was engaged by ARTC to undertake additional ecological assessments for terrestrial ecology along the B2G footprint to complete the mapping of the extent and condition of vegetation communities across the B2G footprint and undertake habitat assessments for flora and fauna matters using detailed habitat scoring metrics for targeted species. Note no targeted flora and fauna surveys were undertaken as part of this work as these have previously been completed (Appendix C).

2.4 Previous survey efforts

Ecological assessments were first undertaken for the B2G section by Eco Logical Australia (2016) to inform the Initial Advice Statement. Future Freight Joint Venture (FFJV) (2018-2019) and Eco Logical Australia (2018-2019) undertook assessments to support the Terrestrial Ecology technical report (and geotechnical investigations) and Aquatic Ecology technical report, respectively. An additional ecological assessment, including targeted flora and fauna surveys, was undertaken by Cardno to provide a more accurate understanding of the ecology through the B2G section (2020-2021). Note the Cardno report is included as Appendix C.

2.5 This report

The report provides the results of GTRE mapping in the B2G Project footprint to further inform the approvals process.

2.6 Staff qualifications

All senior ecologists that undertook the ground surveys are suitably qualified ecologists. Ausecology ecologists collectively have extensive experience with the Regional Ecosystems that could potentially be present within the survey area.

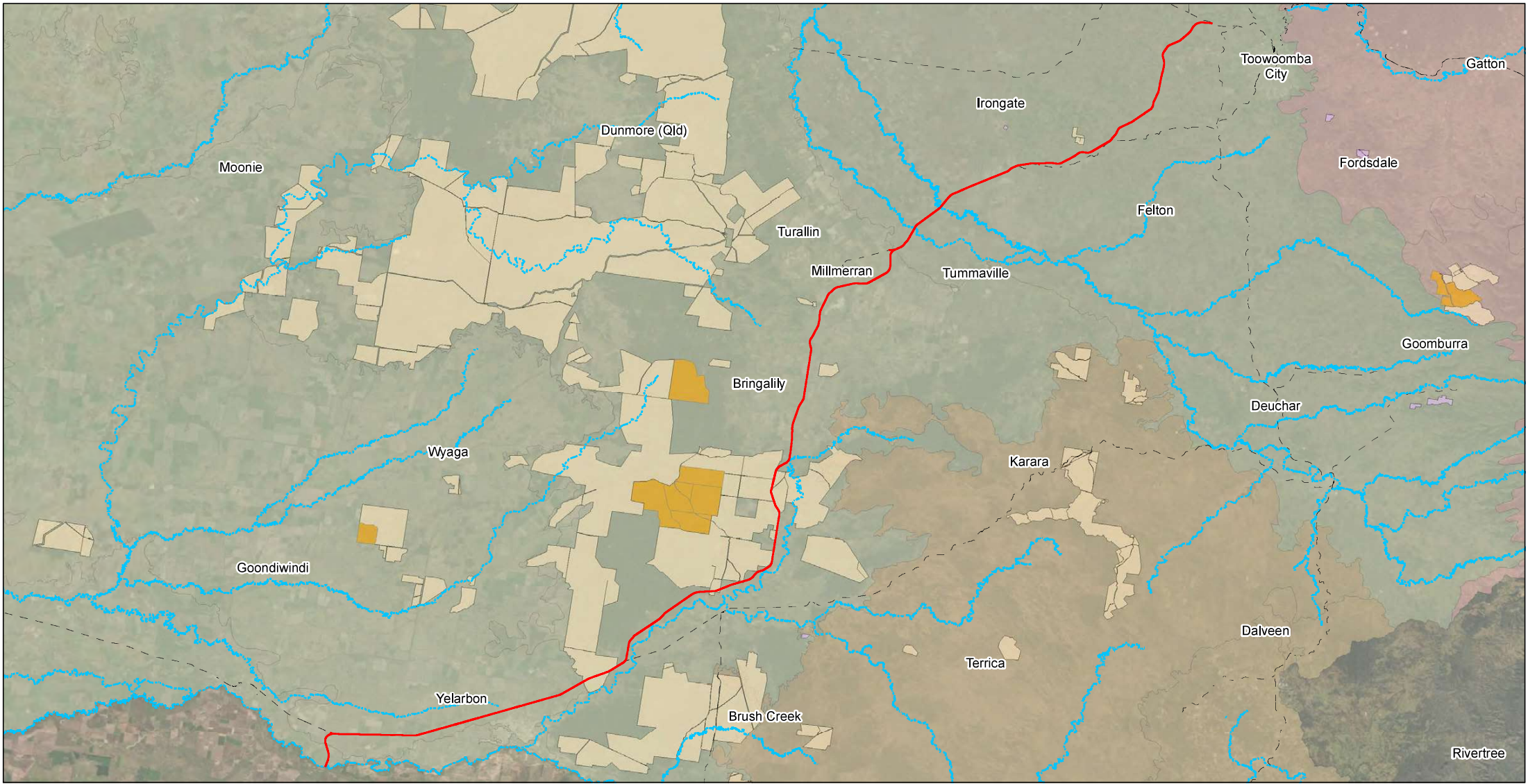
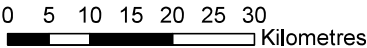




Figure 2-1 - Overview map
ARTC - B2G Alignment



Scale 1:650,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

Legend

— B2G Alignment

- - - Rail_network

Major Watercourse Lines

Protected Area Type

National Park

State Forrest

Conservation Park

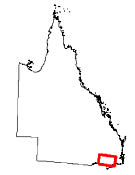
Bioregion Name

Brigalow Belt

New England Tableland

Southeast Queensland

Data Sources:
State of Queensland Department of Resources
Rail Network
State of Queensland Department of Environment
Major watercourse lines
Bioregion Boundary
Protected Areas
Australian Bureau of Statistics
Australian Statistical Geography Standard (ASGS) Edition 3:
Suburb Labels
ARTC
Alignment



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3 Desktop assessment results

3.1 Matters of National Environmental Significance

3.1.1 Threatened Ecological Communities

A total of eight TECs may occur within the B2G Project footprint based on the results of the desktop assessment and supported by the QLD Regional Ecosystem (RE) mapping (Table 3-1).

Table 3-1 Threatened Ecological Communities identified from the desktop assessment

Threatened Ecological Community	EPBC Listing Status	Source
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) ecological community	Endangered	PMST; EIS ;Terms of Reference (ToR)
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	PMST; EIS; ToR
Lowland Rainforest of Subtropical Australia	Critically Endangered	PMST; EIS; ToR
Natural grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland	Critically Endangered	PMST; EIS; ToR
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	PMST; EIS
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	PMST; EIS; ToR
Weeping Myall Woodlands	Endangered	PMST; EIS; ToR
White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands	Critically Endangered	PMST; EIS; ToR

3.2 Matters of State Environmental Significance

3.2.1 Regulated vegetation

A total of three 'Endangered', eight 'Of Concern' REs identified under the provisions of the VM Act are predicted to occur within the B2G Project (Table 3-2).

Table 3-2 Regulated vegetation identified from the desktop assessment

Regional Ecosystem	Regional ecosystem description (DES)	VM Act Status	Source
11.3.2*	<i>Eucalyptus populnea</i> woodland on alluvial plains	Of Concern	DA, EIS, Cardno
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus spp.</i> woodland on alluvial plains	Of Concern	DA, EIS, Cardno
11.3.21#	<i>Dichanthium sericeum</i> and/or <i>Astrelba spp.</i> grassland on alluvial plains. Cracking clay soils	Of Concern	DA, EIS, Cardno
11.4.3^	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Endangered	DA, EIS, Cardno
11.4.10^	<i>Eucalyptus populnea</i> or <i>E. woollsiana</i> , <i>Acacia harpophylla</i> , <i>Casuarina cristata</i> open forest to woodland on margins of Cainozoic clay plains	Endangered	DA
11.5.14	<i>Triodia sp.</i> open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	Of Concern	DA, EIS, Cardno
11.8.3~	Semi-evergreen vine thicket on Cainozoic igneous rocks	Of Concern	DA, EIS
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of Concern	DA, EIS, Cardno
11.9.5^	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	Endangered	DA, EIS, Cardno
11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	Of Concern	DA, EIS, Cardno
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks	Of Concern	Cardno

*Denotes potential poplar box TEC, #denotes potential natural grasslands TEC, ^ denotes potential brigalow TEC, ~denotes potential SEVT TEC.

4 Field assessment methodology

The field assessment methodology employed was determined based on the results from the desktop assessment described in Section 3. This section outlines the survey methods employed during the field investigations undertaken on the B2G Project including:

1. Ground-truthing Regional Ecosystems (REs) in accordance with Neldner et al. 2020 and determining the RE extents.
2. Assessing Threatened Ecological Communities (TECs) and verifying their status and condition.
3. Undertaking BioCondition assessments in each identified assessment unit across the survey area to determine vegetation condition.
4. Completing detailed habitat assessments in accordance with the *Guide to determining terrestrial habitat quality* (DES 2017 and 2020).

4.1 Ground-truthing Regional Ecosystems

The quaternary assessment methodology was used to collect data on vegetation characteristics (floristic structure and composition), broad ecological condition and the extent and classification of vegetation communities across the survey area. These assessments were conducted as per the *Methodology for Surveying and Mapping Regional Ecosystems and Vegetation Communities in Queensland Version 5.1* (Neldner et al., 2020). Quaternary assessments were undertaken and the RE classification was confirmed using the definitions of remnant, regrowth, and non-remnant vegetation, as defined under the VM Act and using the relevant BioCondition benchmark to assess height and coverage of the canopy and characterises species, in conjunction with technical descriptions for the RE where available. Regrowth was confirmed in the field and where aerial imagery has shown these areas have not previously been cleared for last 15 years the regrowth was classified as High Value Regrowth (HVR) in the data.

4.2 Identifying Threatened Ecological Communities

The legal definition of each potentially occurring TEC was examined and, following ground-truthing of REs, any REs likely to be associated with one (or more) TECs were further assessed in the field against the descriptions, condition categories and thresholds as detailed in the respective approved conservation advice documents and summarised below. TEC assessments were undertaken by Cardno (2021) during spring 2020 and post wet 2021 surveys and additional data was collected by Ausecology during multiple survey events between August and December 2021. Areas adjacent to the TEC impact areas were assessed for viability post impact to ensure that the remaining patches will remain functionally viable and continue to meet the relevant condition threshold/key diagnostic criteria.

4.2.1 Brigalow (*Acacia harpophylla* dominant and co-dominant)

The key diagnostic characteristics for the 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' TEC, henceforth referred to as the 'Brigalow TEC' are as follows (Department of the Environment, 2013):

- The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch¹. *A. harpophylla* is either dominant in the tree layer, or co-dominant with other species (notably *Casuarina cristata*, other species of *Acacia*, or species of *Eucalyptus*).

AND

- In Queensland, within the Brigalow Belt Bioregion, the patch meets the description of one of the following 12 Qld REs: 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21

AND/OR

- The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Brigalow Belt Bioregion REs. This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise.

The patch must also meet the following condition thresholds:

- The patch is 0.5 ha or more in size;

AND

- Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.

Note that in some areas *Casuarina cristata* may be locally dominant and more abundant than *A. harpophylla*, and form pockets of vegetation within or on the margins of the Brigalow TEC, these areas have been included as TEC.

4.2.2 Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions

In Queensland, the following REs are representative of the TEC where the requirements of the key diagnostic characteristics and condition thresholds are met:

- RE 11.3.3 *Eucalyptus coolabah* woodland on alluvial plains;
- RE 11.3.15 *Eucalyptus coolabah*, *Acacia stenophylla*, *Muehlenbeckia florulenta* fringing woodland on alluvial plains;
- RE 11.3.16 *Eucalyptus largiflorens*, $\pm$ *Acacia cambagei* $\pm$ *A. harpophylla* woodland to low open woodland on alluvial plains;
- RE 11.3.28 *Eucalyptus coolabah* $\pm$ *Casuarina cristata* open woodland on alluvial plains;
- RE 11.3.37 *Eucalyptus coolabah* fringing woodland on alluvial plains.

Key diagnostic attributes for Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions TEC, henceforth referred to as the 'black box' TEC, are as follows (Threatened Species Scientific Committee, 2011):

- Distribution is limited to the Darling Riverine Plains and the Brigalow Belt South bioregions (IBRA v6.1).
- It typically occurs on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream levees.
- A tree canopy layer is present that shows these features:

¹ a patch is defined as a discrete and continuous area of the ecological community. However, a patch may include small-scale disturbances, such as tracks or breaks (including exposed soil), watercourses/drainage lines or localised changes in vegetation that do not act as a permanent barrier or significantly alter its overall functionality.

- *Eucalyptus coolabah subsp. coolabah* (Coolibah) must be present in the tree canopy;
- Coolibah typically is dominant ($\geq 50\%$ of tree crown cover);
- Where Coolibah and *E. largiflorens* (Black Box) co-occur, together they make up the dominant species in the tree canopy layer ($\geq 50\%$ of tree crown cover);
- Hybrids of Coolibah or Black Box with each other and other *Eucalyptus* species (typically Bimble Box) are included as dominant tree species.
 - The mid or shrub layer may or may not be present. When present it is typically sparse or clumped and is of variable composition.
 - The ground layer is of variable composition and cover ranging from sparse to dense. Ground cover lifeforms typically comprise native graminoids, other herbs, chenopods and other low shrubs that are typically under 50 cm tall

The patch must also meet certain condition thresholds. A patch is considered the black box TEC if it meets these minimum criteria, listed below:

- Minimum patch size of 5 ha This may include areas of native vegetation that may be naturally open or contain regrowth.

AND

- Tree crown cover in the patch must be $\geq 8\%$

AND

- Coolibah and/or Black Box in the tree canopy must be present in the patch that are either:
 - Mature trees with a main stem that has a DBH ≥ 30 cm; **OR**
 - Hollow-bearing live trees (live or dead); **OR**
 - coppiced trees with a main stem that has a DBH ≥ 20 cm.

AND

- 10% or more of the ground cover comprises native graminoids, other herbs, chenopods and/or native low shrubs (i.e., woody plants typically less than 50 cm tall).

AND

- In the ground layer, the percentage cover of non-native perennial plant species does not exceed the percentage cover of native plant species (annual or perennial).

4.2.3 Lowland rainforest of subtropical Australia

In Queensland, the following REs are representative of the TEC where the requirements of the key diagnostic characteristics and condition thresholds are met:

- RE 12.3.1 Complex to simple notophyll vine forest- Gallery rainforest (notophyll vine forest) on alluvial plains.
- RE 12.5.13 Microphyll to notophyll vine forest +/- *Araucaria cunninghamii*.
- RE 12.8.3 Complex notophyll vine forest – complex notophyll vine forest on Cainozoic igneous rocks.
- RE 12.8.4 Complex notophyll vine forest with *Araucaria spp.* on Cainozoic igneous rocks.
- RE 12.8.13 Araucarian complex microphyll vine forest on Cainozoic igneous rocks.

- RE 12.11.1 Simple notophyll vine forest often with abundant *Archontophoenix cunninghamiana* (“gully vine forest”) on metamorphics +/- interbedded volcanics.
- 12.11.10 Notophyll vine forest +/- *Araucaria cunninghamii* on metamorphics +/- interbedded volcanics.
- 12.12.1 Simple notophyll vine forest usually with abundant *Archontophoenix cunninghamiana* (“gully vine forest”) on Mesozoic to Proterozoic igneous rocks.
- RE 12.12.16 Notophyll vine forest on Mesozoic to Proterozoic igneous rocks.

Key diagnostic attributes for Lowland rainforest of subtropical Australia TEC, henceforth referred to as the ‘lowland rainforest’ TEC, are as follows (Threatened Species Scientific Committee, 2011):

- Distribution of the ecological community is primarily in the NSW North Coast and South Eastern Queensland bioregions, according to Interim Biogeographic Regionalisation for Australia (IBRA) version 6.1 (2004).
- The ecological community occurs on: soils derived from basalt or alluvium; or enriched rhyolitic soils; or basaltically enriched metasediments.
- The ecological community generally occurs at an altitude less than 300 m above sea level.
- The ecological community typically occurs in areas with high annual rainfall (>1300mm).
- The ecological community is typically more than 2 km inland from the coast.
- The structure of the ecological community is typically a tall (20 m–30 m) closed forest, often with multiple canopy layers.
- Patches of the ecological community typically have high species richness (at least 30 woody species).

The patch must also meet certain condition thresholds (see Figure 4-1). A patch is considered the lowland rainforest TEC if it meets these minimum criteria.

Patch Type (evidence of remnant vegetation & regeneration status)	A Natural remnant evident by the persistence of mature residual trees from <u>Appendix B</u> .	B Some residual trees from <u>Appendix B</u> are present plus evidence of either: natural regeneration ^{*1} AND/OR regeneration with active management ^{*2}	C A non-remnant patch that has recovered through a) natural regeneration ^{*1} AND/OR b) supplementary planting that has stature and quality that is reflective of the 'Description' ^{*3}
	AND	AND	AND
Patch Size (excludes buffer zone)	≥ 0.1 ha AND	≥ 1 ha AND	≥ 2 ha AND
Canopy Cover (over entire patch) ^{*4}	Emergent/canopy/subcanopy ^{*4} cover is ≥ 70% AND		
Species Richness (over entire patch)	contains ≥ 40 native woody species ^{*5} from Appendix A AND	contains ≥ 30 native woody species ^{*5} from Appendix A AND	
Percent of total vegetation cover that is native ^{*6} (use sample plot)	≥ 70% of vegetation ^{*6} is native	≥ 50% of vegetation ^{*6} is native	
Notes: ^{*1} Evidence of natural regeneration is shown by the presence of seedlings of a range of native species that did not originate through deliberate plantings. ^{*2} A patch that is actively managed has regular (e.g. every 1–2 years) on the ground human regenerative activity such as weed control or supplementary plantings. ^{*3} Closed canopy, 20–30 m tall, of representative species (e.g. white booyong, hoop pine, figs, brush box, yellow carabeen, red cedar, rosewood, white beech) ^{*4} Canopy cover (projective foliage cover) is estimated over the entire patch. When assessing the ecological community, the canopy includes the emergents and subcanopy (everything above 10 m tall). Canopy/sub-canopy includes all trees and vines (native and non-native). ^{*5} Woody species are trees, shrubs or vines that contain wood or wood fibres that consist mainly of hard lignified tissues. Excluded from woody species are graminoids, other herbs and non-woody vines. ^{*6} Total vegetation cover includes emergents/canopy/subcanopy and understorey and ground layers.			

Figure 4-1 Condition thresholds for identifying the Lowland rainforest TEC (Threatened Species Scientific Committee, 2011).

4.2.4 Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern QLD

The key diagnostic characteristics for the 'Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern QLD' TEC, henceforth referred to as the 'natural grassland' TEC, are as follows (Threatened Species Scientific Committee, 2009):

- Distribution mainly in the Darling Downs of southern Queensland
- Associated with fine textured, often cracking clay soils derived from either basalt or alluvium
- Occurrence on landforms that are typically flat to very low slopes (less than 5 percent/1 degree)

- Tree canopy usually absent to sparse, comprising less than 10% projective crown cover
- Ground layer typically dominated by perennial native grasses and contains three or more 'indicator' native species²
- Associated with Qld REs: 11.3.21 or 11.3.24

The patch must also meet certain condition thresholds (Table 4-1). A community is considered the natural grasslands TEC if it meets either the 'best quality' or 'good quality' condition criteria.

Table 4-1 Condition thresholds and classes for identifying the natural grasslands TEC

Attribute	Condition Classes	
	Best Quality	Good Quality
Patch size	At least 0.5 ha; AND	At least 2 ha; AND
Grasses	At least 4 native perennial grass species from the list of indicator species ² ; AND	At least 3 native perennial grass species from the list of indicator species; AND
Tussock cover	At least 200 native perennial grass tussocks; AND	At least 200 native perennial grass tussocks; AND
Woody shrub¹ cover	Total projected canopy cover of shrubs is less than 30%; AND	Total projected canopy cover of shrubs is less than 50%; AND
Introduced species	Perennial non-woody introduced species are less than 5% of the total projected crown cover	Perennial non-woody introduced species are less than 30% of the total projected crown cover

Note that the listing advice specifies that unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain. These conditions were met during Cardno surveys. However, these conditions were not met during Ausecology surveys and so no natural grassland TEC assessments were conducted during this period. Therefore, any patches of potential TEC natural grassland not assessed previously by Cardno were assumed to be the natural grassland TEC based on the precautionary principle.

² Indicator species include: *Aristida leptopoda*, *Astrebla elymoides*, *Astrebla lappacea*, *Rytidosperma bipartitum*, *Austrostipa aristiglumis*, *Bothriochloa biloba*, *Bothriochloa erianthoides*, *Dichanthium sericeum*, *Digitaria divaricatissima*, *Elymus plurinervis*, *Eriochloa crebra*, *Eulalia aurea*, *Panicum decompositum*, *Panicum queenslandicum*, *Thellungia advena*, *Themeda avenacea*, *Themeda triandra* (synonym. *T. australis*) and *Walwhalleya proluta*.

4.2.5 Poplar Box Grassy Woodland on Alluvial Plains

The key diagnostic characteristics for the 'Poplar box grassy woodland on alluvial plains' TEC, henceforth referred to as the 'poplar box' TEC, are as follows (Department of the Environment and Energy, 2019):

- Occurs in the Brigalow Belt North, Brigalow Belt South, Southeast Queensland, Cobar Penneplains, Darling Riverine Plains, NSW Southwestern Slopes, Riverina and Murray Darling Depression IBRA bioregions
- Associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, typically duplex soils or sodosols. This includes areas that may not be part of currently defined floodplains
- A grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale
- A tree canopy must be present that shows these features:
 - Canopy tree species are capable of reaching 10 m or more in height
 - *Eucalyptus populnea* (Poplar Box) must be present in the canopy and is the dominant tree species³
 - Where hybrids of Poplar Box with other *Eucalyptus* spp. are present, they should be counted as part of the *Eucalyptus populnea* component of the tree canopy when assessing the previous criterion
 - Mid layer (1-10 m) crown cover of shrubs to small trees is low, about 30% or less
 - A ground layer (<1 m) mostly dominated across a patch by native grasses, other herbs and occasionally chenopods (during extended dry periods), ranging from sparse to thick.

The patch⁴ must also meet certain condition thresholds (Table 4-2). A patch is considered the poplar box TEC if it meets the minimum 'class C' criteria. Assessments of a patch should initially be centred on the area of highest native floristic diversity and/or cover i.e., the best condition area of the patch.

Note, differences in cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition.

³ a species that accounts for at least 50% of the total crown cover across the patch.

⁴ a patch is a discrete and mostly continuous area of the poplar box TEC, which meets the Key diagnostic characteristics and minimum condition thresholds. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks (including exposed soil, leaf litter, cryptogams and watercourses/drainage lines), or localised variations in vegetation that do not significantly alter the overall functionality of the ecological community.

Table 4-2 Condition thresholds and classes for identifying the poplar box TEC

Attribute	Condition Classes			
	Highest Quality		Good Quality	Moderate Quality
Category	A1	A2	B	C
Patch size¹	At least 1 ha; AND	At least 5 ha; AND	At least 5 ha; AND	At least 5 ha; AND
Crown cover of canopy trees	Crown cover is at least 10%; AND	Crown cover is at least 10%; AND	Crown cover is at least 10%; AND	Crown cover is at least 10%; AND
Perennial native vegetation cover in ground layer	At least 90% of perennial vegetation cover in the ground layer ² is native; AND	At least 70% of perennial vegetation cover in the ground layer ² is native; AND	At least 50% of perennial vegetation cover in the ground layer ² is native; AND	If <50% of perennial vegetation cover in ground layer is native, then the patch must have:
Species diversity	At least 30 native plant spp. per patch in ground layer	At least 30 native plant spp. per patch in ground layer	At least 20 native plant spp. per patch in ground layer; or at least 10 mature trees per ha with ≥ 30 cm dbh (and/or hollows)	At least 20 native plant spp. per patch in the ground layer; AND at least 10 mature trees per ha with at least 30 cm dbh (and/or hollows); AND smaller trees, saplings or seedlings suggestive of periodic recruitment

4.2.6 Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

The semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC, henceforth referred to as the 'SEVT' TEC, are considered an extreme form of dry seasonal subtropical rainforest (McDonald 1996). They occur in areas with a subtropical, seasonally dry climate on soils of high to medium fertility and are generally characterised by the prominence of trees with microphyll sized leaves (2.5–7.5 cm long) and the frequent presence of swollen-stemmed "bottle trees" (*Brachychiton australis*) as emergent from the vegetation (Webb 1959, 1968; Webb & Tracey 1981, 1994).

In Queensland, within the Brigalow Belt (north and south) Bioregion, ten REs are included in the SEVT TEC (McDonald, 2010): 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.6, 11.8.13, 11.9.4, 11.9.8, 11.11.18. There are no additional key characteristics or condition threshold criteria that must be considered.

4.2.7 Weeping myall woodlands

In Queensland, the following REs are representative of the weeping myall woodlands TEC, henceforth referred to as the 'weeping myall' TEC, where the requirements of the condition thresholds are met (Threatened Species Scientific Committee, 2009):

- RE 11.3.2 *Eucalyptus populnea* woodland on alluvial plains.
- RE 11.3.28 *Casuarina cristata* ± *Eucalyptus coolabah* open woodland on alluvial plains.

The minimum condition criteria are as follows:

- the tree canopy is dominated (at least 50% of trees present) by living, dead or defoliated Weeping Myall trees;

AND

- the overstorey must have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees/ha;

AND

- the area is at least 0.5 ha in size;

AND

- the patch has either:
 - more than two layers of regeneration of Weeping Myall present; **OR**
 - the tallest layer of living, dead or defoliated Weeping Myall trees is at least 4 m tall and of the vegetative cover present, 50% is comprised of native species.

4.2.8 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

The key diagnostic characteristics for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC, henceforth referred to as the 'white box' TEC, are displayed in Figure 4-2.

In Queensland, the ecological community is a primary component of the following Regional Ecosystems: 11.8.2a, 11.8.8, 11.9.9a, 13.3.1, 13.11.8, 13.12.8 and 13.12.9. It can also be a smaller component of the following regional ecosystems: 11.3.23, 12.8.16, 13.3.4, 13.11.3 and 13.11.4.

The white box TEC exists as remnants in three different states:

- An overstorey of eucalypt trees exists, but there is no substantial native understorey
- A native understorey exists, but the trees have been cleared
- Both a native understorey and an overstorey of eucalypts exist in conjunction.

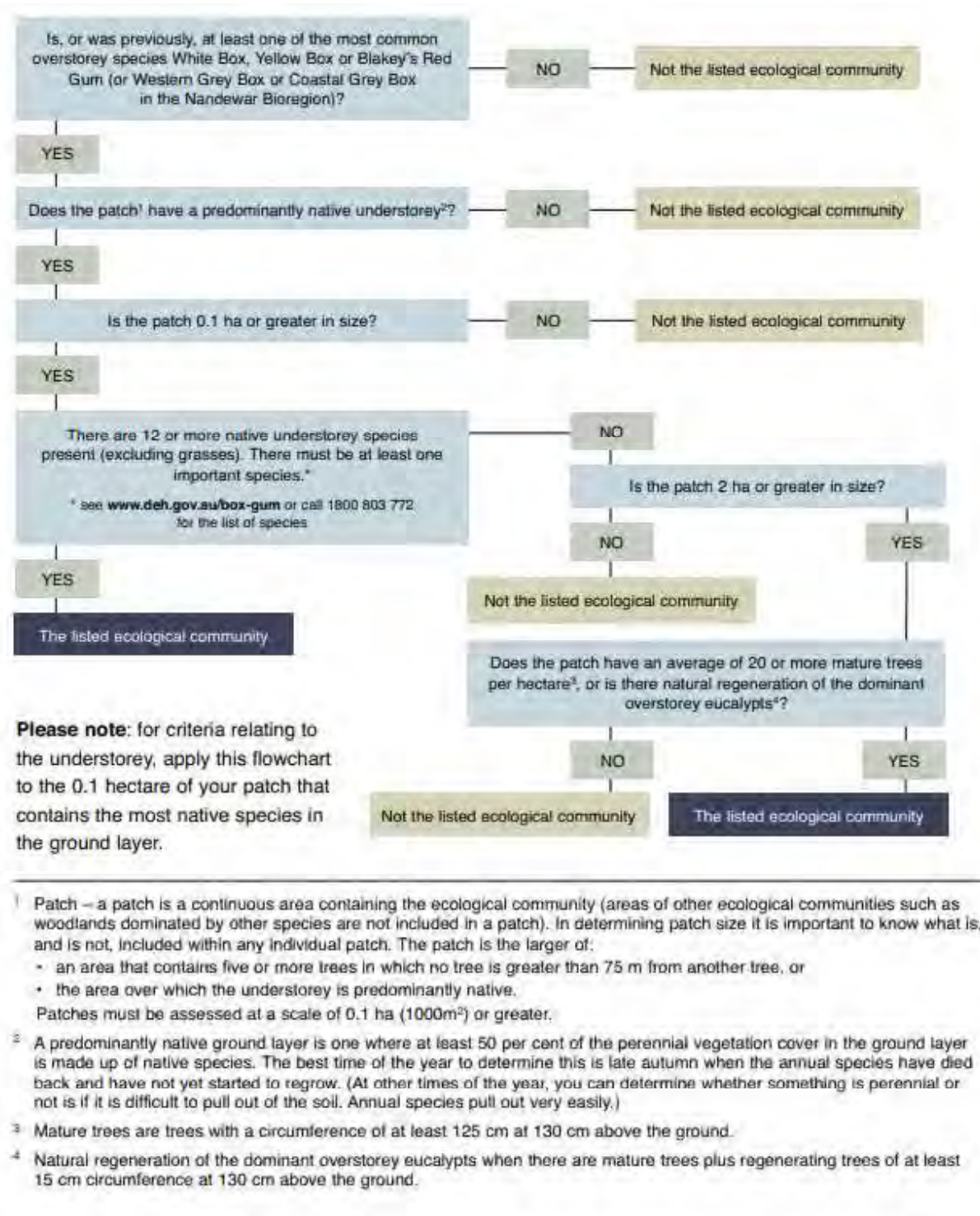


Figure 4-2 Flowchart used to determine whether a patch should be included in the listed white box TEC (Department of the Environment and Heritage, 2006)

4.3 BioCondition assessments

In order to assess vegetation quality and condition, BioCondition assessments were undertaken in accordance with Eyre et al. (2015) and the QLD Guide to Determining Terrestrial Habitat Quality (GTDTHQ). BioCondition assessments were undertaken by Cardno (2021) during spring 2020 and post wet 2021 surveys and by Ausecology during multiple survey events between August and December 2021.

Following collection of field data, further analysis was conducted to determine the BioCondition score for each site. To calculate the BioCondition score, the value for each site condition attribute collected during the field survey was compared to reference ('benchmark') site values. Benchmark site values are specific to each RE and are based on the average or median value from reference sites. Benchmarks or draft benchmarks (provided by the Queensland Herbarium) were available for all REs assessed with the exception of 11.9.9a. Due to the difficulty in finding an appropriate site to establish a new reference site for 11.9.9a, the Queensland Herbarium advised that 11.8.8 could be used as a surrogate benchmark (pers. Comms. Sandy Pollock, Queensland Herbarium).

4.3.1 Assessment units

Assessment units have been defined as outlined in GHD *MNES Habitat Suitability Analysis* report (2023) prepared for ARTC.

4.4 Habitat assessment methodology

Habitat assessments were undertaken by Ausecology and were co-located at BioCondition sites and were undertaken in accordance with QLD Guide to Determining Terrestrial Habitat Quality (GTDTHQ). Additional habitat assessments were also undertaken opportunistically within the B2G Project footprint to capture particular habitat features and/or provide a more comprehensive sample of the condition of an assessment unit and the supporting habitat.

Habitat assessments were undertaken across all REs within the B2G Project footprint including those areas that contained remnant, regrowth and non-remnant vegetation. Habitat assessments included the collection of habitat associated data required for undertaking the habitat quality assessment methodology (further details are discussed below). The assessments included the identification of notable habitat features that were representative of the general area, with a particular emphasis on habitat for terrestrial MNES/MSES/MLES matters. For example, features included (but were not limited) to the following:

- Presence and abundance of small, medium and large hollow-bearing trees and stags
- Presence and abundance of fallen logs, hollow logs and woody debris
- Presence, abundance and depth of cracking clay soil
- Presence of watercourses, wetlands, gilgai features or artificial waterbodies (e.g., dams)
- Presence and abundance of important koala food and shelter trees
- Availability and abundance of leaf litter cover, bare ground, grasses, and low forbs/shrubs in which fauna can seek cover and protection
- Presence and abundance of fruiting and nectar producing plant cover
- Presence and abundance of mistletoe etc.

5 Field assessment results – vegetation communities

This section presents the general descriptions of the habitat encountered along the B2G Project footprint are provided in Table 5-1.

Table 5-1 General habitat categories

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Dry sclerophyll (Eucalypt) woodlands (remnant)		
	Dry sclerophyll (i.e. Eucalypt) woodland communities in the B2G Project footprint are typically comprised of a dominant mixed eucalypt species canopy and/or subcanopy of with a sparse shrub layer and a ground layer of mixed native and non-native grasses and forbs. The average canopy tree height through these remnant woodland areas in the B2G Project footprint was 16 m and the average canopy cover was 40%. A large amount (i.e. over 40%) of sites lacked any large trees (as per the BioCondition RE benchmarks), which is likely attributable to recent and/or historical logging and can also be a reflection of less fertile soils through some of these remnant patches. The majority of western sections of the Project footprint (i.e. between Canning Creek and the Qld/NSW border) contain Eucalypt woodlands dominated by mature box, ironbark and red gum woodlands that have remained largely intact including expansive areas of State Forest, as they are typically of low agricultural value with low grazing pressures despite these areas being subjected to previously logging. These woodlands in the west of the Project footprint regularly had a subdominant tree layer of <i>Acacia</i> and/or <i>Casuarina/Allocasuarina</i> species and an abundance of mistletoe, both of which provide good foraging habitat for various bird species including painted honeyeater, glossy black cockatoos and roosting habitat for various microchiropteran bat species. The eucalypt woodland communities to the east of the Project were characterised by more fragmentation, often consisting of ironbark communities including <i>Eucalyptus melanophloia</i> and regularly with a ground layer dominated by exotic herbs/forbs and grasses. These remnant areas to the east were not only often subject to high vegetation fragmentation but also higher levels of grazing pressure; which can be attributable to a history of intensive cropping, grazing and other agricultural land uses. Overall, dry sclerophyll (eucalypt) communities were found to contain a low to medium abundance of small to medium sized tree hollows, which are known to provide suitable habitat for small to medium	11.3.1, 11.3.2, 11.3.18, 11.3.14, 11.3.17, 11.3.25, 11.3.27i, 11.3.4, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.4, 11.7.5, 11.7.7, 11.8.4, 11.8.5, 11.9.7, 11.9.9a

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
	arboreal mammals (e.g., sugar/squirrel gliders), hollow nesting birds and roosting microbats. Despite this, areas of RE 11.3.25 (approx. 12 ha) with <i>E. tereticornis</i> or <i>E. camaldulensis</i> woodland fringing creek and drainage lines was found to contain larger tree hollows; however, these areas often occurred in highly to severely fragmented areas due to intensive cropping and grazing agricultural land uses. The ground layer within this habitat type typically has a shallow layer of leaf litter and a moderate abundance of woody debris. It is these microhabitat features that can provide important refuge and foraging opportunities for a range of reptiles, amphibians and small mammal taxa. Overall, there is a lack of old growth remnant dry sclerophyll communities with intact connectivity across the B2G Project footprint. Notwithstanding, where connected remnant dry sclerophyll vegetation remains, is known or likely to provide important dispersal and/or foraging resources for a range of biodiversity including a diverse range of threatened species (e.g. koala) in an otherwise fragmented landscape.	

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Disturbed areas of Eucalypt woodlands (regrowth)		
	When compared to remnant dry sclerophyll (eucalypt) woodland, regrowth areas of eucalypt woodland have largely been subject to higher levels of historical clearing, tree thinning, poisoning and grazing pressure. Resultingly, number of large hollows, large hollow logs and coarse woody debris and leaf litter recorded across the majority of regrowth sites was significantly less. The average tree canopy height through these areas was 9 m with an average of tree canopy cover of 19%. The sparse tree canopy, modified vegetation structure and lack of ground cover provides a limited level of habitat quality in the B2G Project footprint. Notwithstanding, these areas are still considered important to a range of species including reptile and bird taxa.	11.3.2, 11.3.14, 11.3.25, 11.3.4, 11.5.1, 11.5.4, 11.5.14, 11.5.20, 11.7.7, 11.8.5

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Eucalyptus and/or <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest		
	Along the B2G Project footprint, these areas were characterised by the dominance of belah (<i>Casuarina cristata</i>) and brigalow (<i>Acacia harpophylla</i>) woodland with the occasional mixed Eucalyptus species in the canopy and/or sub-canopy and were typically found on cracking clay soils. The brigalow communities lacks an abundance of medium or large sized tree hollows and the ground layer can be dense, with coarse woody debris and leaf litter providing important habitat for reptiles. Deep cracking clay soils also provide important habitat for a range of amphibians, particularly during the wet season when the gilgai's are inundated. Throughout the B2G project footprint these areas had been largely subjected to vegetation fragmentation with regular occurrences of discrete regrowth and remnant habitat patches. Given the fertile soils known for these communities, these patches were often isolated and surrounded by intense cropping and grazing pressures. To the west of the Project footprint, remaining brigalow patches were often used as shadelines along fencelines and along road reserves. In these areas impacts from sheep and cattle grazing/trampling were evident amongst the ground and shrub layers. These shadelines and road reserves also contained an abundance of mistletoe; providing important habitat for birds including, the painted honeyeater that was recorded regularly through these areas. Importantly, <i>Casuarina cristata</i> was considered the most dominant canopy tree species throughout most of these areas, which is known to provide important foraging and roosting habitat for glossy black cockatoo amongst other bird species.	11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.10

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Natural grasslands		
	Along the B2G Project footprint, natural grassland communities consisted of 11.3.21, 11.8.11 and 11.5.14. RE 11.3.21 consisted of grassland dominated by <i>Dichanthium sericeum</i>, and <i>Aristida leptopoda</i>, scattered mixed native forbs with cracking clay soils on alluvial plains. The average native perennial grass cover in RE 11.3.21 was 60.5% and the average non-native ground cover was 2% (according to BioCondition data). It should be noted that exostic plant species richness and cover was often abundant with weed invasion a common occurrence across almost all survey sites. The most common weeds included <i>Sorghum halepense</i>, <i>Chloris gayana</i>, <i>Salvia reflexa</i>, <i>Rapistrum rugosum</i> and other Brassica species. The RE 11.3.21 grasslands generally contained cracking clay soil with scattered to abundant soil cracks between 1-20 cm depth. These microhabitat features provide refuge and foraging opportunities for reptiles including the Condamine earless dragon; however, presence of intense agricultural impacts was widespread across all areas, due to grazing by livestock and/or proximity of cropping. RE 11.5.14 areas were dominated by <i>Melaleuca densispicata</i> with a groundcover of <i>Sclerolaena</i> spp. and mixed forbs. RE 11.8.11 areas were dominated by <i>Dichanthium sericeum</i>, <i>Panicum decompositum</i> and mixed <i>Aristida</i> spp. The average native perennial grass cover in these areas was ~20% and the average non-native cover was ~10% (according to BioCondition data). The most common weeds included <i>Rapistrum rugosum</i>, <i>Medicago polymorpha</i> and <i>Bidens pilosa</i>, with several infestations of <i>Bryophyllum delagoense</i>. Bare ground cover ranged from scattered to very common, with occasional shallow cracking clay soils. Inundated gilgais were also present at several sites, providing habitat for reptiles and amphibians. Overall, the areas were moderately-severely impacted by cattle grazing/trampling and/or by slashing.	11.3.21, 11.5.14, 11.8.11

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Freshwater wetlands		
	Along the B2G Project footprint, these areas are characterised by the prominence of permanent and ephemeral freshwater wetlands with fringing sedgeland or woodlands on depressions on floodplains, billabongs, and were typically of palustrine nature. Vegetation cover and species richness was variable depending on drainage and water inundation at the time of survey. Throughout all of these areas, hydrophytic sedge and herb species dominated including <i>Eleocharis plana</i>, <i>Marsilea mutica</i>, mixed <i>Cyperus</i> and <i>Juncus</i> spp. At more wooded sites, the average tree canopy height was 12 m with an average canopy cover of 6.4%. Emergent aquatic vegetation was generally present, with a height of 0.2-5 m. Overall, across all areas, weed abundance and grazing intensity was low. Despite the intermittent nature of wetland systems within the Project footprint, when seasonal conditions are suitable, these areas are likely to provide important refuge and potential breeding sites for a diverse range of fauna taxa, especially wader and wetland bird species including, Australasian bittern, Australian painted snipe, Latham's snipe, common greenshank, glossy ibis, and sharp-tailed sandpiper.	11.3.27, 11.3.27b, 11.3.27i

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Non remnant disturbed pasture, cropping areas and other land uses		
	Along the B2G Project footprint, these areas largely consist of highly modified vegetation communities subject to cropping and grazing. Generally, these areas are non-remnant and usually lack a distinct canopy or subcanopy; although, some areas contained discrete patches of trees including scattered large 'paddock trees' that likely provide refuge to mobile fauna on passage between remnant/regrowth patches. The average perennial native grass cover in these areas was 30.6% and the average non-native cover was 29.3% (according to BioCondition data). The most common weeds included <i>Glandularia aristigera</i>, <i>Cenchrus ciliaris</i>, <i>Cirsium vulgare</i>, <i>Lepidium bonariense</i>, <i>Medicago polymorpha</i>, <i>Rapistrum rugosum</i>, <i>Sonchus oleraceus</i>, <i>Verbena bonariensis</i> and <i>Opuntia</i> spp. The non-remnant areas frequently contained cracking clay soil with scattered to abundant soil cracks between 1-20 cm depth. These microhabitat features provide refuge and foraging opportunities for reptiles. The non-remnant areas were also often located on floodplains or in close proximity to farm dams. Presence of agricultural impacts was widespread across all areas, with low-severe grazing intensity and frequent cattle trampling and/or cropping (often resulting in severe soil compaction).	Non-remnant

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
		

5.1 Ground-truthed Regional Ecosystems

In total, 653 quaternary assessments and 128 BioCondition assessments were undertaken to ground-truth the extent and condition of the regulated vegetation community mapping. The ground-truthed mapping frequently differed from the regulated vegetation mapping, with the status, extent and condition of several REs updated accordingly.

The final ground-truthed RE mapping is provided in Appendix A and with assessment photos provided in Appendix C.

A summary of the ground-truthed REs, including the relevant number of BioCondition and Quaternary assessments undertaken, their associated condition status and total areas within the B2G Project footprint are provided in Table 5-2. Note additional BioCondition and Quaternary points noted in the numbers above were located adjacent to the alignment during changes to the footprint. New REs ground-truthed in the alignment not previously found in the Government mapping have been denoted with a (*). In total, there was 2,260 ha of non-remnant vegetation and 586 ha of remnant vegetation, 250 ha of high value regrowth and 43 ha of regrowth vegetation.

Table 5-2 Ground-truthed Regional Ecosystems within the B2G Project footprint

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.3.1*	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Endangered	1.46	1	1	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Of Concern	33.82	3	17	16.83	10.58	0	15	375.28	6	34
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	Least Concern	22.15	3	5	0	6.94	1	3	21.84	-	2
11.3.17*	<i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains	Of Concern	4.12	0	1	0.00	0.00	N/A	N/A	0.00	N/A	-

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	Least Concern	0.00	N/A	N/A	N/A	N/A	N/A	N/A	26.54	0	-
11.3.21	<i>Dichanthium sericeum</i> and/or <i>Astrebla</i> spp. grassland on alluvial plains. Cracking clay soils	Of Concern	18.39	6	14	N/A	N/A	N/A	N/A	181.77	5	41
11.3.24	<i>Themeda avenacea</i> grassland on alluvial plains. Basalt derived soils	Endangered	0.00	N/A	N/A	N/A	N/A	N/A	N/A	3.63	0	-
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Least Concern	18.48	2	13	1.58	0.00	0	0	53.2	2	2
11.3.27	Freshwater wetlands	Least Concern	0.71	0	0	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.27b	Vegetation ranges from open water +/- aquatics and emergents. Often with fringing woodland	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	3.75	0	1
11.3.27i*	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer	Least Concern	7.91	0	0	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	Of Concern	9.55	1	2	5.16	2.38	0	2	64.07	0	-

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Endangered	34.43	4	20	61.75	6.6	1	31	277.5	5	8
11.4.10	<i>Eucalyptus populnea</i> or <i>E. woollsiana</i> , <i>Acacia harpophylla</i> , <i>Casuarina cristata</i> open forest to woodland on margins of Cainozoic clay plains	Endangered	23.09	1	9	2.36	1.93	0	1	14.78	1	1
11.5.1*	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Least Concern	113.8	4	30	26.97	2.59	2	4	162.68	1	8
11.5.1a	<i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	10.2	0	1
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	Least Concern	113.06	4	17	58.51	0.3	0	4	61.09	3	16
11.5.14	<i>Triodia</i> sp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	Of Concern	32.07	1	4	1.85	2.64	2	4	23.56	1	2
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E.</i>	Least Concern	11.21	2	4	11.03	0.29	2	6	89.03	2	6

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
	<i>crebra</i> woodland on Cainozoic sand plains											
11.7.4	Eucalyptus decorticans and/or Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius woodland on Cainozoic lateritic duricrust	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	0.54	N/A	-
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	2.87	N/A	-
11.7.7	<i>Eucalyptus fibrosa subsp. nubilis</i> +/- Corymbia spp. +/- Eucalyptus spp. woodland on Cainozoic lateritic duricrust	Least Concern	20.39	1	1	18.04	0.00	0	0	7.68	0	-
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks	Of Concern	0.00	N/A	N/A	0.16	0.00	0	0	9.26	1	-
11.8.4	<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks.	Least Concern	22.05	2	3	5.17	1.03	2	2	131.06	0	10
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	Least Concern	67.18	4	10	19.11	5.65	1	8	375.91	4	35
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of Concern	25.25	1	4	N/A	N/A	N/A	N/A	92.28	2	4

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.9.5 (eastern)	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	Endangered	2.42	0	3	21.33	2.48	2	20	224.48	5	11
11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	Of Concern	0.00	N/A	N/A	0.00	N/A	N/A	N/A	36.45	0	-
11.9.9a*	<i>Eucalyptus albens</i> +/- <i>E. crebra</i> +/- <i>E. tereticornis</i> +/- <i>Callitris baileyi</i> woodland. Occurs in southern part of bioregion.	Least Concern	3.19	1	1	0.00	0.00	N/A	N/A	0.00	N/A	-
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks	Of Concern	1.4	0	1	0.00	0.00	N/A	N/A	10.48	0	0
Total			586	41	161	249.8	43.4	12	100	2,260	38	182

A total of four 'Endangered', eight 'Of Concern' (Table 5-3) have been confirmed in the B2G Project footprint based on the results of the ground truthed survey.

Table 5-3 Of Concern and Endangered REs confirmed within the B2G Project footprint

Regional Ecosystem	VM Act Status	Area (ha)			
		Remnant	High Value Regrowth	Regrowth	Total
11.3.1	Endangered	1.46	0.00	0.00	1.46
11.4.3	Endangered	36.44	61.75	4.38	102.57
11.4.10	Endangered	23.09	2.36	1.93	27.38
11.9.5	Endangered	2.42	21.33	2.48	26.23
11.3.2	Of Concern	33.63	16.76	10.66	61.05
11.3.4	Of Concern	9.55	5.16	2.38	17.09
11.3.17	Of Concern	4.12	0.00	0.00	4.12
11.3.21	Of Concern	17.32	0.00	0.00	17.32
11.5.14	Of Concern	32.07	1.85	2.64	36.56
11.8.3	Of Concern	0.00	0.16	0.00	0.16
11.8.11	Of Concern	25.25	0.00	0.00	25.25
11.9.10	Of Concern	1.4	0.00	0.00	1.4
Total		186.75	109.37	24.47	320.59

5.2 Threatened Ecological Communities

Following ground-truthing, 207.16 ha from five EPBC listed TECs were confirmed to occur within the B2G Project footprint. The below sections summarise each confirmed TEC area, condition status (where relevant) and area (ha). The locations of the TECs are displayed in Appendix B.

5.2.1 Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland Threatened Ecological Community

The Natural Grassland TEC was recorded in several areas of the B2G Project footprint. Natural Grassland TEC recorded in the Project footprint met the description of the following two RE's:

- 11.3.21- *Dichanthium sericeum* and/or *Astrelba* spp. grassland on alluvial plains. Cracking clay soils
- 11.8.11- *Dichanthium sericeum* grassland on Cainozoic igneous rocks

A shrub layer was absent across most Natural Grassland TEC sites in the Project footprint. A tree canopy layer and subcanopy layer comprising of scattered trees (i.e. <10% of projective crown cover) was also typically absent across Natural Grassland TEC sites. Areas of RE 11.3.21 were dominated by *Dichanthium sericeum* (Queensland bluegrass) and *Aristida leptopoda* (white speargrass), with scattered mixed native forbs on cracking clay soils on alluvial plains. Common invasive weeds in 11.3.21 included, *Cenchrus ciliaris* (buffel grass), *Cirsium vulgare* (scotch thistle), *Sorghum halepense* (Johnson grass), *Chloris gayana* (Rhodes grass), *Salvia reflexa* (mintweed), *Rapistrum rugosum* (turnipweed) and other Brassica species.

Areas of RE 11.8.11 were dominated by *Dichanthium sericeum* (Queensland bluegrass), *Panicum decompositum* (native millet) and mixed *Aristida* spp. (wiregrass). Common invasive weeds in 11.8.11 sites included, *Cenchrus ciliaris* (buffel grass), *Bryophyllum delagoense* (mother of millions), *Medicago polymorpha* (burr medic), *Bidens pilosa* (cobbler's pegs), *Rapistrum rugosum* (turnipweed) and other Brassica species. Bare ground was often scattered, with microrelief (i.e. gilgai) present at several sites. Areas were moderately to severely impacted by cattle grazing/trampling and/or by slashing throughout most Natural Grassland TEC sites.

Where a comparison of site condition against the condition thresholds listed under the listing advice for Natural Grassland TECs was not able to be undertaken due to the timing and seasonality of the surveys or recent disturbance events (i.e. grazing and slashing), a precautionary measure was applied and 'best quality' condition class was applied. Best quality condition class includes the following criteria to be satisfied:

- A patch size of at least 0.5 ha; and
- At least four native perennial grass species from the list of perennial native grass indicator species (refer to the listing advice for Natural Grassland TEC); and
- At least 200 native grass tussocks; and
- Total projected canopy cover of shrubs is <30%; and
- Perennial non-woody introduced species are <5% of the total projected perennial plant cover

Table 5-4 Natural Grassland TEC mapped in the B2G Project footprint

TEC	Condition status	Area (ha)	Total (ha)
Natural grasslands TEC	Good quality	13.29	66.63
	Best quality	47.74	

5.2.2 Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community

The Brigalow TEC within the B2G Project footprint was characterised by the presence of *Acacia harpophylla* (brigalow) as dominant or co-dominant with other species, particularly, *Casuarina cristata* (belah) or seldomly with other species of *Acacia* or *Eucalyptus* spp. Areas of Brigalow TEC met the description of the following RE's recorded in the Project footprint:

- 11.3.1 – *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
- 11.4.3 – *Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains
- 11.4.10 - *Eucalyptus populnea* or *E. woollsiana*, *Acacia harpophylla*, *Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains
- 11.9.5 – *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks

Areas of Brigalow TEC within the Project footprint were mostly on acidic and salty clay soils with deep cracking clay soils containing occasional microrelief patterns (i.e. gilgai's), which intermittently fill with water typically during the wet season. The Brigalow TEC occurred mostly on flat to gently undulating Cainozoic clay plains that were not associated with current alluvium, or on gently undulating plains on fine grain sedimentary rocks. The tree layer varied in height from about 10 m to 25 m, which often depended on the soil type and disturbance history. The lower tree layer and shrub layers typically contained species such as *Geijera parviflora* (wilga) and *Eremophila mitchellii* (sandalwood). The ground layer was typically spare with scattered patches of

native perennial grasses including: *Enteropogon acicularis* (curly windmill-grass), *Panicum decompositum* (native millet), *Paspalidium* spp. and *Sporobolus* spp. Herbs and forbs were dominated by *Enchylaena tomentosa* (ruby saltbush), *Einadia nutans* (climbing saltbush), *Sclerolaena* spp., and *Nyssanthus* spp. (barb-wire weed). Dominant forbs included, *Cyperus gracilis* (especially in gilgai areas), and ferns *Cheilanthes distans* and *C. sieberi*. Common invasive weeds included, *Cenchrus ciliaris* (buffel grass), *Opuntia tomentosa* (velvety tree pear), and *Megathysus maximus* (Guinea grass).

The condition of Brigalow TEC varied considerably across the Project footprint in vegetation and composition including remnant, high-value regrowth, and non-remnant condition. All Brigalow TEC areas were 0.5 ha or more in size and contained <50% exotic perennial plants over the total vegetation cover of the patch and were assessed over a minimum sample area of 0.5 ha, in areas that were representative of the patch. Areas of brigalow woodland regrowth were not considered part of the TEC if they were of poor quality including cleared (not just thinned) within the last 15 years, had exotic perennial plant cover >50%, and were <0.5 ha.

Table 5-5 Brigalow TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition status	Area (ha)	Total (ha)
Brigalow TEC	11.3.1	Remnant	1.46	103.68
	11.4.10	Remnant	12.33	
	11.4.3	Remnant	82.28	
	11.9.5	Regrowth	7.61	

5.2.3 Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community

Poplar Box Grassland Woodland on Alluvial Plains (hereafter called 'Poplar Box TEC') within the Project footprint was characterised by a canopy dominated by *Eucalyptus populnea* (poplar box) and an understorey dominated by native perennial grasses and other herbs. Typically, a low density of a shrubby understorey was noted, however in some instances a thickened regrowth understorey occurred. Vegetation ground cover varied considerably especially in areas surveyed during dry periods where ground cover was often sparse. Areas within proximity to ephemeral water sources were subject to occasional inundation and often contained sedges that may become more prolific during wet seasons. The canopy ranged between 8 m to 20 m and occasionally contained other Eucalypt species. A patchy understorey was characterised by *Eremophila mitchellii* (sandalwood), *Geijera parviflora* (Wilga), *Acacia salicina* (Sally's wattle), and *Acacia stenophylla* (river cooba). The ground layer was dominated by native perennial grasses included multiple *Aristida* spp. (wiregrass), *Enteropogon acicularis* (curly windmill grass), *Sporobolus* spp., *Sclerolaena birchii* (galvanised burr). Common invasive weeds included *Cenchrus ciliaris* (buffel grass), *Glandularia aristigera* (Mayne's pest), and *Opuntia tomentosa* (velvety tree pear).

Areas of Poplar Box TEC met the description of the 11.3.2 RE recorded in the Project footprint.

The Poplar Box TEC typically occurred on gently undulating to flat plains, gentle slopes, back plains and occasionally on higher terraces and levees along ephemeral watercourses and depressions. Soil types were of alluvial and recent depositional origin and were variable including, texture contrast, deep uniform clays, massive earths with occasionally cracking clays.

Table 5-6 Poplar Box TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition Class	Area (ha)	Total
Poplar box TEC	11.3.2	A1	0	39.09
		A2	4.5	

TEC	Analogous REs	Condition Class	Area (ha)	Total
		B	22.99	
		C	11.60	

5.2.4 Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions Threatened Ecological Community

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (hereafter called 'SEVT TEC') was recorded in a single small patch in the B2G Project footprint. Areas of SEVT TEC met the description of the following RE recorded in the Project footprint:

- 11.8.3 – Semi-evergreen vine thicket on Caonozoic igneous rocks

The SEVT was located on a small hillock with clay soils and abundant igneous rocks occurring on the surface. The SEVT patch was considered a small regrowth patch and was mostly surrounded by extensively cleared areas for grazing. A very scarce layer (i.e. <5% cover) of emergent trees (7-12.5 m height) included, *Brachychiton populneus* (kurrajong), *Casuarina cristata* (belah), and *Eucalyptus orgadophila* (mountain coolibah). The ecological dominant layer (EDL) consisted of a dense low canopy and subcanopy (4-6 m height) and was characterised by an abundance of *Ehretia membranifolia* (weeping koda) and *Notelaea microcarpa* (native olive), with other associated species including, *Capparis lasiantha* (nipan), *Psyrax odorata* (shiny-leaved canthium) and mixed native vine species. A dense shrub layer was as dominated by *E. membranifolia*, *N. microcarpa* as well as *Alectryon diversifolius* (scrub boonaree), *Carissa ovata* (currentbush), and *Atalaya hemiglauc* (whitewood). A sparse ground layer included native species such as *Coleus australis* (native coleus), *Geitonoplesium cymosum* (scrambling lily), *Clematicissus opaca* (small-leaved water vine), and *Jasminum didymum* (native jasmine). Common invasive weeds were more common along edges of the SEVT patch and included, *Cenchrus ciliaris* (buffel grass), *Solanum nigrum* (black nightshade), *Setaria sphacelata* (pigeon grass), *Opuntia tomentosa* (velvety tree pear) and *Malvastrum americanum* (spiked mallow).

Table 5-7 SEVT TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition status	Total Area (ha)
SEVT TEC	11.8.3	High Value Regrowth	0.16

5.2.5 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened Ecological Community

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (hereafter called 'White-Box TEC') was recorded in a single small patch in the Project footprint. Areas of White-box TEC met the description of the following RE recorded in the Project footprint:

- 11.9.9a – *Eucalyptus albens* +/- *E. crebra* +/- *E. tereticornis* +/- *Callitris baileyi* woodland. Occurs in southern part of bioregion on fine-grained sedimentary rocks.

The White-box TEC contained a remnant patch and was characterised by *Eucalyptus albens* (white box) with a sub-dominant layer of *E. crebra* (narrow-leaved ironbark) (10-17 m canopy height). A subcanopy was scarce and was dominated by a mix of native tree species (5-8 m height). The shrub layer was dominated by patches of *Carissa ovata* (currant bush) with associated species including *Alectryon diversifolius* (scrub boonaree), *Denhamia oleaster* (stiff Denhamia), *Capparis mitchellii* (wild orange), and *Santalum lanceolatum* (Queensland sandalwood). An understorey was predominately native (i.e. ≥50% vegetation ground cover containing native perennial species) with more than 12 native understorey species recorded including mixed herbs and forbs.

Grasses were dominated by mixed native and non-native species however several species were difficult to determine to species level due to recent grazing by horses and seasonality at the time of the survey. Invasive weeds were common and most prolific within proximity to the drainage line whereas other adjoining areas were noted to have less weed cover overall. The overall patch size was greater than 0.1 ha in size.

Table 5-8 White box TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition status	Total Area (ha)
White box TEC	11.9.9a	Remnant	3.43

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Appendix A - GTRE mapping



Appendix A-2 - Regional Ecosystem Mapping



0 250 500
Metres

Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

 HVR - Endangered

 Non Remnant

 B2G Footprint

 Chainage Points

 Major Watercourse Lines

 Bringalily state forest

 Whetstone state forest

Data Sources:

Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage

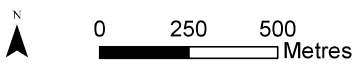


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C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-3 - Regional Ecosystem Mapping



Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Endangered
 - HVR - Endangered
 - Regrowth - Endangered
 - Non Remnant
- B2G Footprint**
- Chainage Points
 - Major Watercourse Lines
 - Bringalily state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage

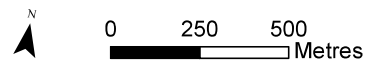


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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-4 - Regional Ecosystem Mapping



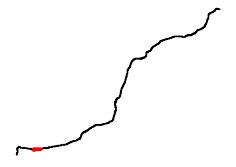
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Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Endangered
 - HVR - Endangered
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
- Major Watercourse Lines**
- Bringalily state forest
 - Whetstone state forest

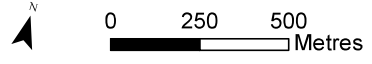
Data Sources:
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Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:					
Rev	Reason for Issue	Author	Reviewer	Approver	Date
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C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-5 - Regional Ecosystem Mapping



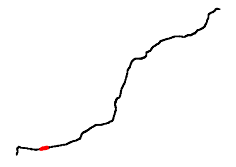
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Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Endangered
 - HVR - Endangered
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- B2G Footprint**
- Habitat Assessment
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 - Bringality state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage

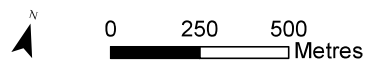


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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-6 - Regional Ecosystem Mapping



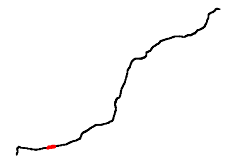
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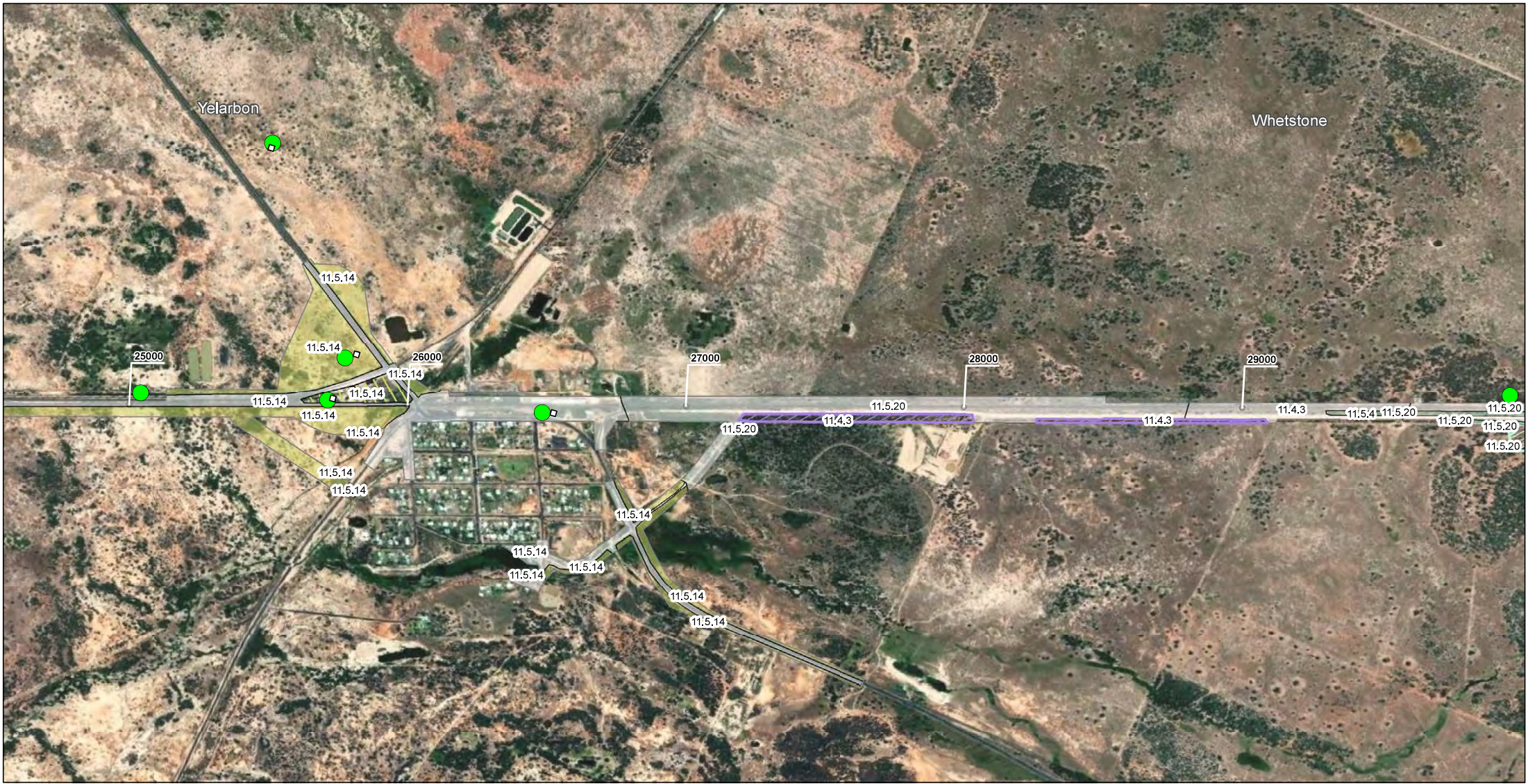
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- GTRE (Vegetation Condition, VM Status)**
- Remnant - Endangered
 - Remnant - Of Concern
 - HVR - Endangered
 - Regrowth - Endangered
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringalily state forest
 - Whetstone state forest

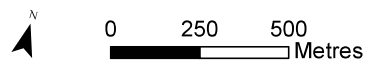
Data Sources:
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State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-7 - Regional Ecosystem Mapping



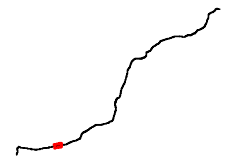
Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Of Concern
 - Remnant - Least Concern
 - HVR - Endangered
 - HVR - Least Concern
 - Regrowth - Of Concern
 - Regrowth - Least Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringality state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-8 - Regional Ecosystem Mapping



0 250 500 Metres

Scale 1:10,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

Non Remnant

B2G Footprint

Habitat Assessment

Bioconditions

Chainage Points

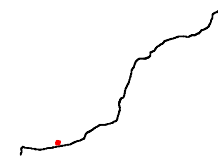
Major Watercourse Lines

Bringally state forest

Whetstone state forest

Data Sources:

Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-9 - Regional Ecosystem Mapping



0250500
Metres

Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

Remnant - Endangered

Remnant - Of Concern

Remnant - Least Concern

HVR - Endangered

HVR - Of Concern

HVR - Least Concern

Non Remnant

B2G Footprint

Habitat Assessment

Bioconditions

Chainage Points

Major Watercourse Lines

Bringality state forest

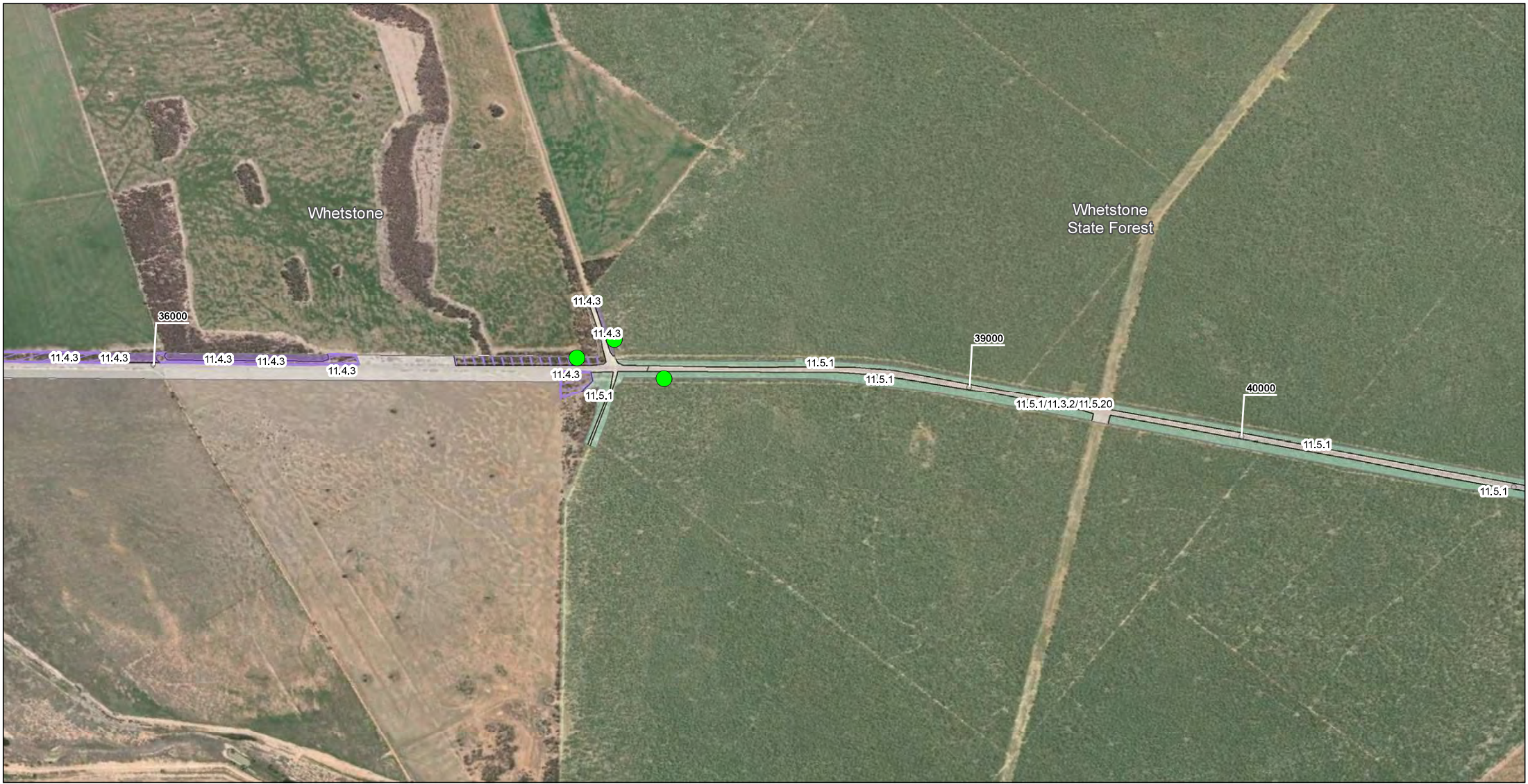
Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-10 - Regional Ecosystem Mapping

0250500
Metres

Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

- Remnant - Endangered
- Remnant - Least Concern
- HVR - Endangered
- Regrowth - Endangered
- Non Remnant

- B2G Footprint
- Bioconditions
- Chainage Points
- Major Watercourse Lines
- Bringalily state forest
- Whetstone state forest

Data Sources:

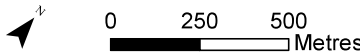
- Ausecology
- Survey Layers
- State of Queensland Department of Environment
- Major WatercourseLines
- State Forest
- ARTC
- Footprint
- Chainage

Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-11 - Regional Ecosystem Mapping



Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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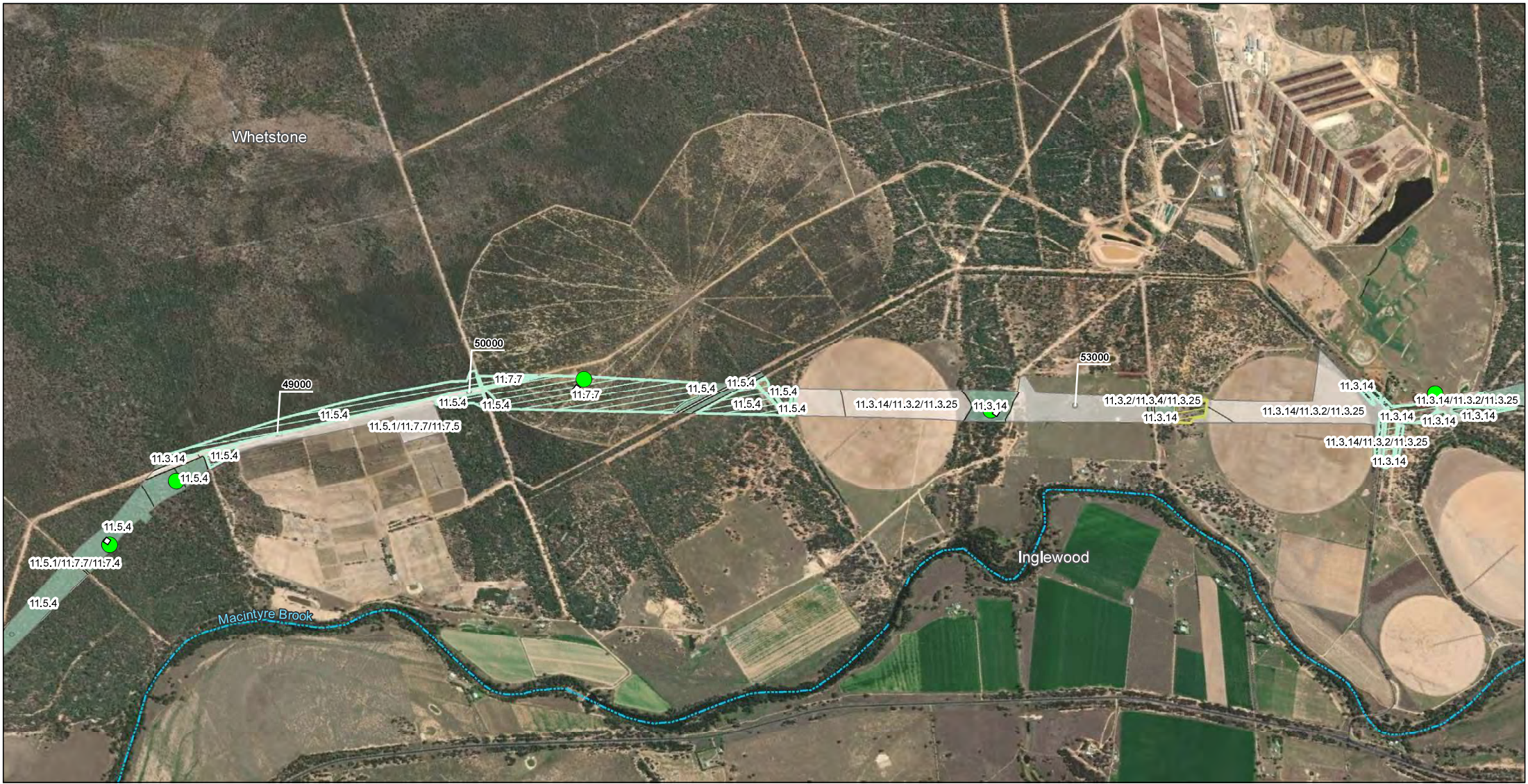
Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Of Concern
 - Remnant - Least Concern
 - HVR - Of Concern
 - HVR- Least Concern
 - Regrowth - Of Concern
 - Non Remnant
- Other Features:**
- B2G Footprint
 - Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringality state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage



Document History:					
Rev	Reason for Issue	Author	Reviewer	Approver	Date
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-12 - Regional Ecosystem Mapping



02505007501,000Metres

Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

Remnant - Least Concern

HVR - Of Concern

HVR- Least Concern

Regrowth - Least Concern

Non Remnant

B2G Footprint

Habitat Assessment

Bioconditions

Chainage Points

Major Watercourse Lines

Bringality state forest

Whetstone state forest

Data Sources:

Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-13 - Regional Ecosystem Mapping

0 250 500 750 1,000 Metres

Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

- Remnant - Least Concern
- HVR - Of Concern
- HVR- Least Concern
- Regrowth - Of Concern
- Regrowth - Least Concern
- Non Remnant

- B2G Footprint
- Habitat Assessment
- Bioconditions
- Chainage Points
- Major Watercourse Lines
- Bringalily state forest
- Whetstone state forest

Data Sources:

- Ausecology
- Survey Layers
- State of Queensland Department of Environment
- Major WatercourseLines
- State Forest
- ARTC
- Footprint
- Chainage

Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
A	Internal Draft	JS	AD	LG	20/12/2021
B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-14 - Regional Ecosystem Mapping



02505007501,000Metres

Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

- Remnant - Of Concern
- Remnant - Least Concern
- HVR - Of Concern
- Regrowth - Least Concern
- Non Remnant

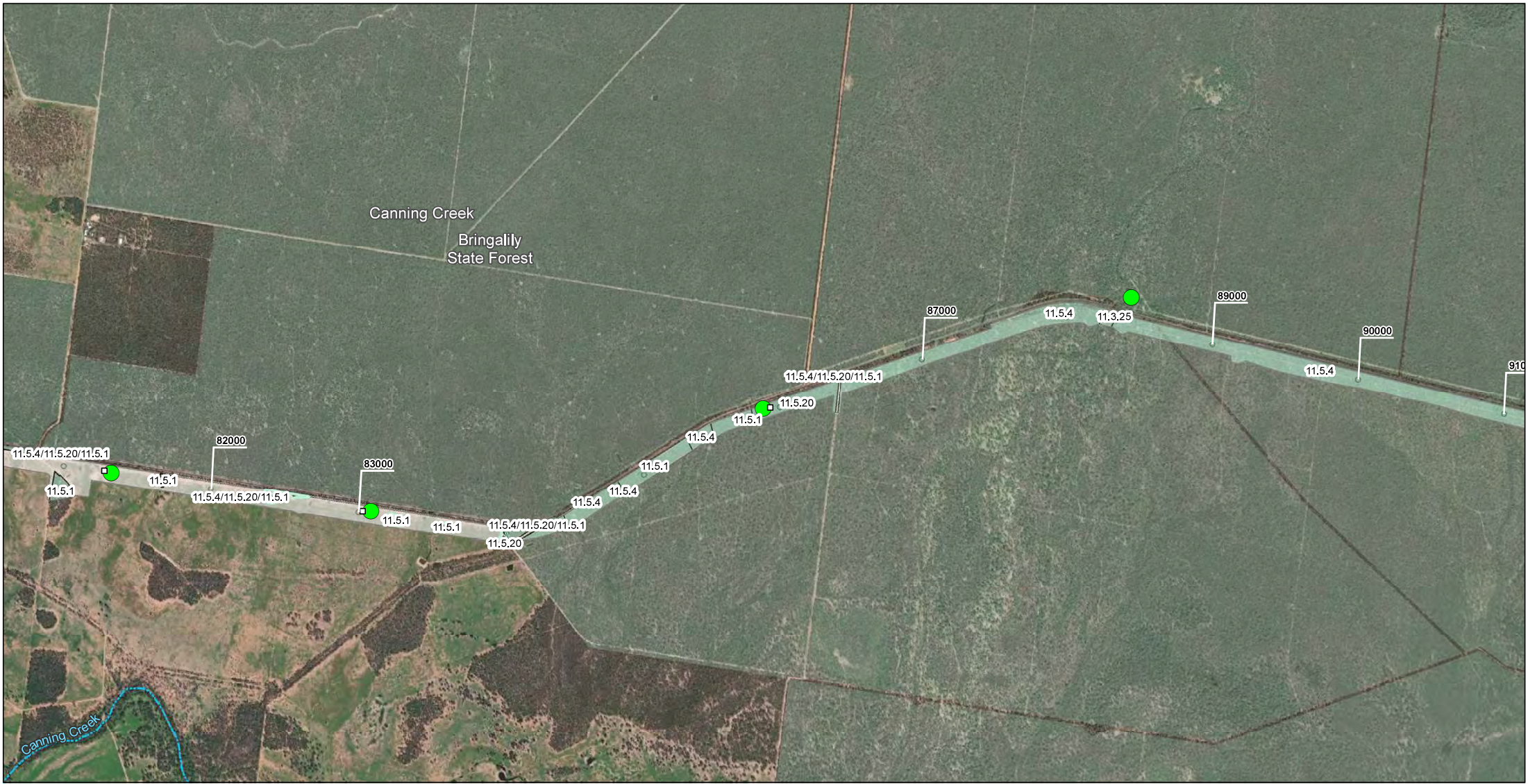
- B2G Footprint
- Habitat Assessment
- Bioconditions
- Chainage Points
- Major Watercourse Lines
- Bringalily state forest
- Whetstone state forest

Data Sources:

- Ausecology
- Survey Layers
- State of Queensland Department of Environment
- Major WatercourseLines
- State Forest
- ARTC
- Footprint
- Chainage



Document History:					
Rev	Reason for Issue	Author	Reviewer	Approver	Date
A	Internal Draft	JS	AD	LG	20/12/2021
B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-16 - Regional Ecosystem Mapping


0 250 500 750 1,000
Metres

Scale 1:25,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

- Remnant - Least Concern
- HVR- Least Concern
- Regrowth - Least Concern
- Non Remnant

- B2G Footprint
- Habitat Assessment
- Bioconditions
- Chainage Points
- Major Watercourse Lines
- Bringalily state forest
- Whetstone state forest

Data Sources:

- Ausecology
- Survey Layers
- State of Queensland Department of Environment
- Major WatercourseLines
- State Forest
- ARTC
- Footprint
- Chainage



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-18 - Regional Ecosystem Mapping



0250500
Metres

Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

Remnant - Endangered

Remnant - Of Concern

Remnant - Least Concern

HVR - Of Concern

Regrowth - Endangered

Regrowth - Of Concern

Non Remnant

B2G Footprint

Habitat Assessment

Bioconditions

Chainage Points

Major Watercourse Lines

Bringalily state forest

Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage

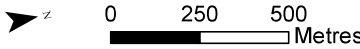


Document History:

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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-19 - Regional Ecosystem Mapping



Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Endangered
 - Remnant - Least Concern
 - HVR - Endangered
 - Regrowth - Endangered
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringalily state forest
 - Whetstone state forest

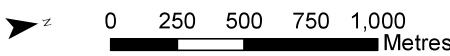
Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:					
Rev	Reason for Issue	Author	Reviewer	Approver	Date
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-20 - Regional Ecosystem Mapping



Legend

- GTRE (Vegetation Condition, VM Status)**
- HVR - Endangered
 - HVR - Of Concern
 - Non Remnant
- Other Features:**
- B2G Footprint
 - Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringalilly state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage

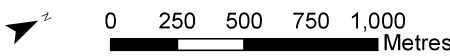


Document History:

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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-21 - Regional Ecosystem Mapping



Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

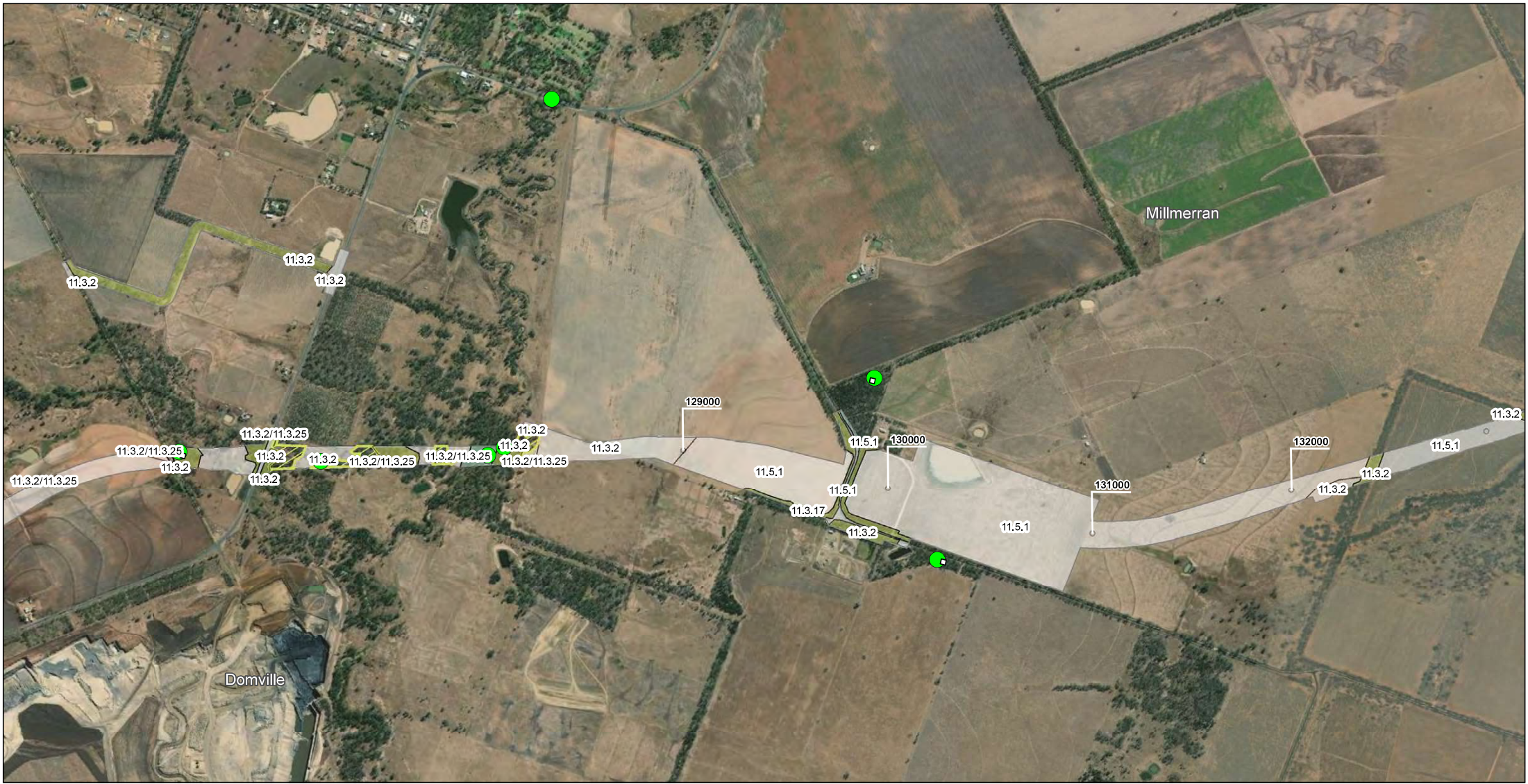
- GTRE (Vegetation Condition, VM Status)**
- Remnant - Endangered
 - Remnant - Least Concern
 - HVR - Endangered
 - Regrowth - Endangered
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringality state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-22 - Regional Ecosystem Mapping



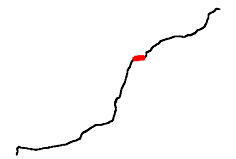
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Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Of Concern
 - Remnant - Least Concern
 - HVR - Of Concern
 - Regrowth - Of Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringality state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:

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D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-23 - Regional Ecosystem Mapping



02505007501,000
Metres

Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend
GTRE (Vegetation Condition, VM Status)

Remnant - Of Concern

Remnant - Least Concern

Regrowth - Of Concern

Non Remnant

B2G Footprint

Habitat Assessment

Bioconditions

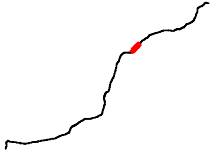
Chainage Points

Major Watercourse Lines

Bringalily state forest

Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



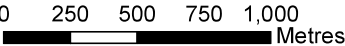
Document History:

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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-24 - Regional Ecosystem Mapping



Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

- Remnant - Least Concern
- Non Remnant

- B2G Footprint
- Habitat Assessment
- Bioconditions
- Chainage Points
- Major Watercourse Lines
- Bringalily state forest
- Whetstone state forest

Data Sources:

- Ausecology
- Survey Layers
- State of Queensland Department of Environment
- Major Watercourse Lines
- State Forest
- ARTC
- Footprint
- Chainage

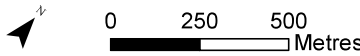


Document History:

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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-25 - Regional Ecosystem Mapping



Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Of Concern
 - HVR- Least Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
- Major Watercourse Lines**
- Bringality state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
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C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-26 - Regional Ecosystem Mapping



02505007501,000Metres

Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

Remnant - Of Concern

HVR - Of Concern

Regrowth - Of Concern

Non Remnant

B2G Footprint

Habitat Assessment

Bioconditions

Chainage Points

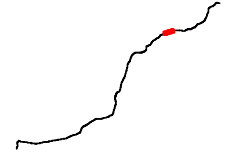
Major Watercourse Lines

Bringalily state forest

Whetstone state forest

Data Sources:

Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:

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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-27 - Regional Ecosystem Mapping



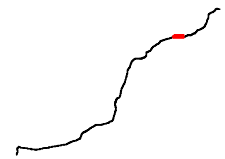
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Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Endangered
 - Remnant - Of Concern
 - Remnant - Least Concern
 - HVR - Endangered
 - HVR - Least Concern
 - Regrowth - Least Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringalily state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage



Document History:					
Rev	Reason for Issue	Author	Reviewer	Approver	Date
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C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-28 - Regional Ecosystem Mapping



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Metres

Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

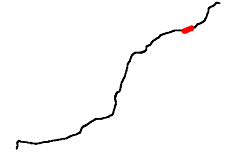
GTRE (Vegetation Condition, VM Status)

- Remnant - Of Concern
- Remnant - Least Concern
- HVR- Least Concern
- Non Remnant

- B2G Footprint
- Habitat Assessment
- Bioconditions
- Chainage Points
- Major Watercourse Lines
- Bringality state forest
- Whetstone state forest

Data Sources:

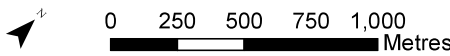
- Ausecology
- Survey Layers
- State of Queensland Department of Environment
- Major WatercourseLines
- State Forest
- ARTC
- Footprint
- Chainage



Document History:					
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-29 - Regional Ecosystem Mapping



Scale 1:20,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Least Concern
 - HVR- Least Concern
 - Regrowth - Least Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringalily state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage

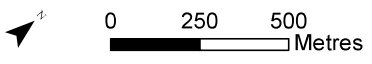


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Appendix A-30 - Regional Ecosystem Mapping



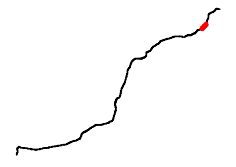
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Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Least Concern
 - HVR- Least Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringality state forest
 - Whetstone state forest

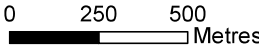
Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:					
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C	Internal Draft	JS	LG	LG	06/01/2022
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Appendix A-31 - Regional Ecosystem Mapping



Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Of Concern
 - Remnant - Least Concern
 - HVR- Least Concern
 - Non Remnant
- B2G Footprint**
- Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringalily state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage

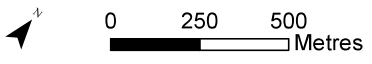


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C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-32 - Regional Ecosystem Mapping



Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Of Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
- Major Watercourse Lines**
- Bringality state forest
 - Whetstone state forest

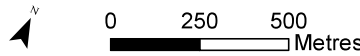
Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major Watercourse Lines
State Forest
ARTC
Footprint
Chainage



Document History:					
Rev	Reason for Issue	Author	Reviewer	Approver	Date
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B	Internal Draft	JS	AD	LG	22/12/2021
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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix A-33 - Regional Ecosystem Mapping



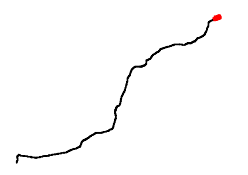
Scale 1:15,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

- GTRE (Vegetation Condition, VM Status)**
- Remnant - Of Concern
 - HVR- Least Concern
 - Regrowth - Least Concern
 - Non Remnant
- B2G Footprint**
- Habitat Assessment
 - Bioconditions
 - Chainage Points
 - Major Watercourse Lines
 - Bringalily state forest
 - Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:					
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D	Internal Draft	JS	LG	LG	12/05/2022





Appendix A-34 - Regional Ecosystem Mapping



0250500
Metres

Scale 1:10,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Legend

GTRE (Vegetation Condition, VM Status)

 Regrowth - Of Concern

 Non Remnant

 B2G Footprint

 Habitat Assessment

 Bioconditions

 Chainage Points

 Major Watercourse Lines

 Bringalily state forest

 Whetstone state forest

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major WatercourseLines
State Forest
ARTC
Footprint
Chainage



Document History:

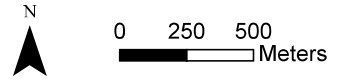
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B	Internal Draft	JS	AD	LG	22/12/2021
C	Internal Draft	JS	LG	LG	06/01/2022
D	Internal Draft	JS	LG	LG	12/05/2022

Appendix B – Threatened Ecological Communities



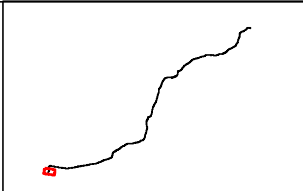
Appendix B-1 - Threatened Ecological Communities

ARTC - B2G



- Legend**
- TEC Type**
- Poplar Box TEC
 - B2G Alignment
 - Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:					
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C	Internal Draft	JS	LG	LG	31/03/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-2 - Threatened Ecological Communities

ARTC - B2G



0 250 500
Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

Page 2 of 21

Legend

TEC Type

Brigalow TEC



B2G Alignment



Chainage Points

Data Sources:

Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



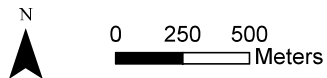
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C	Internal Draft	JS	LG	LG	31/03/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-3 - Threatened Ecological Communities

ARTC - B2G



Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

Brigalow TEC



B2G Alignment



Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-4 - Threatened Ecological Communities

ARTC - B2G



0 250 500
Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

Brigalow TEC



B2G Alignment



Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-5 - Threatened Ecological Communities

ARTC - B2G



0 250 500
Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

Brigalow TEC



B2G Alignment



Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage

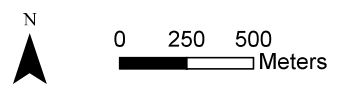


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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-6 - Threatened Ecological Communities
ARTC - B2G



Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

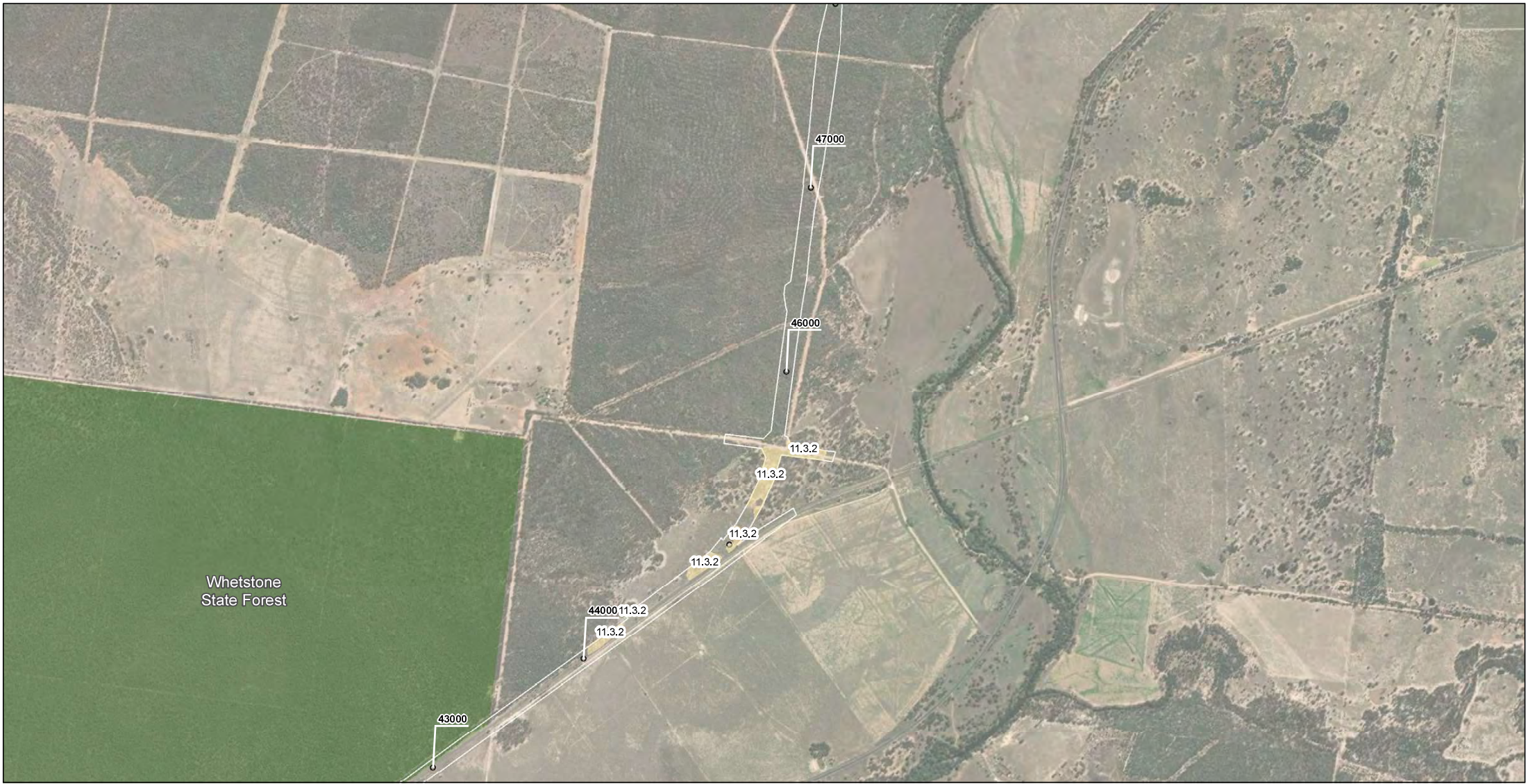
- TEC Type**
-  Brigalow TEC
 -  State Forest
 -  B2G Alignment
 -  Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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C	Internal Draft	JS	LG	LG	31/03/2022
D	Internal Draft	JS	LG	LG	12/05/2022





Appendix B-7 - Threatened Ecological Communities
ARTC - B2G



0 250 500
Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

Legend

TEC Type

 Poplar Box TEC
  State Forest

 B2G Alignment
  Chainage Points

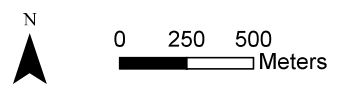
Data Sources:
 Ausecology
 Survey Layers
 State of Queensland Department of Environment
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 Vegetation Management Act 1999 Status
 ARTC
 Footprint
 Chainage



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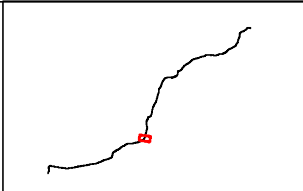
Appendix B-8 - Threatened Ecological Communities
ARTC - B2G



- Legend**
- TEC Type**
- Brigalow TEC
 - State Forest
 - Chainage Points

- B2G Alignment

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:					
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D	Internal Draft	JS	LG	LG	12/05/2022





Appendix B-9 - Threatened Ecological Communities
ARTC - B2G



N

0 250 500

Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

Brigalow TEC

Poplar Box TEC

B2G Alignment

State Forest

Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage

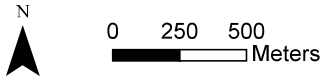


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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-10 - Threatened Ecological Communities
ARTC - B2G



- Legend**
- TEC Type**
-  Brigalow TEC
 -  B2G Alignment
 -  Chainage Points

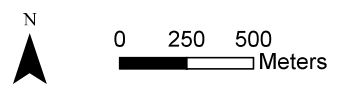
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State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
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Footprint
Chainage



Document History:					
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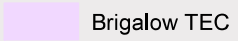
Appendix B-11 - Threatened Ecological Communities
ARTC - B2G



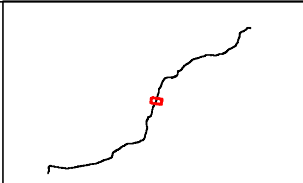
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Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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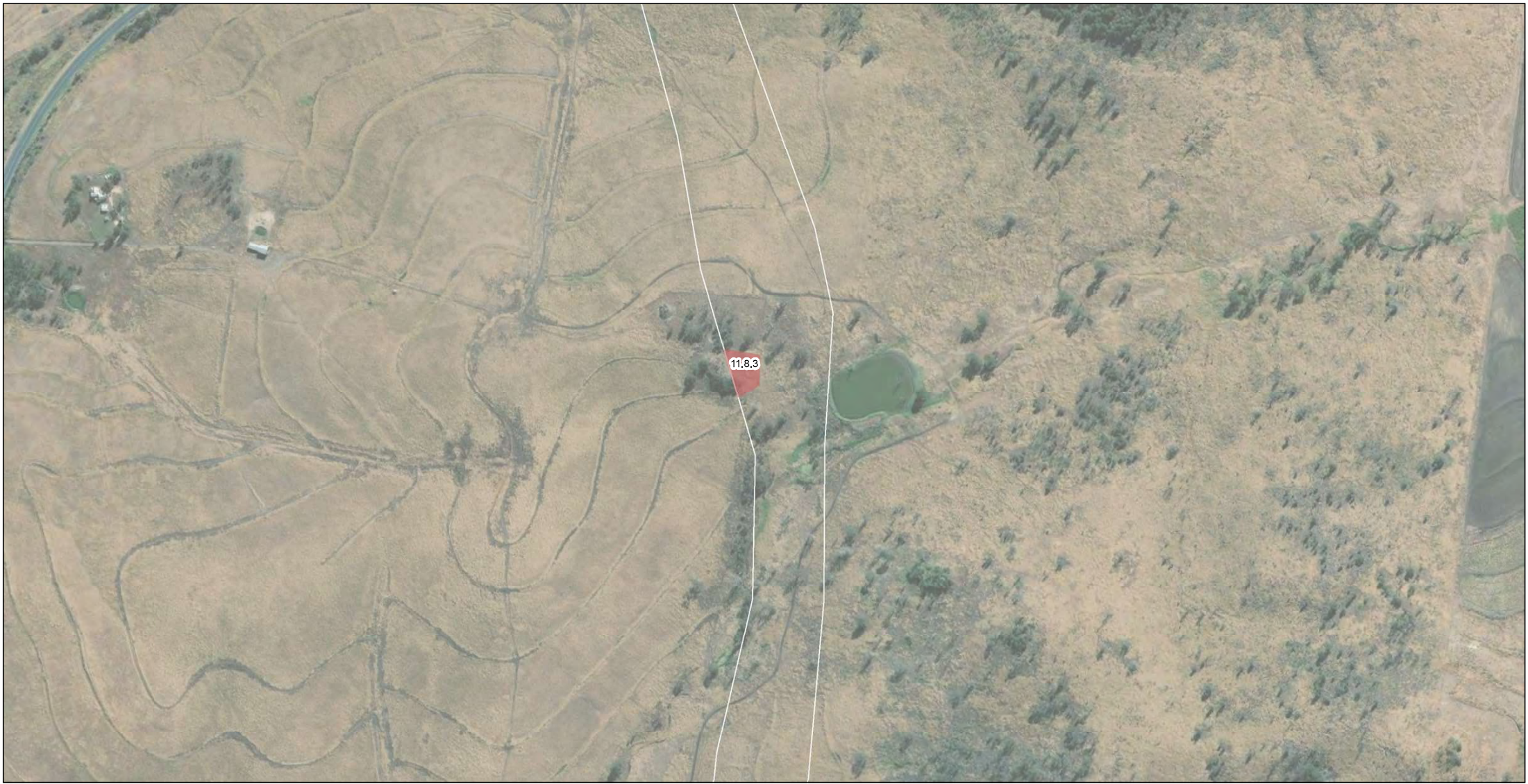
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- TEC Type**
-  Brigalow TEC
 -  B2G Alignment
 -  Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:					
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Appendix B-12 - Threatened Ecological Communities
ARTC - B2G



0 80 160
Meters

Scale 1:4,500 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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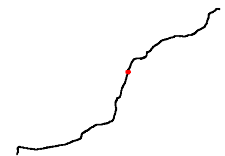
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TEC Type

SEVT TEC

B2G Alignment

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-13 - Threatened Ecological Communities
ARTC - B2G



0 80 160
Meters

Scale 1:4,500 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

 Box-Gum Grassy Woodland TEC

 B2G Alignment

 Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



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Appendix B-14 - Threatened Ecological Communities
ARTC - B2G



Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

 Poplar Box TEC

 B2G Alignment

 Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-15 - Threatened Ecological Communities
ARTC - B2G



0 250 500
Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

 Poplar Box TEC



B2G Alignment



Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage

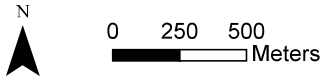


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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-16 - Threatened Ecological Communities
ARTC - B2G



Legend

TEC Type

 Natural Grasslands NSW and QLD TEC

 B2G Alignment
 Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-17 - Threatened Ecological Communities
ARTC - B2G



0 165 330
Meters

Scale 1:9,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

 Natural Grasslands NSW and QLD TEC

 B2G Alignment

 Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-18 - Threatened Ecological Communities

ARTC - B2G



0 112.5 225 Meters

Scale 1:6,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

Brigalow TEC

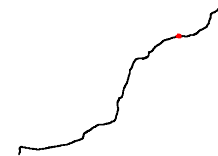


B2G Alignment



Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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C	Internal Draft	JS	LG	LG	31/03/2022
D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-19 - Threatened Ecological Communities
ARTC - B2G



Scale 1:6,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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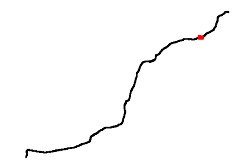
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TEC Type

 Natural Grasslands NSW and QLD TEC

 B2G Alignment
 Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-20 - Threatened Ecological Communities
ARTC - B2G



0 250 500
Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

 Natural Grasslands NSW and QLD TEC

 B2G Alignment

 Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



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D	Internal Draft	JS	LG	LG	12/05/2022



Appendix B-21 - Threatened Ecological Communities

ARTC - B2G



0 250 500
Meters

Scale 1:20,000 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

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Legend

TEC Type

 Natural Grasslands NSW and QLD TEC

 B2G Alignment

 Chainage Points

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
major watercourse lines
Vegetation Management Act 1999 Status
ARTC
Footprint
Chainage



Document History:

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C	Internal Draft	JS	LG	LG	31/03/2022
D	Internal Draft	JS	LG	LG	12/05/2022

Appendix C – Cardno Ecological Survey Report

Ecological Assessment Report

Border to Gowrie

NE30044

2-093-310-EAP-00-RP-001_D



Prepared for
Australian Rail Track Corporation

30 July 2021

Contact Information

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Fortitude Valley QLD 4006

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David Francis

Senior Principal -

Environment

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Executive Summary

During the period 19 October and 13 November 2020 (the Spring Survey Period), and 8 March to 27 March 2021 (the Post-Wet Survey Period), Cardno delivered a series of terrestrial ecology assessments on behalf of Australian Rail Track Corporation (ARTC). The purpose of these assessments was to build upon the studies undertaken for the draft Environmental Impact Statement for the Inland Rail Border to Gowrie (B2G) project (the Project), and are required to inform the detailed design and construction of the Project. More specifically, the objective of these surveys was to determine the presence or likelihood of presence for species and/or ecological communities protected under relevant State and Commonwealth legislation and local government environmental planning requirements.

The 'Survey Area' included the:

- > 'Project footprint' (as defined in the Environmental Impact Statement (EIS)).
- > A 100m buffer to centreline of the proposed rail combined with the Project footprint being the 'Flora Study Area'.
- > Targeted terrestrial fauna survey sites, which comprise a number of locations that extend 1km from a mid-point centred on the alignment.

The key findings of the surveys completed for the Project have been outlined below.

Vegetation Communities

A total of 20 Regional Ecosystems (RE) were recorded and mapped within the project footprint, including two listed as Endangered under the *Vegetation Management Act 1999* (VM Act) and five listed as Of Concern. The REs recorded and mapped include the following:

- > Endangered REs: 11.4.3 and 11.9.5;
- > Of Concern REs: 11.3.2, 11.3.4, 11.3.21, 11.5.14, 11.8.11 and 11.9.7; and
- > Least Concern REs: 11.3.14, 11.3.18, 11.3.25, 11.3.27b, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.4, 11.7.7, 11.8.4 and 11.8.5.

The following Threatened Ecological Communities (TECs) scheduled under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded within the Flora Study Area:

- > Brigalow (*Acacia harpophylla* dominant and co-dominant) (Endangered)
- > Poplar Box Grassy Woodland on Alluvial Plains (Endangered);
- > Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered);
- > Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered); and
- > White box-yellow box- Blakely's red gum grassy woodland and derived native grasslands (Critically Endangered).

Flora Species

Over the course of the surveys, a total of ten threatened flora species listed under either the EPBC Act and/or *Nature Conservation Act 1992* (NC Act) were observed. Individual samples from populations of suspected threatened flora were verified during field surveys or identified upon completion of field work. A small number of samples were also submitted to the Queensland Herbarium for verification of 'in field' identifications made by Cardno. Of these species; seven are listed under the EPBC Act, and are considered to be Matters of National Environmental Significance (MNES). Six of the EPBC listed species are also listed under NC Act. Two species are listed solely under the NC Act, however only one, *Picris barbarorum* is a Matter of State Environmental Significance (MSES) as *Digitaria porrecta* (Finger Panic) is listed as Near Threatened which do not constitute MSES. The ten threatened species recorded during Cardno's surveys included:

- > *Cyperus clarus* (NC Act);
- > *Dichanthium queenslandicum* (King Bluegrass; NCA and EPBC Act);
- > *Digitaria porrecta* (Finger Panic; NC Act);
- > *Homopholis belsonii* (Belson's Panic; EPBC Act);

- > *Lepidium monoplacoides* (Winged peppergrass; NCA and EPBC Act);
- > *Picris barbarorum* (NC Act);
- > *Picris evae* (Hawkweed; NCA and EPBC Act);
- > *Rhaponticum australe* (Austral cornflower; NCA and EPBC Act);
- > *Westringia parvifolia* (NCA and EPBC Act); and
- > *Xerothamnella herbacea* (NCA and EPBC Act).

Fauna Species and Habitat

A total of 281 fauna species were observed during the surveys. Of the species observed, eight are listed under either the EPBC Act or NC Act. All observations of fauna species were verified during field surveys by fauna specialists. Two suspected observations of the threatened New Holland mouse (*Pseudomys novaehollandiae*) were submitted to the Queensland Museum for verification and ultimately determined to be Delicate mouse (*Pseudomys delicatulus*). Five of these are listed under both the EPBC Act and the NC Act and are considered to be both MNES and MSES, while four of the species found are listed under the NC Act only and are considered to be as MSES. Threatened fauna species recorded during Cardno's fauna surveys included:

- > *Calyptorhynchus lathami lathami* (Glossy black-cockatoo (eastern); NC Act);
- > *Pteropus poliocephalus* (Grey-headed Flying-fox; NCA and EPBC Act);
- > *Grantiella picta* (Painted honeyeater; NC Act);
- > *Hirundapus caudacutus* (White-throated needletail; NCA and EPBC Act);
- > *Nyctophilus corbeni* (South-eastern long-eared bat; NCA and EPBC Act);
- > *Phascolarctos cinereus* (Koala; NCA and EPBC Act);
- > *Tachyglossus aculeatus* (Short-beaked echidna; NC Act); and
- > *Hemiaspis damelii* (Grey snake; NC Act).

High quality fauna habitat was identified in various locations throughout the project area particularly within areas of remnant and regrowth vegetation, but also within narrow and moderately disturbed environments associated with the existing road reserve and rail line. Observations of recognised fauna habitat features included the opportunistic recording of 1,824 potential animal breeding places within close proximity to the proposed alignment. Hollows within hollow-bearing trees and stags were the most frequently recorded animal breeding place during the surveys.

Weeds and Pests

An array of exotic flora and fauna species was observed during the survey period. In terms of flora, this included 12 Category 3 – Restricted invasive pest plants listed under the *Biosecurity Act 2014*; four of which are also listed as Weeds of National Significance (WONS; denoted with an Asterix), with *Opuntia tomentosa* being the most widely distributed and having the highest density throughout the alignment. Observed Restricted invasive pest plants included:

- > *Asparagus africanus* (Climbing asparagus fern);
- > *Harrisia martinii* (Harrisia);
- > *Harrisia pomanensis* (Harrisia);
- > *Harrisia tortuosa* (Harrisia);
- > *Opuntia aurantiaca* (Tiger pear) *;
- > *Opuntia stricta* (Prickly pear) *;
- > *Opuntia tomentosa* (Velvety tree pear) *;
- > *Bryophyllum delagoense* (Mother of millions);
- > *Lycium ferocissimum* (African boxthorn) *;
- > *Dolichandra unguis-cati* (Cat's claw creeper);
- > *Celtis sinensis* (Chinese elm); and

- > *Lantana montevidensis* (Creeping lantana).

Five restricted invasive fauna species listed under the *Biosecurity Act 2014* were recorded within the survey area, including:

- > *Canis lupus* (Dingo);
- > *Felis catus* (Cat);
- > *Mus musculus* (House mouse);
- > *Sus scrofa* (Feral pig); and
- > *Vulpes vulpes* (European fox).

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1 Introduction

Cardno has been commissioned by Australian Rail Track Corporation (ARTC) to complete ecological assessments for the Inland Rail - Border to Gowrie (B2G) Project (the Project), including both the temporary and permanent disturbance footprints of the reference design used in the Project's Environmental Impact Statement (EIS) reporting. The aim of these assessments is to determine the presence, location, extent, quality and significance of any species or ecological communities protected under relevant State, Commonwealth or local government environmental planning legislation. The aim of these ecological assessments is to provide information to the Project that will allow it to:

- > avoid, minimise and mitigate impacts to these species and/or communities; and
- > determine the resulting significant residual impacts (where impacts have been deemed unavoidable) for the purpose of establishing the offset obligation associated with the Project.

The field survey methods used to complete this assessment incorporate seasonal surveys for the purpose of identifying certain fauna and flora species as identified in Commonwealth, State and industry guidelines. The surveys were completed in spring (Spring Survey Period) and autumn (Post-wet Survey Period) to coincide with the preferred seasonal survey timeframes for threatened fauna, flora and ecological communities that may occur in the Project area.

1.1 Ecological Assessment Report Scope

This Ecological Assessment Report (EAR) provides a summary of the methodologies and results of the targeted flora and fauna surveys that were completed following the Stage 1 - Detailed Desktop Assessment and Gap Analysis stage of the Project.

Specifically, the objectives of the field assessments were to provide information relating to the following:

- > Presence and distribution of Matters of National, State and Local Government Environmental Significance (MNES, MSES and MLES) and/or their associated habitats;
- > Collection of data that will ultimately help inform ARTC's Offset Strategy planning requirements and Project offset obligations for both State and Commonwealth requirements;
- > Presence and distribution of invasive plants and animals listed under the *Biosecurity Act 2014* (Biosecurity Act) or as key threatening processes under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- > Collection of data that will ultimately be used to support preparation of compliance and approvals, including secondary approvals; and
- > Collection of baseline data that may be used to support site restoration, rehabilitation and landscaping practices.

This EAR describes the environmental values present within the bounds of the 'Survey Area' for the Project, which specifically includes the following:

- > 'Project footprint' (as defined in the Environmental Impact Statement (EIS)). This incorporates the construction compound, permanent and temporary construction impact zones, laydown, stockpile and storage areas
- > A 100m buffer to centreline of the proposed rail combined with the Project footprint being the 'Flora Study Area'.
- > Targeted terrestrial fauna survey sites, which comprise a number of locations that extend 1km from a mid-point centred on the alignment.

It is understood that the Project's EIS will be updated using the findings of this report to address the implications of the ecological findings, particularly with regards to offset obligations, while a range of Project specific flora and fauna management plans will be prepared that address potential impacts and the associated impact avoidance and minimisation measure that can be employed by the Project.

1.2 Site Locality

The Project extends from the Queensland and New South Wales border (approximately 18 km to the south-east of Goondiwindi) to Gowrie (before the Inland Rail connection to Queensland Rail's West Moreton line on the south-eastern outskirts of Kingsthorpe). The Project provides a link between the adjacent Inland Rail projects of:

- > North Star to New South Wales/Queensland border, in the south at the Macintyre River; and
- > Gowrie to Helidon project in the north, which connects into Queensland Rail's (QR) West Moreton Line.

The Project occurs within the Goondiwindi Regional Council (GRC) and Toowoomba Regional Council (TRC) local government areas (LGAs). The project area is entirely within the Brigalow Belt South bioregion. From the west to east, the Project is located within the Commoroon Creek Floodout subregion, Inglewood Sandstones subregion and the Eastern Darling Downs subregion. The extent of the Project is shown in **Figure 1-1**.

The Project footprint traverses approximately 216 km across multiple lots of varying land uses, and is situated close to a number of towns, rivers and state forests.

- > The following towns are in close proximity to the Project footprint:
 - > Yelarbon;
 - > Inglewood;
 - > Millmerran;
 - > Pampas;
 - > Brookstead;
 - > Pittsworth;
 - > Southbrook;
 - > Wellcamp; and
 - > Gowrie Junction.
- > The following rivers and forests traverse the Project alignment:
 - > Macintyre River and Macintyre Brook;
 - > Condamine River and Condamine River – North Branch and associated flood plains; and
 - > Bringalily and Whetstone State Forests.
- > The dominant land-uses surrounding the Project footprint are primarily:
 - > agricultural, including grazing and cropping;
 - > light commercial and industrial;
 - > rural residential settlements; and
 - > the Wellcamp Airport and nearby quarry operations.

The Project is located within the Brigalow Belt South bioregion and as such is characterised by a subhumid climate with no pronounced Spring season. It consists of landscapes derived from extensive basalt flows and quartz sandstones with variable soils and vegetation depending on the local rock type or sediment present. The land within the broad locality of the Project has undergone extensive modification, with much of the land either cleared or modified for agricultural or resource development purposes. Most remaining areas of intact vegetation occur within State forests, along roadsides or as isolated remnant patches (ARTC, 2019).

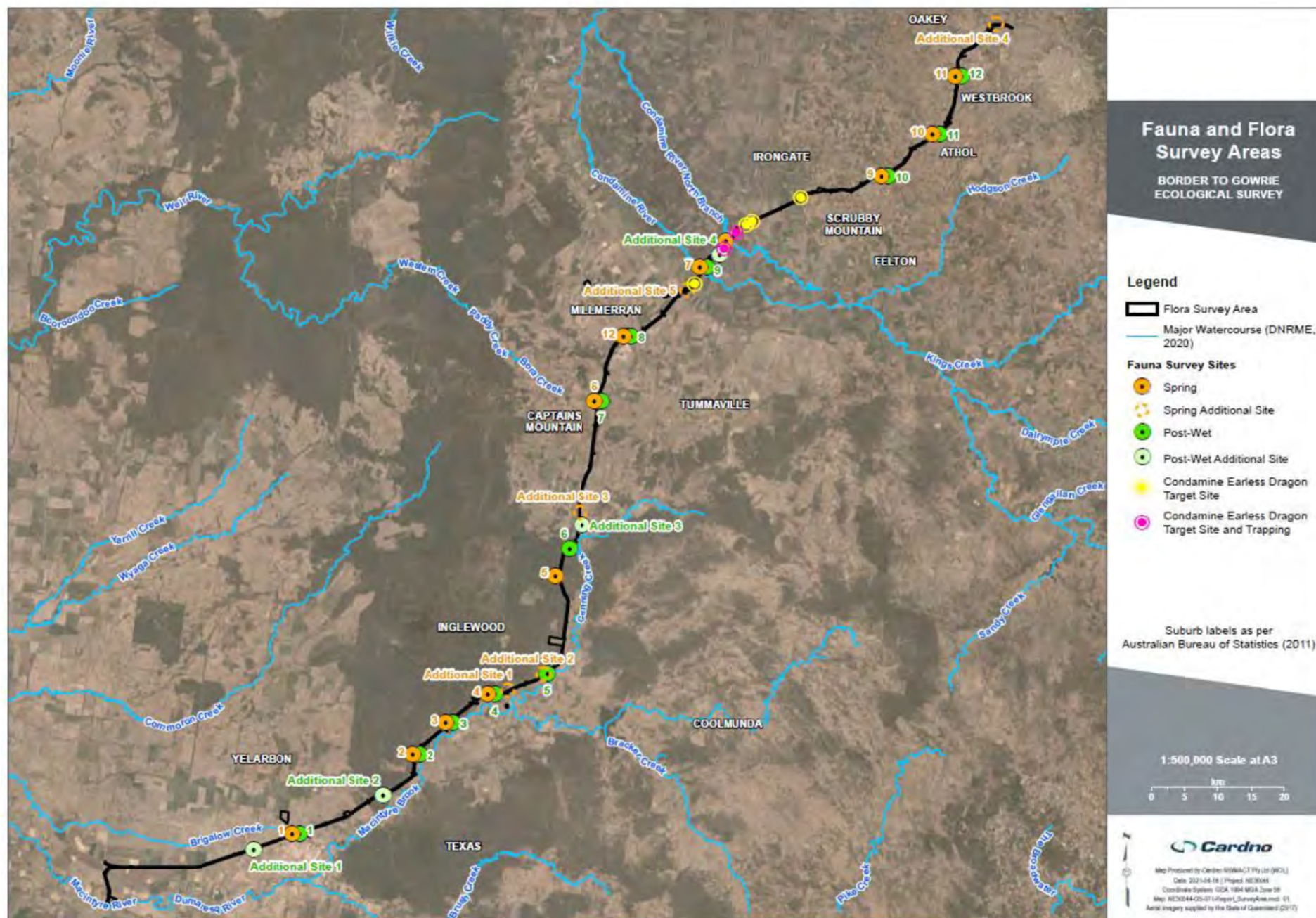


Figure 1-1 Ecological Survey Area

1.3 Proposed Works

The Project is one of the 13 projects that make up the Inland Rail Program for the delivery of 1,700 km of freight rail line. Five of these projects are located in Queensland. The Project will provide one of the missing links within the Inland Rail Program, which provides a more direct route between the Melbourne and Brisbane when compared to existing inland and coastal road and rail networks. The Project connects directly to the North Star to Border (NS2B) project to the south and the Gowrie to Helidon (G2H) project in the northeast.

The B2G Project has been intentionally located along the existing South Western Line and Millmerran Branch Line rail corridors where possible to minimise the extent and number of new properties requiring acquisition. The construction will include a 216.2 km section of new single-track railway between the NSW/QLD border and Gowrie, Queensland. Specifically, the Project includes the below-listed elements:

- > Construction of a ballasted track system (including bridges) consisting of continuously welded rail, fasteners, rail pads and concrete sleepers at 600 m centres;
- > Use of 7 km of standard-gauge rail and 209.2 km of dual standard/ narrow-gauge rail;
- > Establishment of 145 km of new rail corridor and use of 71.2 km of existing rail corridor (currently in use by Queensland Rail);
- > Rail corridor widening within existing rail corridor areas; and
- > Construction of new rail infrastructure, including crossing loops, turnouts, bridges, drainage infrastructure, road-rail interfaces, rain maintenance access roads, utility/service crossings, and fencing.

Additional information relating to the activities involved, the permanent and temporary disturbance footprints, and project chainages for the Project is provided in The Border to Gowrie Environmental Impact Statement (EIS) (ARTC, 2019).

2 Methodology

2.1 Desktop Assessment

Following review of the Project EIS, a Field Action Plan – Ecological Surveys (Field Action Plan) was prepared to provide a framework for the flora and fauna surveys within the Project footprint (Cardno, 2020). The Field Action Plan included a gap analysis and proposed additional flora and fauna survey efforts targeting threatened species that are known, likely, or have the potential to occur within the Survey Area. The process of identifying species that are known, or have the potential to occur within the Survey Area involved the below-listed actions:

- > Identifying those species listed in the Initial Advice Statement (IAS) Inland Rail – Border to Gowrie as potential, likely, or known to occur (ARTC, 2018).
- > Comparing those listed in the IAS with those presented in the EIS to identify whether all species have been considered in the EIS and/or whether the likelihood of presence was adjusted between the IAS and EIS. Specifically, the following sections of the EIS were considered:
- > Appendix J of the EIS (Terrestrial Ecology Technical Report) in Table 4.2, Table 4.5 and Appendix A (Tables 2.1 & 2.2) ('possible', 'likely' and 'known' species only); and
- > Appendix L of the EIS (Matters of National Environmental Significance Technical Report) in Appendix A (Table 2.1)
- > A review of contemporary information (i.e. Commonwealth's Protected Matters Search Tool [PSMT] and the Department of Environment and Science's WildNet database) consistent with the impact assessment area (i.e. 1 km radius from Project footprint) as defined in the EIS (Chapter 10 – Flora and Fauna) to determine whether additional species required assessment. Searches were expanded to include a 1 km buffer from laydown areas and the construction footprint, to ensure species captured included those impacted by additional infrastructure not previously addressed in the EIS.

The assessment also extended to identification of known and likely Regional Ecosystems (REs) scheduled under the *Vegetation Management Act 1999* and Threatened Ecological Communities (TECs) scheduled under the EPBC Act. REs include those mapped as remnant (Category B) and high-value-regrowth (Category C) by the Department of Resources. Likely TECs include those identified in the PMST output and can include vegetation that, at a State level, is mapped as remnant, High Value Regrowth or non-remnant.

Field assessment survey effort was determined following completion of the gap analysis detailed above. This analysis identified that Spring and Post-wet season surveys would be most appropriate for detection of the target species and to comply with relevant Commonwealth and State guidelines.

More detailed information regarding the desktop assessment process is provided in the Project's Field Action Plan (Cardno, 2020), which is provided in **Appendix A**.

2.2 Survey Area

Surveys were undertaken at a variety of sites within the Survey Area over the course of the Spring and Post-wet Survey Periods. The locations of the survey sites were determined following consideration of areas which had not been previously subject to adequate surveys as part of the EIS, ensuring inclusion of:

- > Representative examples of each distinct vegetation community (REs and/or TECs) and, where appropriate, accounting for remnant, regrowth and non-remnant areas;
- > Landscape features that were considered likely to support threatened species based on known habitat preferences; and
- > Areas known or predicted to support threatened species and other MNES and MSES.

The extent of the Survey Area, showing sites surveyed during both the Spring and Post-wet Survey Periods is shown in **Figure 1-1**.

2.3 Field Assessment - Flora

Targeted flora and vegetation community surveys were undertaken over a 26-day period from 19 October to 13 November 2020 (the Spring Survey Period) and a 30-day period from 25 February to 27 March 2021 (the Post-wet Survey Period). In addition to the two main survey periods, a targeted threatened flora survey was completed within a portion of the existing rail line between Millmerran and Pittsworth between 26 February and 13 March 2021.

All surveys involved traversing the Survey Area by two teams of two suitably qualified ecologists. Specifically, areas within the Survey Area were surveyed to assess the locations of TECs; presence, accuracy and habitat quality of REs containing remnant and both regulated and unregulated regrowth vegetation; and locations of protected flora and declared weeds identified as likely to occur in the EIS.

2.3.1 Vegetation Communities

2.3.1.1 Regional Ecosystems

The floristics and structure of RE mapped areas within the Survey Area was captured using Quaternary plots as described within the *Methodology for surveying and mapping Regional Ecosystems and vegetation communities in Queensland (Version 5.1)*, (Neldner *et al.* 2020). Particular focus was given to Endangered (11.3.21, 11.4.3 & 11.9.5) and Of Concern (11.3.2, 11.3.4 & 11.9.7) REs mapped as being within the Survey Area. Where access was not permitted, or impracticable, data points were collected from adjacent accessible areas (with the aid of binoculars where necessary) and the point manually shifted to the relevant target 'patch' using the editing capabilities of Arc Collector software in the field.

2.3.1.2 Biocondition

Vegetation quality was assessed and scored in accordance with the methodology contained within Chapter 1 of the *Guide to Determining Terrestrial Habitat Quality – version 1.3 February 2020*, which necessitated the use of Biocondition Assessment Sites. These Sites were primarily positioned within the construction footprint, with some extending into the 100m buffer associated with the Survey Area.

Following collection of field data further analysis was conducted to determine the overall Biocondition Score which required the calculation of landscape attributes.

In accordance with the *Guide to Determining Terrestrial Habitat Quality (2020; Version 1.3)*, site-based and landscape attributes are weighted to standardise relative 'importance', meaning the degree to which the attribute:

- > Has a potential impact upon long-term condition (e.g. non-native plants);
- > Is difficult or takes a long time to replace in a system if lost (e.g. large trees); and
- > Has habitat value based on empirical research.

The environmental attributes and their relative weightings have been displayed in **Table 2-1**.

Table 2-1 Biocondition Attributes and Relative Weightings

Field / Desktop	Attribute	Weighting (%)	Total (%)
Site-based condition attributes	Large Tress	15	80
	Tree canopy height	5	
	Recruitment of canopy species	5	
	Tree canopy cover	5	
	Shrub layer cover	5	
	Course woody debris	5	
	Native plant species richness for four lifeforms	20	
	Non-native plant cover	20	
	Native perennial grass cover (%)	5	
	Litter cover	5	
Landscape attributes (fragmented subregions)	Size of patch	10	20
	Context	5	
	Connectivity	5	

Field / Desktop	Attribute	Weighting (%)	Total (%)
TOTAL			100

BioCondition scores also consider Regional Ecosystem Benchmarks which provide quantitative values that are derived from reference or 'Best on Offer' sites relating to each BioCondition attribute. According to the *Guide to Determining Terrestrial Habitat Quality (2014)*, if there is no benchmark then a reference site must be established in accordance with the *Methodology for Establishment and Survey of Reference Sites for Biocondition (2017)*. Reference sites were chosen based on the 'best on offer' within the Flora Survey Area. Benchmarks were available for all REs assessed with the exception of 11.3.14 and 11.5.14.

2.3.1.3 Threatened Ecological Communities

For each TEC identified by the desktop assessment, corresponding REs (as described by the Commonwealth) were highlighted as potential TEC locations using the pre-clearing Regional Ecosystem spatial layer (QSpatial, 2018). Verification of TEC presence was completed via on-foot surveys. The steps used to assess the presence or absence of the TECs potentially present in the Study Area are outlined in **Table 2-2**, **Table 2-3** and **Table 2-4** below. This includes an additional TEC not identified as part of the desktop assessment, but identified during field work.

Table 2-2 Key diagnostic criteria and condition thresholds

TEC	Key diagnostic characteristics	Condition thresholds	Assessment approach
Brigalow (<i>Acacia harpophylla</i> dominant and codominant	The presence of Brigalow <i>Acacia harpophylla</i> as one of the most abundant tree species in the patch. <i>A. harpophylla</i> is either dominant in the tree layer, or co-dominant with other species (Notably Belah <i>Casuarina cristata</i> , other species of <i>Acacia</i> or <i>Eucalyptus</i> ; <u>and</u>	The patch is 0.5 ha or more in size; <u>and</u>	The approach utilised multiple streams of evidence to delineate patches of the TEC. This included:
	In Qld Brigalow Belt Bioregion and meets the description of one of the following REs: – 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21. <u>and/or</u>	Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.	1. Accepting an area as the TEC where there was a direct correlation with the remnant RE and the RE was ground truthed; and/or
	The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Qld REs (although species density may be reduced). This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise.		2. Undertaking Biocondition Assessment Sites in patches of woody vegetation supporting Brigalow and/or Belah to measure floristics, exotic cover and height ¹ ; and/or
Natural grassland on basalt and fine-textured alluvial plains of northern New	Distribution mainly in the Darling Downs of southern Queensland and the Liverpool Plains and Moree Plains of northern NSW. Occurrence is mainly associated with fine	Refer to condition thresholds detailed in Table 2-3 .	3. Quaternary assessments in patches of woody vegetation supporting Brigalow and/or Belah to ascertain floristics, exotic cover and height; or
			4. Aerial photographic review where the vegetation 'signature' is consistent with areas confirmed in the above three approaches.
			Patches <0.5ha were not included.
			A preliminary TEC map was prepared based on:

¹ Studies in the region indicate that Brigalow regrowth of >2-3m height approximates with regrowth that is 15 years old (J.Dwyer, unpublished data). Data collected in the Tara, Taroom and Dingo districts between September and December 2007.

TEC	Key diagnostic characteristics	Condition thresholds	Assessment approach
South Wales and southern Queensland	textured, often cracking clay soils derived from either basalt or alluvium. Occurrence on landforms that are typically flat to very low slopes (less than 5 percent/1 degree). Tree canopy usually absent to sparse, comprising less than 10% projective crown cover. The ground layer is typically dominated by perennial native grasses and contains 3 or more of the indicator native species listed below: – <i>Aristida leptopoda</i> – <i>Astrebla elymoides</i> – <i>Astrebla lappacea</i> – <i>Austrodanthonia bipartita</i> – <i>Austrostipa aristiglumis</i> – <i>Bothriochloa biloba</i> – <i>Bothriochloa erianthoides</i> – <i>Dichanthium sericeum</i> – <i>Digitaria divaricatissima</i> – <i>Elymus plurinervis</i> – <i>Eriochloa crebra</i> – <i>Eulalia aurea</i> Silky – <i>Panicum decompositum</i> – <i>Panicum queenslandicum</i> – <i>Thellungia advena</i> – <i>Themeda avenacea</i> – <i>Themeda triandra</i> (synonym. <i>T. australis</i>) – <i>Walwhalleya proluta</i>		1. The pre-clearing extent of RE 11.3.21; and 2. Identification of areas not impacted by disturbance (e.g. regular cropping, road surfaces, infrastructure). These largely included road and rail reserves. Ground truthing of all patches was undertaken through Quaternary sites and transects. The start and end of 100m transects were 'captured' as Biocondition Sites in Arc Collector. Consistent with the "Nationally Threatened Ecological Communities: Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland, and Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin - A guide to the identification, assessment and management of nationally threatened ecological communities" a 0.1ha area was assessed by assessing 5m either side of the 100m transect. Diagnostic species were identified within the 0.1ha area, and where insufficient diagnostic species were encountered in adjacent and contiguous areas within the patch. The number of clumps and weed cover were measured in six 1x1m quadrats placed at 0, 20, 40, 60, 80 and 100m (noting one transect did not employ quadrats). Depending on species/weed/woody vegetation cover criteria outlined in Table 2-3 patches >0.5 or 2ha were included in the mapping. Where Quaternary sites were the primary means of demarcation data captured included diagnostic species, weed abundance and extent of woody vegetation. Another important consideration was the substrate. Areas of anthropogenic fill (e.g. rail ballast) were disregarded even if diagnostic species were present.

TEC	Key diagnostic characteristics	Condition thresholds	Assessment approach
Weeping Myall Woodlands	The dominant overstorey species, Weeping Myall, goes through regular cycles of senescence and regeneration. As such, percentage canopy cover will fluctuate from very sparse to 30 percent. The death of canopy trees is not considered to be an indicator of poor condition. Consequently, a patch must fit the following criteria in order to be included in the listed ecological community: - the tree canopy is dominated (at least 50% of trees present) by living, dead or defoliated Weeping Myall trees; and - the overstorey must have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees/ha; and - the area is at least 0.5 ha in size; and - the patch has either: - more than two layers of regeneration of Weeping Myall present; or - the tallest layer of living, dead or defoliated Weeping Myall trees is at least 4 m tall and of the vegetative cover present, 50% is comprised of native species.		The occurrence of Weeping Myall was recorded where encountered during field work. Where encountered diagnostic criteria (e.g. presence of >24 Weeping Myall/ha) was considered.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	The White Box – Yellow Box – Blakely's Red Gum grassy woodlands that existed prior to European settlement now exists as remnants in three different states. The three states are: - An overstorey of eucalypt trees exists, but there is no substantial native understorey. - A native understorey exists, but the trees have been cleared. - Both a native understorey and an overstorey of eucalypts exist in conjunction. In order for an area to be included in the listed ecological community, a patch must have a predominantly native understorey.		Note: Only one patch of this community was identified during field work located on land to which access was not granted. The assessment was therefore undertaken from the edge of the land where <i>Eucalyptus albens</i> was the dominant canopy element. Binoculars were used to ascertain whether the patch met the TEC in accordance with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland information guide. Specifically, the assessment focused on: - The presence of an understorey that is predominantly native perennial vegetation (i.e. >50% cover); and - The presence or otherwise of 12 or more understorey species (excluding grasses) and the presence of at least one 'important species'; or - The presence of 20 or more mature trees/ha. Quaternary points and weed observation points were used to capture this diagnostic information.
Poplar Box Grassy Woodland on Alluvial Plains	Occurs in the Brigalow Belt North, Brigalow Belt South, Southeast Queensland, Cobar Penneplains, Darling Riverine Plains, NSW South Western Slopes, Riverina and Murray Darling Depression IBRA bioregions Associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, typically duplex soils or sodosols. This includes areas that may not be part of currently defined floodplains.	The minimum condition thresholds (Moderate and High condition categories A, B, or C) are provided in Table 2-4.	The approach utilised multiple streams of evidence to delineate patches of the TEC. This included: Accepting an area as the TEC where there was a direct correlation with the remnant RE and the RE was ground truthed (i.e. RE 11.3.2

TEC	Key diagnostic characteristics	Condition thresholds	Assessment approach
	A grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale. A tree canopy must be present that shows these features: - Canopy tree species are capable of reaching 10 m or more in height; - Poplar Box (<i>Eucalyptus populnea</i>) must be present in the canopy and is the dominant tree species; - Where hybrids of Poplar Box with other <i>Eucalyptus</i> spp. are present, they should be counted as part of the <i>Eucalyptus populnea</i> component of the tree canopy when assessing the previous criterion. Mid layer (1-10 m) crown cover of shrubs to small trees is low, about 30% or less. A ground layer (<1 m) mostly dominated across a patch by native grasses, other herbs and occasionally chenopods (during extended Spring periods), ranging from sparse to thick (in response to canopy development, soil moisture, disturbance and/or management history). A list of diagnostic native plant species and some of the key native fauna that make up the ecological community is provided as an appendix to the Conservation Advice (DEWHA, 2019).		which is wholly consistent with the TEC); and/or - Undertaking Biocondition Assessment Sites in patches of woody vegetation dominated by Poplar Box to measure floristics, exotic cover and tree density; and/or - Quaternary assessments in patches of woody vegetation dominated by Poplar Box to ascertain floristics, exotic cover and tree density (nb number of plant species were counted up to a maximum of 30 species); or - Aerial photographic review where the vegetation 'signature' is consistent with areas confirmed in the above three approaches. Patch sizes were ascertained in a GIS platform.
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	The recovery plan² for the community includes the following passage regarding the southern occurrence of the TEC: "The vine thickets occur mainly on hills on light clay soils derived from basalt (Benson et al. 1996) but also occur in areas with sandy loams derived from sediments (Williams 1999). The vine thickets are dominated by a variety of low tree and shrub species, with the species composition varying from north to south, possibly due to rainfall differences (Benson et al. 1996). Characteristic canopy species include red olive plum <i>Elaeodendron australe</i> var. <i>integrifolium</i>, peach bush <i>Ehretia membranifolia</i>, wilga <i>Geijera parviflora</i>, native olive <i>Notelaea microcarpa</i>, yellow lemon <i>Pouteria cotinifolia</i> var. <i>pubescens</i> and wallaby apple <i>Pittosporum spinescens</i>. The trees and tall shrubs are usually 2–10m tall (Floyd 1990)" Further, the listing advice states "To determine whether a vine thicket remnant is part of a listed regional ecosystem in Queensland its location should be checked against the distribution maps of the Queensland Environmental Protection Authority and/or against geology, soil or land system maps".	Not applicable	Species and structure were assessed in the field. The TEC is consistent with RE 11.8.3-Semi-evergreen vine thicket on Cainozoic igneous rocks. There is no minimum patch size prescribed in the listing advice.

² McDonald, W.J.F. 2010. National recovery plan for the "Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions" ecological community. Report to Department of the Environment, Water, Heritage and the Arts

Table 2-3 Condition thresholds for the Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ecological community (extract from TEC Listing Advice (TSSC, 2009))

	Best quality	Good quality
Patch size	Patch size Minimum patch size at least 0.5 ha AND	Minimum patch size at least 2 ha AND
Grasses	At least 4 native perennial grass species from the indicator species list AND	At least 3 native perennial grass species from the indicator species list AND
Tussock cover	At least 200 native perennial grass tussocks AND	At least 200 native perennial grass tussocks AND
Woody shrub cover ¹	Total projected canopy cover of shrubs is less than 30% AND	Total projected canopy cover of shrubs is less than 50% AND
Introduced species	Perennial non-woody introduced weed species are less than 5% of the total projected crown cover	Perennial non-woody introduced weed species are less than 30% of the total projected crown cover
¹ Shrubs are typically absent. When present, they are defined as woody plants more than 0.5 m tall that occupy the mid vegetation layer. The upper, tree canopy layer also is typically absent but may comprise scattered trees to less than 10% projective crown cover.		
Sampling should be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain.		

Table 2-4 Condition categories and thresholds for the Poplar Box Grassy Woodland on Alluvial Plains ecological community (extract from the TEC Conservation Advice (DEWHA, 2019))

Category and rationale	Native cover and diversity thresholds	Minimum patch size
Class A Highest Quality		
Category A1. Little to no perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% AND ≥ 90% of perennial vegetation cover in the ground layer is native AND ≥ 30 native plant species per patch in the ground layer	≥ 1 ha
Category A2. A large patch with low perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% AND ≥70% of perennial vegetation cover in the ground layer** is native AND ≥ 30 native plant spp. per patch in the ground layer	≥ 5 ha
Class B Good Quality		
Category B. A large patch with good quality native understorey or with mature trees	The crown cover of canopy trees in the patch is ≥10% AND ≥ 50% of perennial vegetation cover in ground layer is native AND EITHER ≥ 20 perennial native plant species per patch in the ground layer OR ≥ 10 mature trees+ per ha with ≥ 30cm dbh (and/or hollows)	≥ 5 ha
Class C Moderate Quality		
Category C A large patch with low native cover but retains good native understorey diversity and habitat features of mature trees	The crown cover of canopy trees in the patch is ≥10% AND If < 50% of perennial vegetation cover in ground layer is native, then the patch must have: ≥ 20 native plant spp. per patch in the ground layer AND ≥ 10 mature trees+ per ha with ≥ 30cm dbh (and/or hollows) AND smaller trees+, saplings or seedlings suggestive of periodic recruitment	≥ 5 ha

2.3.2 Flora Species

The survey effort for threatened flora species involved traversing the Survey Area, with specific attention to habitat considered suitable for the target species. Significant flora species that were not previously encountered, or species that were unidentifiable in the field (when sampling occurred), were collected and lodged at the Queensland Herbarium for formal identification.

2.3.2.1 Conservation Significant Flora Species

The location of threatened flora species identified during on-foot surveys, were recorded via Global Positioning System (GPS) and using the ArcGIS product *Collector*. Additional detail relating to the methodology used to survey threatened plants is provided in the Field Action Plan (**Appendix A**).

Given that the date of construction for the Project is not yet known, formal flora surveys in full accordance with the *Flora Survey Guidelines - Protected Plants* (Flora Survey Guidelines), prepared by the Department of Environment and Science (DES) were not completed over the construction footprint of the Project. As these surveys are only valid for a 12-month period and clearing needs to be undertaken within two years of submitting the flora survey report to the Queensland DES, Flora surveys should be scheduled once construction timelines are known. Nonetheless, flora surveys were comprehensively undertaken in habitat known or considered likely to support the range of species expected to occur in the Survey Area.

Formal flora surveys in full accordance with the Flora Survey Guidelines have been completed over part of the Project footprint associated with the early works package of the Geotechnical Program.

2.3.2.2 Weeds

General abundance and the location of weeds listed under the *Biosecurity Act 2014* were recorded within the Project footprint and opportunistically during surveys. An average density of cover for each weed species observed was recorded every 1 km throughout the Survey Area. Averages were based on criteria listed in the Spatial Pest Attributes Standard (Calvert, 2012), further explained in **Table 2-5** and **Table 2-6**.

For grasses and herbs, vines, aquatic weeds and cacti, densities were calculated from a percentage of ground-cover, refer to **Table 2-5**.

Table 2-5 Percentage weedy ground cover criteria

Percentage Ground-cover	Density
<10	Scattered
10-20	Low
20-30	Moderate
>30	High

For woody vegetation, densities were calculated from the number of woody stems/10 m², refer to **Table 2-5** below.

Table 2-6 Average number of stems per 10 square metres (10m x 10m).

Number stems	Density
1-2	Scattered
3-4	Low
5-6	Moderate
>7	High

2.4 Field Assessment – Fauna

A total of 12 targeted terrestrial fauna survey sites were visited between 19 October and 11 November 2020 and 8 March to 27 March 2021 (see **Figure 1-1** for Site locations). Each survey site was surveyed over five days and four nights (per Survey Period), with each fauna survey team completing two full targeted trapping sites over each five day and four-night period. Each of the fauna survey sites comprised a 1 km buffer around

a mid-point centred on the alignment. Cumulatively, the proposed survey effort resulted in over 1,200-person hours of active survey. Further detail regarding the specific methodologies used to target fauna within this survey is provided in Section 4.3 and Appendix B of the Field Action Plan, provided herein as **Appendix A**

A further ten 'additional sites' were surveyed over the duration of the Spring and Post-wet Survey Periods. These locations were only surveyed over a single day each and all surveys were 'passive', consisting of habitat assessments and opportunistic observations only (i.e. did not involve trapping of fauna). The focus of these additional sites was to search for threatened fauna and their habitat, map habitat features in close proximity to the proposed alignment, and increase the overall coverage of the survey footprint.

The majority of the sites surveyed in the Spring Survey Period were also surveyed in the Post-wet Survey Period; however, alterations to the Survey Area and adjustments to the Field Action Plan were made between the Spring and Post-wet Survey Periods for the below-listed reasons:

- > Site 8, which had poor access and limited habitat, was moved to a new site closer to Bringalily State Forest (noting that a similar suite of species was expected, based on EIS modelling and field observations, at the new site);
- > Site 6 was moved slightly to the north to capture an area of habitat identified as having higher value to a range of species during the Spring Survey Period;
- > Two of the Additional Sites were relocated to areas of potential habitat for the Condamine Earless Dragon in the Condamine River Floodplain to target detection of this species; and
- > Additional sites were only surveyed once (either in Post-wet or Spring) to increase overall coverage of the Project footprint.

Each survey day (with the exception of surveys at additional sites) generally consisted of the activities listed in **Table 2-7**. Elsewhere along the alignment, fauna and habitat observations were recorded opportunistically using GIS software. For details on specific effort afforded to target species including consideration of how this meets guideline requirements, refer to Table 1-6 in Appendix B of the Field Action Plan, herein provided as **Appendix A**.

Table 2-7 Survey effort for terrestrial fauna trapping sites.

Method	Fauna group targeted by method and survey effort per Site [^]	Duration per Site
Call playback	Birds: 5 hours Mammals: 1 hour	5 days 4 nights
Spotlighting	Mammals: 2 x 200m transects Reptiles: min. 6 hours over 4 nights	4 nights
Stag watching	Mammals – 40 minutes before dusk & 40 minutes after dusk	2 nights
Dawn survey	Birds and Butterfly: minimum 4 hours	2 days
Dusk survey	Birds and Butterflies: minimum 4 hours Bats (fly-out): minimum 4 hours	2 days
Habitat assessment	All groups – 4 hours	n/a
Indirect detection (scats, tracks) / area searches / incidental flushing	All groups – 8 hours	5 days
Active diurnal searches (searches for individuals and habitat, raking leaves for reptiles)	Mammals – 2 x 100m transects Reptiles – 3 hours Birds: 4 hours	5 days
Camera traps	All: 10 traps	4 nights
Hair tube traps	Mammals: 20 traps	4 nights
Pitfall traps	Reptiles: 6 pitfalls along a 30m drift fence	4 nights
Elliot traps (a)*	Mammals: 20 traps	4 nights
Cage traps / Elliot traps (b)	Mammals: 10 traps	4 nights

Method	Fauna group targeted by method and survey effort per Site [^]	Duration per Site
Artificial burrows	Condamine earless dragon: 58 traps across 2 target sites	6 nights
Unattended bat detector	Microbats: 1 x Anabat or Songmeter	4 nights
Attended bat detector	Microbats: 4 hours	4 nights
Harp traps	Microbats: 1 x harp trap	4 nights
Funnel traps	Reptiles – minimum 2 traps (1 on either end of pitfall drift fence)	4 nights
Pest animal assessment	Methods as per above.	5 days / 4 nights
Wildlife corridors	Opportunistic assessment	5 days
Habitat features	Opportunistic assessment	5 days

[^] effort reflects total 'person hours' as each site will be assessed by two ecologists.

* were deployed where presence of Yakka skink burrows within a survey site was known or suspected.

Following initial observations regarding the availability and location of suitable habitat for the Condamine earless dragon (*Tympanocryptis condaminensis*) within the Survey Area, additional survey effort targeting this species was undertaken during the Post-wet Survey Period. The following methodology was devised following completion of the Field Action Plan, provided in **Appendix A**, and as such has been expanded upon more fully here.

Prior to the commencement of the Post-wet Survey Period potential habitat was identified and refined using:

- > Pre-clearance RE mapping for areas of grassland RE 11.3.21;
- > The location of past observations made of the species as recorded within the EIS and the Atlas of Living Australia; and
- > The observations made by the Cardno team of other areas of likely habitat within the Survey Area which was collected during the Spring Survey Period; including areas of 'converted grassland' associated with the rail line and road reserves. This included areas where the pre-clearing mapping supported woodland REs (e.g. RE 11.3.2), where woody vegetation has largely been removed from the landscape and a ground layer is present supporting both native and exotic grass, forb and herb species.

Following the desktop analysis, the suitability of these predetermined sites for the Condamine earless dragon was assessed during the Post-wet Survey Period using a qualitative ranking system of 'Best', 'Good' and 'Poor' for the known and expected habitat requirements of this species; including the presence of:

- > Suitable soils – typically cracking black soils within the Condamine River floodplain;
- > Suitable vegetation dominated by tussock grasses; and
- > Availability and proximity of sunning, foraging and refuge habitat – including that provided by cultivated land, rail ballast and presence of existing arthropod burrows and soil cracks.

Following on from this assessment, two sites were selected for the placement of species-specific traps in the form of small artificial arthropod burrows. These burrows were constructed and placed as per the methods recommended by Osborne (2018), the burrows were arranged in monitoring grids spaced 10 m apart, although the actual arrangement of rows was slightly altered to fit within the available habitat. Due to the size of the available habitat a total of 28 traps per site were installed. Traps were checked twice daily. Walking visual transects in the surrounding habitat were carried out in close proximity to the alignment for approximately three-person hours per day for six days.

The location of the Condamine earless dragon survey and trapping sites is shown by **Figure 1-1**.

2.5 Climatic Conditions

Heavy rainfall was recorded during both the Spring and Post-wet Survey Periods, in particular during the Post-wet fauna Survey Period, during which extensive flooding occurred over parts of the project extent. Climatic statistics for the Spring and Post-wet Survey Periods are presented in **Table 2-8**.

Table 2-8 Climatic conditions recorded during the Survey Period[^]

Inglewood BOM Station 041527			Millmerran BOM Station 041527	
Date	Rainfall (mm)	Temperature (°C)	Rainfall (mm)	Temperature (°C)
Spring Survey Period				
19-Oct-20	13	26.4	7.2	24.1
20-Oct-20	0	29.8	0	25.8
21-Oct-20	2	24.6	1.2	20
22-Oct-20	25	27.6	15.6	22.6
23-Oct-20	0	28.0	7	24.3
24-Oct-20	5	23.1	3.4	20.1
25-Oct-20	0	29.2	14.4	26.8
26-Oct-20	0	27.0	32.6	25.1
27-Oct-20	0	29.1	0.2	23
28-Oct-20	0	27.7	17.4	22.3
29-Oct-20	0	27.5	0.8	25.3
30-Oct-20	0	32.0	0	29.2
31-Oct-20	0	29.5	0	28.5
1-Nov-20	0	29.0	0	26.3
6-Nov-20	0	29.1	0	25.5
7-Nov-20	0	30.5	0	25.6
8-Nov-20	0	28.3	0	20.5
9-Nov-20	0	29.5	0	23
10-Nov-20	0	31	0	24
11-Nov-20	0	32.2	0	25.9
Inglewood			Millmerran BOM Station 041527	
Date	Rainfall (mm) BOM Station 041391	Temperature (°C) BOM Station 041100	Rainfall (mm)	Temperature (°C)
Post-wet Survey Period				
25-Feb-2021	0	31.2	0.6	27.7
26-Feb-2021	0	34.0	0.2	31.3
27-Feb-2021	0	32.5	0	25.9
28-Feb-2021	0	34.5	0	30.9
01-Mar-2021	0	33.5	0	26
02-Mar-2021	8	35.0	0	34.4
03-Mar-2021	0	32.5	0	26.8
04-Mar-2021	4	30.6	0.2	23.8
05-Mar-2021	0	32.5	0.2	29.9
06-Mar-2021	0	32.5	0	29.6
07-Mar-2021	0	33.0	0	28.2
08-Mar-2021	0	30.5	0	27

	Inglewood BOM Station 041527		Millmerran BOM Station 041527	
09-Mar-2021	29	31.8	23.6	29.2
10-Mar-2021	0	33.0	0.2	27.6
11-Mar-2021	0.5	30.0	0.4	23.6
12-Mar-2021	0	30.4	0.4	26.1
13-Mar-2021	0	32.5	0	27.7
14-Mar-2021	0	31.5	0	30.1
15-Mar-2021	49	24.5	13.8	19.9
16-Mar-2021	0	23.3	22.6	17.7
17-Mar-2021	0	24.1	21.8	19.6
18-Mar-2021	7	28.0	7.8	22.9
19-Mar-2021	0	30.6	0.4	26.7
20-Mar-2021	0	29.5	0	25.2
21-Mar-2021	0	30.5	0.4	25.1
22-Mar-2021	1.5	23.0	9.8	19.5
23-Mar-2021	97	26.3	55.6	23.4
24-Mar-2021	22	26.2	21.8	24.5
25-Mar-2021	No data available	26.3	0	24.8
26-Mar-2021	No data available	27.0	0	25
27-Mar-2021	No data available	27.6	0	25.6

^ data availability necessitated the use of different BOM Weather stations to derive these statistics between the two survey periods.

2.6 Survey Limitations

In general the detection of flora and fauna species during targeted surveys may be limited by a range of factors including:

- > Surveys occurring outside of the optimal timing for the detectability of flowering species; or
- > Climatic conditions or temperatures which may reduce activity levels of certain fauna groups.

As such, failure to detect a species does not necessarily equate to absence of a species within the Survey Area. The completion of the seasonal surveys for flora and fauna species within the Survey Area has helped ensure survey results are as unbiased as possible due to the broad limitations noted above.

However, the below-listed limitations may have reduced the detectability of certain species or otherwise have impacted on the intended survey effort.

- > Not all properties to which land access was granted were assessed in detail owing to:
- > These properties being 'land-locked' by an area of inaccessible land to which access was not granted; or
- > Preliminary field observations confirming general flora homogeneity of the landscape meaning that effort could be better applied to other key locations. It should be noted that this is an accepted and standard approach to appropriately conduct field surveys.
- > Detailed flora surveys targeted areas with the highest likelihood of occurrence for threatened species. Typically, detailed flora surveys excluded highly modified environments; being areas of cultivation and existing sealed and unsealed roads, although it is noted that these areas cannot be entirely disregarded.

To mitigate the reduction of survey area due to the above access limitations, alternate suitable sites were identified as surrogates wherever possible.

- > In addition to the limitations listed above, adverse weather conditions during both the Spring and Post-wet Survey periods resulted in a reduction in fauna survey effort (climatic data recorded for the duration of the fauna Survey Period is provided in **Table 2-8**) for animal welfare and safe access considerations, as detailed below:
- > For animal welfare reasons, the deployment of capture traps (i.e. Elliot traps, harp traps, pitfall traps and cage traps) was not possible during nights of heavy rain or where heavy rain was predicted. To offset this reduction in fauna survey effort, replacement effort was made in the form of additional on-foot surveys at affected sites, as well as the numerous non-capture survey methods employed by this survey (e.g. such as camera trapping, unattended bat detectors and hair tube traps);
- > Inundation by floodwater rendered the artificial burrow traps (targeting the Condamine earless dragon) ineffective for part of the time period they were deployed (**Figure 2-1**);
- > In some instances, the weather conditions or ground substrate was not conducive to pitfall trap placement (i.e. soil substrate was very rocky and could not be dug). Where this was the case, pitfall traps were not used and additional funnel traps were placed along a drift fence and extra effort was afforded to direct searches for reptiles by way of turning rocks and logs. Specific alterations to the proposed methodology are listed below;
 - A combination of pitfalls (two) and funnel traps (four) were placed alongside the drift fence at Site 10 and 6 during the Spring Survey Period; and
 - Six funnel traps were used in place of pitfalls at Sites 1, 9, 11 and 12 during the Spring Survey Period.
 - Pit-fall traps were not able to be left 'open' at survey sites 8, 11 and 12 during the Post-wet Survey Period due to high levels of seasonal rainfall.
- > Access to several sites was affected when access tracks became undrivable after rain. In particular, vehicle access to the northernmost extent of Site 8 was restricted during both the Spring and Post-wet Survey Periods for this reason. In these instances, replacement effort was made in the form of road surveys or additional survey effort in the areas that could be safely accessed;
- > During the Post-wet Survey Period, flooding of the Condamine river resulted in significantly reduced access to Site 9. Several traps were lost to floodwater, including a number of camera traps (**Figure 2-2**). It was considered unsafe to conduct on-foot surveys across the majority of the site during this time, although the highly unusual conditions did result in some opportunistic fauna sightings that may not have occurred under normal circumstances as fauna congregated in area above the flood line; and
- > During both the Spring and Post-wet Survey Periods, access to areas of potentially high-quality habitat was restricted within certain terrestrial fauna trapping sites in which landholder access was not granted. The specific locations have been detailed below. It must be noted that where access was not granted, additional effort was afforded to searches and assessment of potentially suitable habitat within accessible parts of a survey site:

Spring Survey Period

- The western extent of Additional Site 1;
- The eastern extent of Site 5;
- The eastern extent of Additional Site 3;
- Areas along the watercourse present in Additional Site 5; and
- Areas along the watercourse present in Additional Site 4.

Post-wet Survey Period

- The eastern extent of Additional Site 3;
- The eastern extent of Site 7;
- Areas along the watercourse present in Additional Site 5;
- Areas of Site 6 beyond the road reserve; and
- The north-western extent of Site 10.

Despite the limitations outlined above, the total area of potential habitat assessed and survey effort is appropriate for detecting the range of target flora and fauna species considered likely to occur within the Survey Area.



Figure 2-1 Floodwater inundating one of the artificial burrow traps targeting the Condamine earless dragon



Figure 2-2 One of several camera traps deployed at Site 9 during the Post-wet Survey that was submerged by floodwater

3 Results

3.1 Desktop Assessment

3.1.1 Threatened Communities

Of the four TECs identified in the EIS as being likely to occur within the Survey Area, it was determined that the following required seasonal identification of ground layer elements in order to confirm the presence of the community:

- > Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (grassland TEC);
- > Poplar Box Grassy Woodland on Alluvial Plains (Poplar Box TEC); and
- > White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (White-box TEC).

The Brigalow (*Acacia harpophylla* dominant and codominant) ecological community (Brigalow TEC) was known to occur, based on the findings of the EIS.

3.1.2 Threatened Species

No additional species were added to the species list to be targeted in the surveys based on the review of contemporary databases (i.e. PMST and Wildlife online) as there were no additional confirmed records within the search limits. One species, the Grey snake (*Hemiaspis damelii*), was added to the list of target species for the surveys, based on a potential observation made during initial surveys completed as part of the geotechnical scope, presence of suitable habitat within the Survey Area, and confirmed records within 10 km of the Survey Area.

Table 3-1 and **Table 3-2** list the species considered in the Initial Advice Statement (IAS), EIS, and contemporary databases as possible, likely or known to occur. The likelihood of presence listings from both the IAS and EIS are tabulated along with an assessment of the level of survey effort conducted for the EIS using the following categories:

- > **Not assessed** – not assessed in the EIS;
- > **Survey unnecessary** – the EIS Likelihood of Assessment indicated that it is unlikely that the species or habitat for the species is present. This also applies to species that are Presumed Extinct;
- > **Sufficient survey effort** – targeted surveys have been conducted and no further effort is required;
- > **Limited survey effort** – while some survey effort has been conducted, the survey does not conform with guidelines and/or does not extend to the full extent of the Survey Area; and
- > **No survey effort** – no targeted surveys have been conducted for the species.

The Field Action Plan identified species requiring further assessment during the surveys through a gap analysis which has identified gaps in species data and the survey efforts to-date with respect to requisite guidelines. Species that are regarded as 'data deficient' and thus requiring targeted survey during the surveys are those in **Table 3-1** and **Table 3-2** that:

- > Had "Limited survey effort" as part of EIS surveys; or
- > Had "No survey effort" as part of EIS surveys and the contemporary PMST search indicates the species is "Known" or "Likely" Or the contemporary WildNet search indicates the species has been recorded.

Specific survey guidelines were identified for species to be targeted in the surveys (refer to Section 4.3.2 and Appendix B of the Field Action Plan).

Table 3-1 Flora species assessment

Species	Common Name	Status		IAS Likelihood	EIS Likelihood	EIS Survey	2020 PMST Search	2020 WildNet search	Target?
		NCA	EPBC Act						
Acacia lauta	Tara wattle	V	V	Likely	Possible	Limited survey effort	May occur	-	Yes
Commersonia perkinsiana	-	-	V	-	Unlikely	Survey unnecessary	Likely	-	No
Aristida forsteri	-	E	-	Potential	Not Assessed	Survey unnecessary	-	-	No
Arthraxon hispidus	Hairy-joint grass	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
Bertya opposens	-	-	V	Likely	Possible	Limited survey effort	-	-	Yes
Bothriochloa bunyensis	Satin-top grass	V	V	Likely	Unlikely	Survey unnecessary	-	-	No
Bulbophyllum globuliforme	Miniature moss-orchid	NT	V	Does not occur	Unlikely	Survey unnecessary	-	-	No
Cadellia pentastylis	Ooline	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
Calotis glabrescens	-	PE		Likely	Not Assessed	Survey unnecessary	-	-	No
Clematis fawcettii	Stream clematis	V	V	Potential	Possible	Limited survey effort	May occur	-	No
Commersonia ingewoodensis	-	E	-	Potential	Not Assessed	Survey unnecessary	-	-	No
Cymbonotus maidenii	-	E	-	Likely	Unlikely	Limited survey effort	-	-	Yes
Cyperus clarus	A sedge	V	-	-	Possible	Limited survey effort	-	✓	Yes
Dichanthium queenslandicum	King bluegrass	V	E	Likely	Likely	Limited survey effort	May occur	✓	Yes
Dichanthium setosum	-		V	Likely	Possible	Limited survey effort	Likely	-	Yes
Digitaria porrecta	Finger Panic Grass	NT	E	Likely	Known	Limited survey effort	-	✓	Yes
Eucalyptus curtisii	Plunkett Mallee	NT	-	Potential	Not Assessed	Survey unnecessary	-		No
Eucalyptus infera	Durikai mallee	V	V	Does not occur	Unlikely	Survey unnecessary	-	-	No
Eucalyptus virens	Shiny-leaved ironbark	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
Homopholis belsonii	-	E	V	Known	Likely	Limited survey effort	May occur	✓	Yes
Lepidium monoplacoides	-	-	E	Likely	Likely	Limited survey effort	-	✓	Yes
Lepidium peregrinum	-	-	E	Likely	Possible	Limited survey effort	May occur	-	Yes
Leucopogon sp. Coolmunda	Coolmunda leucopogon	E	E	Potential	Possible	Limited survey effort	-	-	Yes

Species	Common Name	Status		IAS Likelihood	EIS Likelihood	EIS Survey	2020 PMST Search	2020 WildNet search	Target?
		NCA	EPBC Act						
(D. Halford Q 1635)									
Microcarpaea agonis	-	E	E	Unlikely	Unlikely	Survey unnecessary	-	-	No
Macrozamia conferta	-	V	V	Potential	Unlikely	Survey unnecessary	-	-	No
Macrozamia machinii	-	V	V	Known	Possible	Limited survey effort	Likely	-	Yes
Macadamia integrifolia	Macadamia nut	V	V	Unlikely	Unlikely	Survey unnecessary	-	-	No
Microcarpaea agonis		-	E	Unlikely	Unlikely	Survey unnecessary	-	-	No
Picris barbarorum	-	E		Known	Known	Limited survey effort	-	✓	Yes
Picris evae	Hawkweed	V	V	Known	Likely	Limited survey effort	Likely	✓	Yes
Phebalium distans	Mt Berryman phebalium	E	CE	Unlikely	Unlikely	Survey unnecessary	-	-	No
Philotheca sporadica	-	NT	V	Likely	Not Assessed	Survey unnecessary	-	-	No
Pomaderris coomingalensis	-	-	E	Unlikely	Not Assessed	Survey unnecessary	-	-	No
Prostanthera sp. (Dunmore D.M.Gordon 8A)	-		V	Likely	Possible	Limited survey effort	-	-	Yes
Rhaponticum australe	Austral Cornflower	V	V	Known	Likely	Limited survey effort	Likely	✓	Yes
Sarcophilus hartmannii	Waxy sarcophilus	V	V	Unlikely	Unlikely	Survey unnecessary	-	-	No
Sarcophilus weinthalii	Blotched sarcophilus	E	V	Unlikely	Unlikely	Survey unnecessary	Likely	-	No
Sophora fraseri	-	V	V	Known	Possible	Limited survey effort	Known	-	Yes
Solanum papaverifolium	-	E		Likely	Unlikely	Survey unnecessary	-	-	No
Solanum stenopterum	-	V		Likely	Unlikely	Survey unnecessary	-	-	No
Thesium australe	Toadflax	V	V	Likely	Possible	Limited survey effort	Likely	-	Yes
Vincetoxicum forsteri	-	V	V	Likely	Possible	Limited survey effort	May occur	-	Yes
Westringia parvifolia	-	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
Xerothamnella herbacea	-	E	E	Likely	Possible	Limited survey effort	Likely	-	Yes
Notes: NT = Near Threatened, V= Vulnerable, E = Endangered, PE = Presumed extinct									

Table 3-2 Fauna species assessment.

Species	Common Name	Status NCA	EPBC Act	IAS likelihood	EIS likelihood	EIS Survey	2020 PMST Search	2020 WildNet Search	Target?
Birds									
Anthochaera phrygia	Regent Honeyeater	E	CE	Likely	Possible	Limited survey effort	Likely	-	Yes
Botaurus poiciloptilus	Australasian Bittern	-	E	Unlikely	Likely	Limited survey effort	May occur	-	Yes
Calidris ferruginea	Curlew Sandpiper	E	CE, M	Potential	Possible	Limited survey effort	May occur	-	Yes
Calyptorhynchus lathamii	Glossy Black Cockatoo	V	-	Likely	Possible	Limited survey effort	-	✓	Yes
Erythrorhynchus radiatus	Red Goshawk	E	V	Likely	Possible	Limited survey effort	Likely	-	Yes
Falco hypoleucos	Grey Falcon	V	-	Potential	Not Assessed	No survey effort	Likely	-	Yes
Geophaps scripta	Squatter Pigeon (Southern Subspecies)	V	V	Likely	Possible	Limited survey effort	Known	-	Yes
Grantiella picta	Painted Honeyeater	V	V	Likely	Possible	Limited survey effort	Known	-	Yes
Hirundapus caudacutus	White-throated Needletail	-	V, M	Likely	Likely	Limited survey effort	Known	-	Yes
Lathamus discolor	Swift Parrot	E	CE	Likely	Possible	Limited survey effort	May occur	-	Yes
Lophochroa leadbeateri	Major Mitchell's cockatoo	V	-	Unlikely	Possible	Limited survey effort	-	-	Yes
Ninox strenua	Powerful Owl	V	-	Likely	Not Assessed	No survey effort	-	-	No
Poephila cincta	Southern black-throated finch	E	E	Unlikely	Unlikely	Survey unnecessary	-	-	No
Rostratula australis	Australian Painted Snipe	V	E	Potential	Possible	Limited survey effort	Likely	-	Yes
Turnix melanogaster	Black-breasted Button-quail	V	V	Potential	Possible	Limited survey effort	Known	-	Yes
Butterflies									
Hypochrysops piceata	Bullock Jewel butterfly	E	-	Likely	Unlikely	Survey unnecessary	-	-	No
Jalmenus eubulus	Pale Imperial Hairstreak	V	-	Likely	Possible	Limited survey effort	-	✓	Yes
Mammals									
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes

Species	Common Name	Status NCA	EPBC Act	IAS likelihood	EIS likelihood	EIS Survey	2020 PMST Search	2020 WildNet Search	Target?
<i>Dasyurus hallucatus</i>	Northern Quoll	-	E	Unlikely	Unlikely	Survey unnecessary	Likely	-	No
<i>Dasyurus maculatus</i>	Spot-tailed Quoll, Tiger Quoll (SE mainland population)	V	E	Likely	Possible	Limited survey effort	May occur	-	Yes
<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	V	V	Likely	Possible	Limited survey effort	Likely	-	Yes
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	-	-	Possible	Limited survey effort	-	-	No
<i>Petauroides volans</i>	Greater Glider	V	V	Likely	Possible	Limited survey effort	May occur	-	Yes
<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Pseudomys novaehollandiae</i>	New Holland mouse	V	V	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Phascolarctos cinereus</i>	Koala	V	V	Known	Likely	Limited survey effort	Known	✓	Yes
<i>Potorous tridactylus</i>	Long-nosed potoroo	V	V	Potential	Unlikely	Survey unnecessary	-	-	No
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	-	V	Likely	Likely	Limited survey effort	Likely	-	Yes
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	SLC	-	-	Known	Limited survey effort	-	✓	Yes
Molluscs									
<i>Adclarkia cameroni</i>	Brigalow woodland snail	V	E	Likely	Possible	No survey effort	Likely	-	Yes
<i>Adclarkia dulacca</i>	Dulacca woodland snail	E	E	Potential	Unlikely	Survey unnecessary	May Occur	-	No
Fish									
<i>Maccullochella mariensis</i>	Mary river cod	-	E	-	Unlikely	Survey unnecessary	-	-	No
<i>Maccullochella peelii</i>	Murray cod	-	V	Likely	Likely	Sufficient survey effort – Known	Known	-	No
<i>Bidyanus</i>	Silver perch	-	CE	Likely	Unlikely	Sufficient survey effort – Unlikely	-	-	No
Reptiles									
<i>Acanthophs antarcticus</i>	Common death adder	V	-	Likely	Known	Limited survey effort	-	✓	Yes
<i>Anomalopus mackayi</i>	Five-clawed Worm-skink	E	V	Likely	Likely	Limited survey effort	Known	✓	Yes
<i>Delma torquata</i>	Collared delma	V	V	Likely	Possible	Limited survey effort	May Occur	-	Yes

Species	Common Name	Status NCA	EPBC Act	IAS likelihood	EIS likelihood	EIS Survey	2020 PMST Search	2020 WildNet Search	Target?
Egernia rugosa	Yakka skink	V	V	Likely	Possible	Limited survey effort	May Occur	-	Yes
Furina dunmalli	Dunmall's snake	V	V	Likely	Likely	Limited survey effort	May Occur	✓	Yes
Hemiaspis damelii	Grey snake	E	-	Likely	Not Assessed	Survey unnecessary	-	-	Yes [#]
Tympanocryptis condaminensis	Condamine (Darling Downs) earless dragon	E	E	Known	Likely	Limited survey effort	Likely	-	Yes
Uvidicolus sphyrurus	Border thick-tailed gecko	-	V	Unlikely	Unlikely	Survey unnecessary	Likely	-	No
Wollumbinia belli	Bell's turtle	V	V	Unlikely	Unlikely	Sufficient survey effort – Unlikely	-	-	No

Notes: V= Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory, SLC = Special Least Concern

Notes # Whilst this species was not identified as requiring assessment in the EIS and is not identified as requiring assessment by the Terms of Reference for the EIS, a suspected identification of this species was made during the Stage 1 surveys, the Project area supports potentially suitable habitat for this species, and records are known within 10 km of the Survey Area. As such this species was included for further assessment.

3.2 Field Assessment – Flora

3.2.1 Vegetation Communities

3.2.1.1 Regional Ecosystems

During the combined Survey Periods, ground-truthing field assessments were carried out for all REs within the Survey Area. The Survey Area supported a total of eighteen Regional Ecosystems (RE), including two listed as Endangered under the *Vegetation Management Act 1999* (VM Act) and five listed as Of Concern. The REs recorded and mapped include the following:

- > Endangered REs: 11.4.3 and 11.9.5;
- > Of Concern REs: 11.3.2, 11.3.4, 11.3.21, 11.5.14, 11.8.11 and 11.9.7; and
- > Least Concern REs: 11.3.14, 11.3.18, 11.3.25, 11.3.27b, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.4, 11.7.7, 11.8.4 and 11.8.5.

Notable findings with regards to the prevalence of the above REs throughout the Survey Area have been summarised below:

- > There was a total area of 3,796.5 ha of non-remnant vegetation throughout the Survey Area;
- > The most abundant RE throughout the Survey Area was RE 11.5.4, covering an area of 198.7 ha;
- > The RE that was the least abundant was a heterogenous polygon containing 0.02 ha of 11.3.14/11.3.4, and the smallest single RE was 11.8.3 containing 0.2 ha;
- > RE 11.3.2, including examples that are consistent with the Poplar Box TEC, occur primarily as isolated patches and strips with the highest abundance occurring in association with the larger rivers in the Condamine River Catchment and the Macintyre River to the very south of the Survey Area;
- > RE 11.4.3, which in many instances was found to be consistent with the Brigalow TEC, was most commonly encountered towards the southern portion of the alignment from the area around Yelarbon to near the southern limit of the Survey Area. By contrast 11.9.5 which was also found to be regularly consistent with the Brigalow TEC was primarily encountered in the area south of Millmerran to around the Bringalily State Forest region – generally the middle portion of the alignment. Although a small area was also encountered south of Pittsworth; and

- > With the exception of two areas of RE 11.3.21, the only verified RE within the northern portion of the alignment from around Pittsworth to Gowrie are those occurring on land zone 8, specifically RE 11.8.5 and 11.8.4. This area is also the only location within the Survey Area where those two RE occur, reflecting the clear change in the underlying geology in this region.

Field work resulted in the capture of 482 quaternary points and the completion of 37 full biocondition sites to inform vegetation mapping. Mapping illustrating the location of flora survey sites is presented in **Appendix B**. **Appendix C** presents the data collected at biocondition sites. It is noted that where the Grassland TEC was assessed by way of transects a full biocondition assessment was not undertaken (data is presented in **Appendix D**). A full list of the remnant, high-value regrowth and non-remnant regrowth REs verified as occurring within the Survey Area, through either field or desktop verification is provided in **Table 3-3**. Ground-truthed REs were mapped at a ~1:10,000 scale (**Appendix E**). Of the REs identified during the field work period, two are listed as Endangered under the *Vegetation Management Act* 1999 (*VM Act*) and five are listed as Of Concern.

The boundaries of mapped RE polygons were found to be broadly accurate to the scale at which they are mapped, and in this regard the mapping presented herein has been re-mapped to exclude areas of mapped remnant vegetation that was actually found to be cleared land (e.g. existing road pavement or rail track). With regards to the accuracy of the mapped RE present, it is noted that in most instances the dominant RE in heterogeneous polygons was the only RE confirmed as actually being present, in most other respects the RE mapping of RE type was broadly accurate. The total number of REs is likely to be fewer than the number identified by the Vegetation Management Property Report as occurring within the Survey Area owing to some subdominant REs being absent from mapped polygons.

Table 3-3 REs mapped in the Survey Area That were assessed by quaternary or biocondition

RE code	VM Status	Act	Short description	Equivalent TEC
11.3.2	Of concern		<i>Eucalyptus populnea</i> woodland on alluvial plains.	Poplar Box Grassy Woodlands on Alluvial Plains
11.3.4	Of concern		<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains.	NA
11.3.14	Least concern		<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains.	NA
11.3.18	Least Concern		<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	NA
11.3.21	Of concern		<i>Dichanthium sericeum</i> and/or <i>Astrelba</i> spp. grassland on alluvial plains. Cracking clay soils.	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland
11.3.25	Least concern		<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.	NA
11.3.27b	Least concern		Freshwater wetlands.	NA
11.4.3	Endangered		<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains.	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant ecological community)
11.5.1	Least concern		<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces.	NA
11.5.1a	Least concern		<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces.	NA

RE code	VM Status	Act	Short description	Equivalent TEC
11.5.4	Least concern		<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces.	NA
11.5.14	Of concern		<i>Triodia</i> sp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils.	NA
11.5.20	Least concern		<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains.	NA
11.7.4	Least concern		<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust.	NA
11.7.7	Least concern		<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust.	NA
11.8.4	Least concern		<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks.	NA
11.8.5	Least concern		<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks.	NA
11.9.5	Endangered		<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant ecological community)
11.9.7	Of concern		<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks.	NA

3.2.1.2 Biocondition

During the combined survey period, 37 biocondition sites were completed within ground-truthed Category B (remnant) and Category C REs in accordance with methodology outlined in Chapter 1 of the *Guide to Determining Terrestrial Habitat Quality – version 1.3 February 2020*. In addition, a further seven transects that were not full biocondition assessment were undertaken to aid in assessing the presence of the *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* TEC and one transect in an area ultimately determined to be non-remnant. The location of each of these sites is shown in **Appendix B** and **Table 3-4** summarises the number of transects completed for each RE.

Every attempt was made to complete the required number of transects for each RE in accordance with the *Guide to Determining Terrestrial Habitat Quality – version 1.3 February 2020*, however, as noted previously some minor access limitations meant this was not always practicable. The use of additional quaternary assessments throughout the Survey Area has provided additional data that can be used to draw comparisons between those RE for which the number of Biocondition Sites is lower than the recommended number. This is consistent with the stream lining approach as described in Box 1.3 within the *Guide to Determining Terrestrial Habitat Quality – version 1.3 February 2020*.

Table 3-4 Summary of Biocondition assessments undertaken during the Survey Period

Target RE	TEC equivalent	Spring Survey biocondition sites	Post-wet Survey biocondition sites	Total Area	Recommended number of transects [^]	Notes
11.3.2	Poplar Box Grassy Woodlands on Alluvial Plains	0	3	96	3	
11.3.4	NA	1	1	19	2	
11.3.14	NA	1	3	30	2	One biocondition assessment

Target RE	TEC equivalent	Spring Survey biocondition sites	Post-wet Survey biocondition sites	Total Area	Recommended number of transects [^]	Notes
						undertaken in Category C
11.3.21	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	3*	4	31	2	Full biocondition assessment not completed due to non-remnant status. The primary purpose was to determine whether the TEC was present.
11.3.25	NA	1	2	30	2	
11.4.3	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant ecological community)	2	2	139	4	
11.5.1	NA	1	2	191	4	
11.5.1a	NA	0	1	10	2	
11.5.4	NA	2	2	198	4	
11.5.14	NA	0	1	54	3	
11.5.20	NA	0	1	68	3	
11.7.7	NA	2	0	3.6	2	
11.8.4	NA	0	2	66	3	
11.8.5	NA	1	3	97	3	
11.9.5	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant ecological community)	1	1	30	2	
11.9.7	NA	0	1	54	3	
Non-remnant	NA		1			

* - One of these transects was undertaken as part of the geotechnical flora survey

[^] - as per Table 1.2 within the *Guide to Determining Terrestrial Habitat Quality – version 1.3 February 2020*

The Department of Resources regional ecosystem mapping also identified the presence of additional REs for which biocondition sites were not undertaken. These are listed in **Table 3-5** along with an explanation as to why these REs were not assessed.

Table 3-5 REs for which biocondition assessments were not undertaken during the Survey Period

RE	TEC equivalent	Discussion
11.3.27b	NA	This RE was only mapped as a subdominant RE and was not observed during site investigations
11.7.4	NA	This RE was only mapped as a subdominant RE and was not observed during site investigations

Field data for individual sites is presented in **Appendix C** which is split into two sections accounting for Spring and Post-wet survey events. Calculations of biocondition scores for individual sites is presented in **Appendix F** and a summary of results is presented in **Table 3-6**. The scores below have not been 'area weighted' as this is best completed once the final impact areas for each of the RE is understood as the area being impacted will alter the area weighted score.

Table 3-6 Biocondition scores

Regional Ecosystem	Survey Event	Site ID	Site-based Condition Attributes	Landscape Context	Total Score	BioCondition Score
11.3.14	Post-wet	1BD	56/80	14/20	70/100	0.7
11.3.14	Post-wet	2BB	41/80	2/20	43/100	0.43
11.3.14	Post-wet	2BA	78/80	7/20	85/100	0.85
11.3.14	Spring	2BB	56.5/80	16/20	72.5/100	0.725
11.3.2	Post-wet	1BF	65/80	13/20	78/100	0.78
11.3.2	Post-wet	1BJ	63.5/80	11/20	74.5/100	0.745
11.3.2	Post-wet	1BK	62/80	13/20	75/100	0.75
11.3.25	Post-wet	1BR	46/80	16/20	62/100	0.62
11.3.25	Post-wet	2BD	57.5/80	14/20	71.5/100	0.715
11.3.25	Spring	2BE	64/80	20/20	84/100	0.84
11.3.4	Post-wet	1BH	56/80	8/20	64/100	0.64
11.3.4	Spring	2BC	62.5/80	20/20	82.5/100	0.825
11.4.3	Post-wet	1BS	39/80	0/20	39/100	0.39
11.4.3	Post-wet	1BC	53.5/80	18/20	71.5/100	0.715
11.4.3	Spring	1BA	46/80	11/20	57/100	0.57
11.4.3	Spring	1BB	57.5/80	11/20	68.5/100	0.685
11.5.1	Post-wet	1BB	68/80	19/20	87/100	0.87
11.5.1	Post-wet	2BC	75/80	6/20	81/100	0.81
11.5.1	Spring	1BC	52/80	20/20	72/100	0.72
11.5.14	Post-wet	1BO	80/80	20/20	100/100	1
11.5.1a	Post-wet	1BA	58/80	9/20	67/100	0.67
11.5.20	Post-wet	1BN	46/80	4/20	50/100	0.5
11.5.4	Post-wet	2BK	43/80	11/20	54/100	0.54
11.5.4	Post-wet	1BE	46/80	16/20	62/100	0.62
11.5.4	Spring	2BA	64.5/80	19/20	83.5/100	0.835
11.5.4	Spring	1BF	56.5/80	20/20	76.5/100	0.765
11.7.7	Spring	2BD	62.5/80	19/20	81.5/100	0.815
11.7.7	Spring	1BD	58.5/80	18/20	76.5/100	0.765
11.8.4	Post-wet	2BE	53.5/80	8/20	61.5/100	0.615
11.8.4	Post-wet	2BF	70.5/80	18/20	88.5/100	0.885
11.8.5	Post-wet	1BM	72/80	9/20	81/100	0.81
11.8.5	Post-wet	2BG	36.5/80	0/20	36.5/100	0.365
11.8.5	Post-wet	2BH	58.5/80	9/20	67.5/100	0.675
11.8.5	Spring	2BF	62.5/80	9/20	71.5/100	0.715
11.9.5	Post-wet	1BI	59/80	0/20	59/100	0.59
11.9.5	Spring	1BE	49/80	19/20	68/100	0.68

Regional Ecosystem	Survey Event	Site ID	Site-based Condition Attributes	Landscape Context	Total Score	BioCondition Score
11.9.7	Post-wet	1BG	64/80	18/20	82/100	0.82

It should be noted that there was only patch of remnant RE 11.5.14 that was accessible during the field surveys and there are no published benchmarks for this RE. As such, for the purposes of this assessment, the assessment site for RE 11.5.14 was also the reference site. Additionally, because there was recruitment of all species in the ecologically dominant layer and no weed cover it received a site-based condition score of 80/80.

While some biocondition metrics were collected for four sites located in RE 11.3.21 during the Post-wet Survey (2BJ and 2BI) and Spring Survey (1BG and 2BG) the level of detail was not adequate to calculate a full biocondition score. These transects have been omitted from **Table 3-6** due to lack of biocondition score. However, **Appendix C** presents the data that was obtained for these sites.

3.2.1.3 Threatened Ecological Communities

During the Spring and Post-wet Survey Periods, field assessments were carried out for all TECs identified in the EIS. In cases where a TEC was determined to be present at a scale that met the minimum area and condition thresholds outlined by Commonwealth guidelines the TEC was recorded and mapped, regardless of whether the full area fell within the Flora Study Area.

Table 3-7 presents a summary of the ground-truthed TECs identified within the Survey Area that are mapped **Appendix B**.

Table 3-7 Ground-truthed TECs identified within the Survey Area

TEC [Status]	Corresponding RE observed within Survey Area	Discussion	Total Area in Survey Area (ha)	Image
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Grassland TEC) [Critically Endangered]	11.3.21	The TEC occurs in isolated patches primarily around Brookstead and proximate to the Toowoomba Wellcamp Airport. Areas of derived grasslands (e.g. where woody cover has been lost from RE 11.3.2); where the substrate was not consistent with the TEC (e.g. where diagnostic species occur on rail ballast); and where weed cover exceeded the requisite condition thresholds were significant determinants in delineating the TEC. Assessments undertaken as part of the post-wet surveys were important in delineating the TEC owing to the presence of fertile plant material.	31.9 ha	
Poplar Box Grassy Woodland on Alluvial Plains (Poplar Box TEC) [Endangered]	11.3.2	The TEC was confirmed to be present in several areas within the Survey Area. All areas mapped as 11.3.2 were equated with the TEC. Where areas that were not mapped as remnant RE were assessed on ground they were found to support the requisite attributes to be regarded as the TEC.	90.3 ha	

TEC [Status]	Corresponding RE observed within Survey Area	Discussion	Total Area in Survey Area (ha)	Image
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Vine Thicket TEC) [Endangered]	11.9.5 / 11.9.7 / 11.3.25	One occurrence of the TEC was confirmed to be present in an isolated patch accounting for ~0.2ha. While the location where the TEC was identified is shown as REs 11.9.5 / 11.9.7 / 11.3.25 (i.e. REs on sedimentary and alluvial geologies) in pre-clearing mapping, prevailing rocky outcropping was consistent with igneous material. Pre-clearing for 11.8.3 (i.e. an RE on igneous geology) is located ~130m to the east of the patch and as such the patch was considered an outlier of 11.8.3.	0.2 ha	
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (White Box TEC) [Critically Endangered]	n/a	One isolated patch of the TEC was recorded in the Flora Survey Area. Owing to landholder access constraints assessments were made at the property boundary and subsequently through GIS analysis. It was found that the area included >12 understorey species (excluding grasses) and at least two 'important species' being <i>Maireana microphylla</i> and <i>Einadia hastata</i> as viewed from the property boundary. Furthermore, subsequent GIS analysis found the patch supported in excess of the requisite 20 trees/ha to be regarded as the TEC. While White Box was recorded in one other location in the Flora Survey Area (proximate to the Vine Thicket TEC), these were scattered individuals in an area dominated by exotic species.	7.8 ha	
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) ecological community (Brigalow TEC) [Endangered]	11.4.3, 11.9.5	The TEC was found to be present in several locations. Where areas were assessed on ground as having greater than 50% weed cover they were excluded from the TEC.		

3.2.2 Flora Species

A full list of the flora species encountered during the Survey Period is provided in **Appendix G**. The list of compiled flora species have been derived from the range of flora assessments, such as biocondition assessment and quaternary data, during the Post-wet and Spring surveys.

3.2.2.1 Conservation Significant Flora Species

Over the course of the surveys, a total of ten threatened flora species listed under either the EPBC Act or NC Act were observed (**Table 3-8**). With reference to **Table 3-8** the number of individuals recorded should not be viewed as an exact number of each species with the Survey Area. While areas of suitable habitat were comprehensively surveyed, the aforementioned limitation means that there remains a likelihood that additional individuals will be encountered within the Survey Area over time. Images of selected species are presented in **Figure 3-1** to **Figure 3-9**. Seven of these species are listed under the EPBC Act, and are considered to be MNES - including:

- > *Xerothamnella herbacea*;
- > *Picris evae* (Hawkweed);
- > *Rhaponticum australe* (Austral cornflower);
- > *Lepidium monolocoides* (Winged peppergrass);
- > *Westringia parvifolia*;
- > *Homopholis belsonii* (Belson's Panic); and
- > *Dichanthium queenslandicum* (King Bluegrass).

Three species are listed solely under the NC Act, including:

- > *Picris barbarorum*;
- > *Cyperus clarus*; and
- > *Digitaria porrecta*.

Xerothamnella herbacea, *Lepidium monolocoides* and *Dichanthium queenslandicum* are listed as Endangered pursuant to the EPBC Act, whereas *Picris evae*, Austral cornflower, *Westringia parvifolia* and Belson's Panic are listed as Vulnerable. *Lepidium monolocoides* is the only EPBC Act listed species which is not also listed under the NC Act.

Of the species listed solely under the NC Act, *Picris barbarorum* and *Cyperus clarus* are listed as Vulnerable, and are therefore considered to be MSES while *Digitaria porrecta* is listed as Near Threatened and is not a MSES.

In addition to the species listed above, an observation was also made of Queensland western white gum (*Eucalyptus argophloia*), listed as Critically Endangered under the NC Act and Vulnerable under the EPBC Act. This is a commonly planted species on the Darling Downs and the record was made in a planted copse. Therefore it is 'not in the wild' pursuant to the DES Operational policy - *When a protected plant in Queensland is taken to be 'in the wild'*. As such it is not afforded specific conservation significance under the NC Act

The mapped locations of all protected flora encountered within the Survey Area are shown in **Appendix H**.

Table 3-8 NC Act and EPBC Act listed flora species observed during the Survey Period.

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Period observed	Observations
Acanthaceae	<i>Xerothamnella herbacea</i>	-	Endangered	Endangered	Spring	75 individuals found within RE 11.4.3 and non-remnant vegetation.
Asteraceae	<i>Picris barbarorum</i>	-	Vulnerable	-	Spring and Post-wet	392 individuals were found during Spring Survey, and 1 individual was found during the Post-wet Survey in non-remnant vegetation.
Asteraceae	<i>Picris evae</i>	-	Vulnerable	Vulnerable	Spring	1 individual was found during the Spring Survey in non-remnant vegetation
Asteraceae	<i>Rhaponticum australe</i>	Austral cornflower	Vulnerable	Vulnerable	Spring and Post-wet	163 individuals were found growing on hilly sections within non-remnant vegetation in road reserves in the Post-wet Survey, and 1 individual was found in Spring.
Brassicaceae	<i>Lepidium monophloides</i>	Winged peppercre ss	Least Concern	Endangered	Spring and Post-wet	25 individuals were found during the Spring Survey and 7 individuals were found during the Post-wet Survey in RE 11.5.14 and within non-remnant vegetation
Cyperaceae	<i>Cyperus clarus</i>		Vulnerable	-	Post-wet	234 specimens found growing in dense populations in areas containing the geological formation of Cainozoic igneous rocks such as RE 11.8.4 and RE 11.8.5.
Lamiaceae	<i>Westringia parvifolia</i>		Vulnerable	Vulnerable	Spring and Post-wet	214 individuals were found in the Post-wet Survey and 22 individuals were found in Spring Surveys near Yelarbon in RE 11.4.3 and non-remnant vegetation.
Poaceae	<i>Digitaria porrecta</i>	-	Near Threatened	-	Spring and Post-wet	391 individuals were found in Post-wet and 1 individual was found during Spring Surveys typically in non-remnant vegetation and RE 11.3.2, 11.8.4 and 11.8.5.
Poaceae	<i>Homopholis belsonii</i>	Belson's Panic	Endangered	Vulnerable	Spring and Post-wet	2654 individuals were found in the Post-wet surveys while 637 were found during Spring Surveys. Tended to have a preference for shaded areas
Poaceae	<i>Dichanthium queenslandicum</i>	-	Vulnerable	Endangered	Post-wet	100 Individuals were found in the Post-wet Surveys, typically occurring as clumps of a single species.



Figure 3-1 *Xerothamnella herbacea*



Figure 3-2 *Picris barbarorum*



Figure 3-3 *Rhaponticum australe*



Figure 3-4 *Lepidium monoplacoides*



Figure 3-5 *Cyperus clarus*



Figure 3-6 *Westringia parvifolia*



Figure 3-7 *Digitaria porrecta*



Figure 3-8 *Homopholis belsonii*



Figure 3-9 *Dichanthium queenslandicum*

3.3 Field Assessment – Fauna

3.3.1 Conservation Significant Fauna Species

Over the course of the Spring Survey Period, a total of 202 species were observed, including 21 amphibian, 119 bird, 28 mammal, 28 reptile and six insect species. During the Post-wet Survey Period, an additional 79 species were observed, including two amphibian, 36 bird, three gastropod, eight mammal, 15 reptile, 14 insect and one malacostracan species (a yabby), bringing the total number of species observed during the Survey Period to 281.

Of the species observed, eight are listed under either the *EPBC Act* or *NC Act* (**Table 3-9**). Five species are considered to be both MNES and MSES, including:

- > Painted honeyeater (*Grantiella picta*);
- > White-throated needletail (*Hirundapus caudacutus*);
- > South-eastern long-eared bat (*Nyctophilus corbeni*);
- > Grey-headed Flying-fox (*Pteropus poliocephalus*); and
- > Koala (*Phascolarctos cinereus*).

All of the above-listed species are classified as Vulnerable pursuant the *EPBC Act*.

Three of the species found are listed as MSES only, including:

- > Glossy black cockatoo (eastern subspecies) (*Calyptorhynchus lathami lathami*) (*NC Act* Vulnerable);
- > Grey snake (*Hemiaspis damelii*) (*NC Act* Endangered); and
- > Short-beaked echidna (*Tachyglossus aculeatus*) (*NC Act* Special Least Concern),

which are listed as Vulnerable, Endangered and Special Least Concern under the *NC Act*, respectively.

During the post-wet field surveys, two species of native mouse were captured at Site 2 and Site 5. The initial identification made in the field was for the New Holland mouse (*Pseudomys novaehollandiae*), based on tail to head-body measurements, size of ears and fur colour. Hair samples were collected along with measurement and images of the species. The hair sample analysis returned likely House mouse (*Mus musculus*) but noted that the hairs used were not the best for identification purposes. The images and measurements were provided to Scott Burnett of the University of the Sunshine Coast and Kazz Tokek, (both of whom are recognised small mammal experts), as well as the Queensland Museum. The initial field identification of New Holland mouse was verified by Scott Burnett and Kazz Tokek, however, the Queensland Museum considers the species to be Delicate mouse (*Pseudomys delicatus*). Based on the range of identifications received, we have ultimately deferred to the Queensland Museum in this instance and have recorded the species here as Delicate mouse (**Figure 3-10**).

The mapped locations of all threatened fauna encountered within the Survey Area are shown in **Appendix I** and the following sections provide a brief summary of each species within the Survey Area.

Table 3-9 NC Act and EPBC Act listed fauna species observed during the Survey Period.

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Observations
Birds					
Cacatuidae	<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (eastern)	Vulnerable	-	7 individuals
Meliphagidae	<i>Grantiella picta</i>	Painted honeyeater	Vulnerable	Vulnerable	5 individuals
Apodidae	<i>Hirundapus caudacutus</i>	White-throated needletail	Special Concern	Least Vulnerable	2 individuals
Mammals					
Vespertilionidae	<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	Vulnerable	Vulnerable	1 individual
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	Vulnerable	Vulnerable	23 individuals observed and 62 observations

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Observations
					via scat and tracks.
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	Least Concern	Vulnerable	1 individual
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked echidna	Special Concern	Least -	4 individuals
Reptiles					
Elapidae	<i>Hemiaspis damelii</i>	Grey snake	Endangered	-	2 individuals

3.3.1.2 Painted Honeyeater

During the Spring Survey Period, the species was observed utilising non-remnant vegetation dominated by *A. harpophylla* and *C. cristata* along the proposed alignment in areas that tended to be connected to nearby remnant vegetation patches that supported a similar vegetation community. The species was not observed during the Post-wet Survey Period. Refer to **Table 3-12** for a description of habitat found specific to the Painted honeyeater.

The Painted Honeyeater's distribution over summer and spring stretches from inland central Victoria through scattered parts of NSW, the ACT and southern Queensland. During winter, the Painted Honeyeater is known to migrate further to North Queensland, around Cape York Peninsula, and eastern areas of the Northern Territory. Opportunistic sightings have also been recorded in far eastern parts of South Australia (DotEE, 2018).

The species is known to use the same nest sites each season and they are generally seen in pairs or singles, rarely in small flocks of up to six birds (DES 2018; DotEE 2018). They are known to favour habitats that have a high prevalence of mistletoe, their preferred food species. This is consistent with the findings of this survey, with the dominant vegetation community of *A. harpophylla* and *C. cristata* woodland also supporting higher abundance of mistletoe in most locations.

Threatening processes affecting this species that are relevant to the Project include:

- > Destruction of habitat for agriculture and grazing and due to insect-induced eucalypt dieback (Eddy 1961; Garnett 1992); and
- > Reduced regeneration in suitable habitat due to grazing by livestock and rabbits.

3.3.1.3 Grey-headed Flying-fox

During the Post-wet Survey Period, Grey-headed flying-fox individuals were observed foraging in flowering eucalypt trees within remnant and non-remnant vegetation throughout the proposed alignment. It should be noted that no Grey-headed flying-fox camps were sighted within the proposed alignment. Refer to **Table 3-12** for a description of habitat found specific to the Grey-headed Flying-fox.

The species is known to travel great lengths (up to 50 km) to forage fruiting and flowering trees throughout the year (DES, 2013). It is likely that the area provides temporary habitat for individuals that may reside in camps located further away from the proposed alignment.

Threatening processes affecting this species that are relevant to the Project include:

- > Removing vegetation that may provide foraging resources.

3.3.1.4 White-throated needletail

Presence of the White-throated needletail was observed at Site 5 during the Spring Survey Period and at Site 8 during the Post-wet Survey Period. In both instances it was recorded overflying large areas of intact woodland. The White-throated needletail is a trans-equatorial migrant, breeding in the Northern Hemisphere and flying south for the boreal winter. It generally spends the non-breeding season in Australia, where it is widespread in the eastern and south-eastern parts of the country.

This species is almost exclusively aerial and as such, is observed over a range of habitat types. It is most commonly seen foraging at heights 'up to cloud level', although usually much lower. When flying above farmland, they are often recorded above remnant vegetation on the edge of paddocks (Tarburton 1993), as

was the case for the observations recorded during the Survey Period. Refer to **Table 3-12** for a description of habitat found specific to the White-throated needletail.

3.3.1.5 South-eastern Long-eared Bat

Presence of the South-eastern long-eared bat was observed at Site 5 during the Spring Survey Period (**Figure 3-14**). It was captured on two consecutive nights in harp traps installed along an access track located within eucalypt woodland with a very dense secondary tree layer of *Allocasuarina luehmannii*. The distribution of this slow-flying, agile microbat is scattered, falling mostly within the Murray Darling basin area. It inhabits a range of vegetation types; however, it is most commonly found in box, ironbark and cypress pine woodland vegetation on the western slopes and plains of southern Queensland and northern NSW.

The species roosts in tree hollows, crevices and under loose bark, and utilises the understory to hunt non-flying prey such as caterpillars and beetles.

Threatening processes affecting this species that are relevant to the Project include:

- > Loss of remnant semi-arid woodland;
- > Loss of hollow-bearing trees;
- > Disturbance to winter roosting and breeding sites;
- > Inappropriate fire regimes;
- > Loss or modification of habitat; and
- > Application of pesticides in or adjacent to foraging areas.

3.3.1.6 Koala

Koala (**Figure 3-11**), or evidence of Koala presence in the form of scat and scratch marks, was observed at Sites 10 and 5 during the Spring Survey Period and Sites 5, 6, 11 and to the east of Site 10 during the Post-wet Survey Period. It was also frequently recorded along many sections of the proposed alignment, with an area of apparent higher density in and around the Pittsworth region. A total of 23 Koala were directly observed while 62 observations of this species occurrence were also made within the Survey Area. Refer to **Table 3-12** for a notable habitat features specific to the Koala. Typically the Koala (or evidence of their presence) was found in habitats dominated by Eucalyptus woodland. This included the below-listed communities:

- > RE 11.9.7/11.3.4 within Site 5 which includes *E. populnea* and *Eremophila mitchellii* shrubby woodland and *E. tereticornis* woodland;
- > RE 11.5.4/11.3.18 within Site 6, consisting of *E. chloroclada*, *C. glaucophylla*, *C. endlicheri*, *A. leiocarpa* woodland and *E. populnea*, *C. glaucophylla*, *A. luehmannii* shrubby woodland; and
- > REs 11.8.4 and 11.8.5 within Site 10 including, *E. melanophloia* open woodland and *E. orgadophila* open woodland, respectively.

Key threats to this species that are relevant to the Project include:

- > Loss and modification of habitat;
- > Fragmentation and isolation of habitat patches;
- > Barrier effects posed by linear infrastructure;
- > Predation by roaming or domestic dogs; and
- > Vehicle strike.

3.3.1.7 Glossy Black-Cockatoo

Two Glossy black-cockatoos were observed at Site 5 during the Post-wet Survey Period, recorded overflying a patch of *Casuarina cristata*. Other signs of occupation in the form of chewed orts were made along the alignment in areas dominated by *C. cristata*. Refer to **Table 3-12** for a description of habitat found specific to the Glossy Black-Cockatoo. This species has a widespread distribution, from the central Queensland coast to East Gippsland, although it is uncommon within this range. It inhabits open forest and woodlands where sheoak occur. It is a highly specialised feeder, relying on sheoak cones, particularly those of Black sheoak (*Allocasuarina littoralis*), Forest sheoak (*A. torulosa*) and Belah (*C. cristata*). It depends on large, hollow-bearing *Eucalypt* trees for nest sites and lays a single egg between March and May.

Key threats to this species that are relevant to the Project include:

- > Habitat loss from vegetation clearing/removal;
- > Loss and degradation of foraging habitat and reduced regeneration of sheoak stands due to clearing, fragmentations, weed encroachment and / or grazing by domestic stock;
- > Loss of mature eucalypts for nest hollows;
- > Nest predation by feral cats; and
- > Inappropriate fire regimes, resulting in reduced habitat and food quality / availability.

3.3.1.8 Grey Snake

Presence of the Grey snake (**Figure 3-12**) was confirmed at Site 1 during the Spring Survey Period and near Additional Site 2 during preliminary surveys completed for the geotechnical works. At Site 1 it was recorded from the *Melaleuca densispicata* wetland that was recently inundated by heavy rain. It was captured from an area that had an abundance of amphibian fauna at the time of the surveys. The second observation was made at the edge of a riparian woodland associated with a predominantly ephemeral creek that had retained moderate pools of more permanent water. This species is distributed throughout south-eastern Queensland and north-central New South Wales, with a core area of habitat south of the Great Dividing Range between Dalby and Glenmorgan. It inhabits woodlands, particularly Brigalow (*Acacia harpophylla*) and Belah (*Casuarina cristata*), usually on heavier cracking clay soils. Refer to **Table 3-12** for a description of habitat found specific to the Grey Snake

The species is known to shelter under rocks, flood debris, and within soil cracks and abandoned burrows, particularly around waterbodies or in areas with small gullies and ditches (Wilson and Swan 2010). It feeds almost exclusively on frogs.

- > Loss and modification of habitat;
- > Habitat degradation by introduced species such as cattle and rabbits; and
- > Vehicle strike.

3.3.1.9 Short-beaked Echidna

Short-beaked echidna (**Figure 3-13**) were observed at Site 12 during the Spring Survey Period and at Site 1, 3 and 8 during the Post-wet Survey Period. Evidence Short-beaked echidna presence (diggings, scat) was also observed at Site 6 and Site 4 during this period. Refer to **Table 3-12** for a description of habitat found specific to the Short-beaked Echidna.

This species is found throughout Australia in a range of habitats, including forests and woodlands, heath, grasslands, arid environments, farmland and suburban backyards. It requires a large home range and is known to shelter in hollow logs, rock crevices and vegetation. Breeding season takes place in spring, during which time this species will lay a single egg in a nursery burrow. Juveniles do not leave this nursery burrow until 6-8 months old.

Key threats to this species that are relevant to the Project include:

- > Loss and modification of habitat;
- > Fragmentation and isolation of habitat patches;
- > Barrier effects posed by linear infrastructure;
- > Predation by roaming or domestic dogs; and
- > Vehicle strike.



Figure 3-10 Delicate mouse



Figure 3-11 Koala



Figure 3-12 Grey snake



Figure 3-13 Short-beaked echidna



Figure 3-14 South-eastern Long-eared bat

3.3.1.10 Marine and Migratory Fauna

Twenty-two species listed as “Marine” under the *EPBC Act* were found throughout the Survey Area. Of these, three are also listed as “Migratory” species. These are the White-throated needletail, Satin flycatcher and Rufous fantail.

Migratory species are protected under international agreements are considered to be MNES (**Table 3-10**).

Table 3-10 *EPBC Act listed marine/migratory fauna observed during the Survey Period*

Scientific Name	Common Name	EPBC Act - Marine/Migratory	EPBC Act Status	NC Act Status	Period observed
Birds					
<i>Hirundapus caudacutus</i>	White-throated needletail	Marine/Migratory	Vulnerable	Vulnerable	Spring and Post-wet
<i>Myiagra cyanoleuca</i>	Satin flycatcher	Marine/Migratory	-	Special least concern	Post-wet
<i>Rhipidura rufifrons</i>	Rufous fantail	Marine/Migratory	-	Special least concern	Post-wet

3.3.1.11 Condamine Earless Dragon Habitat Assessments

Whilst not directly detected during these surveys, general assessments of fauna habitat have determined that much of the proposed alignment within the Condamine River Floodplain supports habitat which is considered to be important for the Condamine earless dragon (*Tympanocryptis condaminensis*), listed as Endangered under the *EPBC Act* and *NC Act*. Specifically, it was noted that areas of existing rail corridor, road reserves, and adjoining cultivated land provide the combination of ‘complicated’ habitat areas that may be used for retreat as well as exposed areas which may be used for sunning and foraging. As indicated by the the following sections of Appendix L of the Inland Rail Border to Gowrie EIS, habitat for the species within the proposal footprint can include:

- > **Section 4.3.3** - cleared habitats, particularly associated cracking clay soils on the Condamine River floodplain;
- > **Section 4.3.4.2** - The availability of soil cracks and other microhabitat refugia is greatly reduced by soil cultivation. However, cultivated field and adjacent areas are known to provide habitat for MNES species such as the Condamine earless dragon (*Tympanocryptis condaminensis*); and
- > **Section 8.3.1.8** - This dragon species appears to survive in areas that are intensely cropped and previously occupied as naturally treeless grassland. The dragon uses surface debris, including train ballast, surface rocks and rocky outcrops as shelter, while cracks in the black clays of the Condamine River floodplain provide holes to seek alternate shelter when disturbed.

While targeted surveys for this species were impacted by adverse weather events (as described in in **Section 2.6**), walking visual transects provided further confirmation of the presence of suitable habitat conditions for this species. Based on these findings and the fact that known records of this species have been identified within the project footprint, it is considered likely that the species is present with habitat also occurring in areas of ‘converted grassland’ described above and typically associated with the existing rail line easement and road reserves and the fringes of the immediately adjoining cropping land.

3.3.1.12 Other fauna species

In addition to the threatened fauna noted above, a wide range of more common species were encountered throughout the Survey Area. Dedicated searches using a range of techniques targeted toward key groups including Butterflies, Frogs, Snails, Reptiles and Birds resulted in the ‘capture’ of the species listed in **Appendix J**. Sections **Section 3.3.1.12.1– Section 3.3.1.12.6** and **Figure 3-15– Figure 3-25** provide further information regarding each group.

3.3.1.12.1 Butterflies

A total of 17 butterfly species were recorded during surveys. No threatened butterflies were recorded. Searches for butterflies in brigalow failed to record the Pale Imperial Hairstreak (*Jalmenus eubulus*) which is reliant on this species for its life-cycle. In some instances, species including the Caper white (*Belenois java*),

were observed in large numbers in relatively small areas of vegetation supporting its host plants including various species of *Capparis*. Other common species recorded included the Tailed emperor (*Charaxes sempronius*) and the Orchard butterfly (*Papilio aegeus*) illustrated in **Figure 3-15** and **Figure 3-16**.



Figure 3-15 Tailed emperor



Figure 3-16 Orchard butterfly {male & female}

3.3.1.12.2 Amphibians

Both survey periods experienced a number of significant rain events, creating ideal conditions for the detection of amphibian fauna. In total 23 amphibian species were observed. This represents over 80% of the amphibian species expected to occur within the Survey Area. The Ornate burrowing frog (*Platyplectrum ornatum*) was the most widely distributed and most frequently encountered. However, during the Spring Survey Period, within Site 1 near Yelarbon a very diverse range of burrowing frogs from the genus *Cyclorana* were observed. Two of these, the Eastern snapping frog (*Cyclorana novaehollandiae*) and Green striped frog (*Cyclorana alboguttata*) have been illustrated in **Figure 3-17** and **Figure 3-18**.



Figure 3-17 Eastern snapping frog



Figure 3-18 Green striped frog

3.3.1.12.3 Reptiles

While reptile fauna was encountered throughout the Survey Area, abundance and diversity was lower than expected, particularly for snakes and skinks. Geckos were the most frequently encountered, primarily during nocturnal spotlighting events. Of this group the terrestrial Bynoe's Gecko (*Heteronotia binoei*) and the arboreal Dubious dtella (*Gehyra dubia*) were most observed. Other notable species observed include the Bandy bandy (*Vermicella annulata*), Sand swimmer (*Eremiascincus richardsonii*), Blue tongue lizard (*Tiliqua scincoides*) and Eastern spiny-tailed gecko (*Strophurus williamsi*) that have been illustrated below in **Figure 3-19** through **Figure 3-22**.



Figure 3-19 Bandy bandy



Figure 3-20 Sand swimmer



Figure 3-21 Blue-tongued lizard

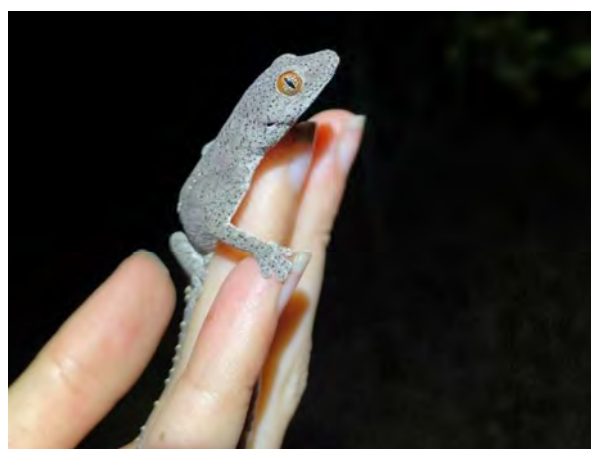


Figure 3-22 Eastern spiny-tailed gecko

3.3.1.12.4 Avifauna

Avifauna were the most abundant fauna group encountered with species ranging from the threatened Painted honeyeater, numerous birds of prey including the Little eagle (*Hieraaetus morphnoides*), nocturnal species such as the Barking owl (*Ninox connivens*) and the Owlet nightjar (*Aegotheles cristatus*) illustrated in **Figure 3-24** to common and more disturbance tolerant species such as the Torresian crow (*Corvus orru*) and the Sulphur crested cockatoo (*Cacatua galerita*) illustrated in **Figure 3-23**.



Figure 3-23 Sulphur-crested cockatoo



Figure 3-24 Owlet nightjar

3.3.1.12.5 Snails

The threatened Brigalow woodland snail (*Adclarkia cameroni*) was not recorded within the Survey Area. Snails recorded during searches for this species included the Darling Downs Woodland Snail (*Ponderconcha gilberti*) and *Pallidelix bennetti*. *P. bennetti* is a native snail species that was not specifically targeted, however was observed throughout the proposed alignment. The species is not commonly recorded is illustrated in **Figure 3-25**.



Figure 3-25 *Pallidelix bennetti*

3.3.1.12.6 Microbats

In addition to the threatened South-eastern long-eared bat, which was captured in a harp trap at Site 5 during the Spring Survey period, numerous other microbat species were detected within the Survey Area. To supplement direct capture methodology, unattended bat detectors were utilised at each Survey Site, for a total of four nights per site. Analysis of the call data recorded by these devices was carried out by external providers. A full list of microbat species identifies via call analysis is provided in **Table 3-11**.

Table 3-11 Microbat species identified via unattended bat detectors during the Spring and Post-west ecological surveys.

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's wattled bat	Least concern	-
Vespertilionidae	<i>Chalinolobus morio</i>	chocolate wattled bat	Least concern	-
Vespertilionidae	<i>Chalinolobus picatus</i>	Little pied bat	Least concern	-

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Vespertilionidae	Nyctophilus sp.		Least concern	-
Vespertilionidae	Scotorepens balstoni	Inland broad-nosed bat	Least concern	-
Vespertilionidae	Scotorepens sp. Scotorepens greyii	/ Central-eastern broad-nosed bat/ Little broad-nosed bat	Least concern	-
Vespertilionidae	Vespadelus regulus	Southern forest bat	Least concern	-
Vespertilionidae	Vespadelus vulturnus	Little forest bat	Least concern	-
Miniopteridae	Miniopterus orianae	Eastern bent-wing bat	Least concern	-
Molossidae	Austronomus australis	White-striped freetail bat	Least concern	-
Molossidae	Ozimops lumsdenae	Northern free-tailed bat	Least concern	-
Molossidae	Ozimops ridei	Eastern free-tailed bat	Least concern	-
Emballonuridae	Saccolaimus flaviventris	Yellow-bellied sheath-tail bat	Least concern	-

3.3.2 Fauna Habitat

Fauna habitat availability and quality varied across the Survey Area, with areas of overall higher value typically linked to the proximity of areas of remnant or well-advanced regrowth vegetation. Even relatively isolated patches or trees, such as areas of roadside vegetation, provide value to native fauna in a fragmented landscape. This is evidenced by the use of these areas by the threatened Painted honeyeater, Koala and a range of other mobile native fauna.

Terrestrial fauna trapping Sites 1 through to Site 6 from the Post Wet Survey period provide particularly high-quality habitat for a number of native bird, reptile, mammal and amphibian species. These areas typically provided higher number of habitat features, hollow-bearing trees, and expanse of intact habitat, generally associated with areas of State forest. Towards the northern extent of the Survey Area, from Post Wet Survey site 10 to 12 the broader landscape is far more fragmented, consequently overall fauna habitat value is considered to be lower. However, pockets of high value do occur, most notably in and around Pittsworth where a high abundance of Koala occurs and in areas with a high density of retained hollow-bearing trees, such as on Site 12.

The middle portion of the Survey Area between Post-Wet Survey Site 6 to the Condamine River flood plain is both highly fragmented and more extensively cleared. While pockets of higher value exist along road reserves, areas of rocky relief and fence lines, this area, by and large is likely to be of lower overall value to native fauna.

Table 3-12 summarises the habitat characteristics observed at the locations where threatened fauna species were recorded within the Survey Area.

Table 3-12 Habitat summary for threatened fauna species encountered during the surveys

Species	General habitat	Notable habitat characteristics
<i>Calyptorhynchus lathami lathami</i>	<i>C. lathami lathami</i> habitat in the Survey Area generally consists of REs containing food trees such as <i>Allocasuarina</i> spp. and <i>Casuarina</i> spp. it was encountered from within and around 11.9.5, 11.9.7 and 11.4.3 within the Survey Area.	Encountered in areas with higher abundance of feed trees (<i>Allocasuarina</i> spp.) typically in narrow strips.
<i>Grantiella picta</i>	<i>G. picta</i> was found in REs 11.3.2/11.3.4/11.3.25 and 11.4.3 which are assumed to provide preferred woodland habitat for foraging.	Species encountered from narrow strips of vegetation with eucalypt and acacia species dominant. Higher abundance of Mistletoe species present throughout.
<i>Hirundapus caudacutus</i>	Observed in the airspace above woodland during surveys. This is consistent with known habitat. Likely to be wide ranging within Survey Area.	No notable features.
<i>Myiagra cyanoleuca</i>	Found in woodland habitat with RE 11.5.4 and 11.5.20	Nearby to minor drainage lines with dense vegetation.
<i>Rhipidura rufifrons</i>	Observed in woodland habitat with RE 11.5.4 and 11.5.20	Likely to be widespread. No notable features.

<i>Nyctophilus corbeni</i>	Captured in RE 11.5.20/11.5.4 in an area with reasonable density of hollow bearing trees and a mix of larger emergent eucalypt and dense understorey	Captured in area with very dense secondary tree layer. Consistent with closed guild 'clutter feeding' species.
<i>Phascolarctos cinereus</i>	<i>P. cinereus</i> was observed along much of the alignment including areas of remnant and regrowth vegetation. In particular the following Eucalypt dominated REs RE 11.9.7/11.3.4 , 11.5.4/11.3.18 , 11.8.4 and 11.8.5.	No notable features.
<i>Pteropus poliocephalus</i>	One individual was found in RE 11.3.2 within the Survey Area but is likely to be more wide ranging in response to flowering of feed trees. Potential habitat likely to broadly overlap with that of the Koala.	No notable features.
<i>Tachyglossus aculeatus</i>	<i>T. aculeatus</i> was found in REs 11.3.2, 11.5.4, and 11.7.7/11.5.1 within the Survey Area.	Typically encountered in areas with sandy soils. Dense ground layer and coarse woody debris often occurring a 'pushed piles' abundant.
<i>Hemiaspis damelii</i>	<i>H. damelii</i> was found in RE 11.3.14 and 11.5.14 within the Survey Area.	Sparse vegetative ground layer at both locations. Larger woody debris present within ground layer. Within ephemeral palustrine wetland with clay soils and typical riverine wetland community with sandy alluvial soils.

3.3.2.2 Potential Breeding Places

The combined Spring and Post-wet Survey Period resulted in the detection of 1,824 potential animal breeding places across the Survey Area (**Table 3-13**). Of these, 147 breeding places (hollow-bearing trees, stags or burrows) were observed to be actively utilised by fauna at the time of survey. The status of remaining breeding places is unknown; however, it is likely that many of these are regularly used by fauna for breeding purposes. **Appendix J** presents the locations of the fauna breeding features encountered in the Survey Area.

Hollow-bearing trees and stags within the Survey Area, particularly those located within Sites 1, 7, 11 and 12 (in which a large number of hollows and stags were observed) are likely to be used by a range of hollow dependent birds, such as parrots, arboreal mammals, and microbat species for breeding purposes. Hollow logs within the Survey Area may provide shelter and breeding habitat for a number of fauna groups including amphibians and reptiles, as well as small terrestrial mammals such as the Short-beaked echidna.

No threatened species or colonial breeding species were directly observed utilising these breeding places during the brief diurnal assessments (although one group of *Hirundo neoxena* (Welcome Swallow) nests was encountered); however, each breeding place was not individually inspected – as such, the possibility of their use by colonial breeding species cannot be discounted. The presence of several colonial breeding species, including various birds and microbats, across the Survey Area suggests that many of the breeding places observed would be used by these species from time to time and consequently should be treated as potential colonial breeding places. As such, a High-Risk Species Management Plan (High- Risk SMP) has been completed in to conserve habitat values and minimise harm to threatened fauna during construction.

Table 3-13 Hollows and habitat features recorded in the Survey Area during the Spring Survey Period

Habitat feature	Total number of features recorded throughout the Impact Area
Nest	52
Woody debris	115
Burrow	13
Hollow*	1,587
Abandoned Buildings (bat roost)	1
Cave	4
Dam	11
Ephemeral Wetland	13

Habitat feature	Total number of features recorded throughout the Impact Area
Gilgai	6
Loose Surface Rock	6
Mud Nest	1
Rock Pile	4
Rocky Outcrop	3
Termite Mound	8

* Includes hollows in hollow-bearing trees, stags and woody debris piles with hollows.

3.4 Biosecurity Matters

The specific flora and fauna species found within the Survey Area which are listed under the *Biosecurity Act 2014* are detailed below.

3.4.1 Invasive Flora

A number of exotic flora species were observed across the Survey Area (**Table 3-14**) listed as Category 3 – Restricted invasive pest plants under the *Biosecurity Act 2014*; four of which are also listed as Weeds of National Significance (WONS) (**Table 3-14**).

One species, while not listed under the *Biosecurity Act 2014* or as WONS, was noted to be present in large quantities in some parts of the Survey Area - African lovegrass (*Eragrostis curvula*). This species has the potential to spread rapidly and may negatively affect pasture and natural habitats.

Appendix L shows weed abundances of those species listed in Table 3-14.

Table 3-14 Introduced flora observed across the Survey Area.

Family	Scientific Name	Common Name	Biosecurity Act 2014 – Restricted Invasive [^]
Asparagaceae	Asparagus africanus	Climbing asparagus fern	Yes
Cactaceae	Harrisia martinii	Harrisia	Yes
Cactaceae	Harrisia pomanensis	Harrisia	Yes
Cactaceae	Harrisia tortuosa	Harrisia	Yes
Cactaceae	Opuntia aurantiaca	Tiger pear	Yes [^]
Cactaceae	Opuntia stricta	Prickly pear	Yes [^]
Cactaceae	Opuntia tomentosa	Velvety tree pear	Yes [^]
Crassulaceae	Bryophyllum delagoense	Mother of millions	Yes
Solanaceae	Lycium ferocissimum	African boxthorn	Yes [^]
Rubiaceae	Dolichandra unguis-cati	Cat's claw creeper	Yes
Ulmaceae	Celtis sinensis	Chinese elm	Yes
Verbenaceae	Lantana montevidensis	Creeping lantana	Yes
[^] = Weed of National Significance (WONS)			

3.4.2 Invasive Fauna

A number of exotic or introduced fauna species were observed during the Survey Period. A summary is presented by **Table 3-15**. Five of these species are recognised as restricted invasive animals under the *Biosecurity Act 2014*.

Table 3-15 Introduced fauna observed across the Survey Area.

Family	Scientific Name	Common Name	Biosecurity Act 2014 – Restricted Invasive [^]
Sturnidae	Acridotheres tristis	Common myna	

Family	Scientific Name	Common Name	Biosecurity Act 2014 – Restricted Invasive [^]
Columbidae	<i>Columba livia</i>	Feral pigeon	
Columbidae	<i>Streptopelia chinensis</i>	Spotted dove	
Nymphalidae	<i>Pieris rapae</i>	Cabbage white	
Bovidae	<i>Bos taurus</i>	European cattle	
Canidae	<i>Canis lupus</i>	Dingo, domestic dog	Yes [^]
Felidae	<i>Felis catus</i>	Cat	Yes [^]
Leporidae	<i>Lepus europaeus</i>	Hare	
Muridae	<i>Mus musculus</i>	House mouse	
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit	Yes
Suidae	<i>Sus scrofa</i>	Feral pig	Yes
Canidae	<i>Vulpes vulpes</i>	European fox	Yes
Muridae	<i>Rattus rattus</i>	Black rat	
[^] = Other than domestic animals			

4 Conclusion

During the period 19 October and 13 November 2020 and 8 March to 27 March 2021 Cardno delivered a series of terrestrial ecology assessments on behalf of ARTC. The purpose of these assessments was to build upon the studies undertaken for the draft Environmental Impact Statement and are required to inform the detailed design and construction of the B2G project. More specifically, the objective of these surveys was to determine the presence or likelihood of presence, location, habitat extent/quality and significance of, any individual/population of a species and/or ecological community protected under relevant State and Commonwealth legislation and local government environmental planning requirements.

A total of eighteen REs were recorded and mapped within the project footprint, including two listed as Endangered under the VM Act and five listed as Of Concern. Biocondition sites were used to assess and score the quality of habitat within the majority of these REs. Five TECs were identified within the project footprint.

Over the course of the Surveys, a total of ten threatened flora species listed under either the EPBC Act and/or NC Act were observed. Of these species; seven are listed under the EPBC Act, and are considered to be MNES, and three are listed solely under the NC Act, and are considered to be MSES.

A total of 281 fauna species were observed during the total Survey Period, including:

- > 23 amphibians;
- > 155 birds;
- > 3 gastropods;
- > 20 insects;
- > 1 malacostracan;
- > 36 mammals; and
- > 43 reptiles.

Of the species observed, eight are listed under either the EPBC Act or NC Act. Five of these listed under both the EPBC Act and the NC Act and are considered to be both MNES and MSES, while three of the species found are listed under the NC Act only two are MSES. High quality fauna habitat was identified across the project area, within remnant, regrowth and disturbed environments. Observations included 1,824 potential animal breeding places within close proximity to the proposed alignment.

An array of exotic flora and fauna species was observed during the survey period. In terms of flora, this included 11 Category 3 – Restricted invasive pest plants listed under the *Biosecurity Act 2014*; four of which are also listed as Weeds of National Significance (WONS). Five restricted invasive fauna species listed under the *Biosecurity Act 2014* were recorded within the Survey Area.

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APPENDIX

A

FIELD ACTION PLAN

Field Action Plan - Ecological Surveys

Inland Rail - Border to Gowrie

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Prepared for
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1 March 2021

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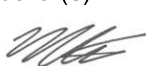
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Version	Effective Date	Description of Revision	Prepared by	Reviewed by
5	1/03/2021	Final	DW	CS

FIELD ACTION PLAN

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1 Introduction

1.1 Purpose of this report

The purpose of this Field Action Plan is two-fold:

1. Review the requirements for seasonal survey and field survey methods.
2. Detail the survey approach for the staged ecological surveys.

Given project timing, the potential need to conduct seasonal surveys, access lead times and the impending change of seasons this report specifically aims to identify the species and potential sites for which urgent survey work is required. Fundamental to understanding the need for seasonal surveys is gaining an appreciation of the field survey methods for the targeted fauna and flora survey identified in Commonwealth, State and industry guidelines.

This field action plan details the recommended approach to ecological surveys which are divided into two stages as follows:

- > **Stage 1 surveys:** recommended survey approach prior to ARTC commencing geotechnical investigation for the Inland Rail Border to Gowrie (B2G) project. The Stage 1 ecological surveys for the geotechnical investigation include:
 - confirmation of the presence/absence of threatened ecological communities (TECs) within the geotechnical investigation footprint;
 - protected plant flora surveys;
 - wildlife habitat assessments; and
 - recording declared weeds.
- > **Stage 2 surveys:** recommended detailed dry and wet season surveys intended to be completed to address gaps identified in previous field assessments to date. Stage 2 surveys include:
 - Targeted threatened fauna species surveys (Matters of National Environmental Significance (MNES), Matters of State Environmental Significance (MSES) & Matters of Local Environmental Significance (MLES)) and habitat assessments;
 - Targeted threatened flora species surveys (MNES, MSES & MLES);
 - Surveys and mapping of vegetation communities and TECs; and
 - Mapping of weed infestations.

1.1.1 Other relevant documents and management plans

This field action plan is supported by a number of additional relevant documents and plans which have been prepared for this Project. This includes:

- > The Project Services Management Plan;
- > Environment Management Plan;
- > Safety Management Plan;
- > Project-specific Safe Work Method Statement (SWMS);
- > COVID-19 Field Work Assessment; and
- > Project Risk Register.

These documents outline the approach to communication, health, safety and environment management aspects of the project, including during the field survey. The Project SWMS has been approved by ARTC and QR.

1.2 Proposed works

1.2.1 Stage 1 geotechnical investigation and access

ARTC is proposing to undertake geotechnical investigations for the B2G project. It is understood that the geotechnical investigation includes the following impact footprint:

- > Test sites will have a footprint of 10m x 10m, which will be reduced in areas of Regulated Vegetation;
- > Access tracks have a designated footprint of 10m, however, clearing will be minimised to the minimum area required for safe access. Noting the 10 m access track footprint allows for realignment should ecological constraints be identified during the survey; and
- > Seismic survey will have a maximum width of 2m, however, will be reduced to the greatest extent practicable with some capacity to alter alignments to avoid ecological constraints where identified.

The following is a summary of the geotechnical investigations based on ARTC's Geotechnical Data Collection Project (**Appendix A**) provided:

- > Access tracks:
 - Geotechnical investigation utilises various equipment from a 4WD vehicle to a truck-mounted drill rig.
 - Several access tracks are required to allow ARTC to safely access geotechnical testing sites.
- > Borehole drilling:
 - Using a truck-mounted drill rig, the drilling requires a relatively flat cleared pad around 20m x 20m.
 - Early stages of drilling will involve hammering a metal sampling tool into the ground.
 - Once complete, the boreholes will be backfilled with soil per relevant legislation and safety codes.
 - Drill pads will be rehabilitated by reinstating the disturbance area to match the surrounding surface as far as practically possible.
 - A piezometer will be installed in some of the boreholes to monitor groundwater levels before being backfilled.
- > Auger drilling
 - A drill mounted ute or small truck is used to drill a hole within a disturbance area no greater than 1m².
 - Auger holes will be backfilled using the soil and/or rock that will come out of the hole during the drilling process.
- > Ground vibration testing
 - Vibration testing utilises a sledgehammer to create sound waves (vibrations) that travel through the ground.
 - The process is non-intrusive, requiring small plates and geophones placed 10cm to 20cm apart along a string.
- > Trench Pit Soil Sampling
 - An excavator is utilised to dig a trench approximately 2-3m deep, 2m long and 30-40cm wide.
 - Once the studies are completed, backfilling of soil will take place as soon as possible.
- > Cone penetration testing (CPT)
 - Using a hydraulic rig, CPT requires pushing an instrumented cone tip vertically into the ground through several rods.
 - The methodology is very low impact, leaving only a 100mm diameter hole in the ground that is backfilled upon survey completion.

1.2.2 Stage 2 – Construction

Stage 2 works will include construction of the B2G portion of the Inland Rail Project. Generally, this will include:

- > Permanent impacts for rail infrastructure (including establishment of approximately 145 km of new rail corridor and use of approximately 71.2 km of existing rail corridor), road infrastructure earthworks, rail maintenance access roads and drainage; and
- > Temporary impacts to accommodate temporary construction-phase activities, facilities and movements.

Field assessments for the Stage 2 works will be limited to the proposed construction footprint (permanent and temporary) and a 100m buffer.

1.3 Objectives of the ecological assessment studies

Section 3 of the brief for this Project summarises the terrestrial ecological assessment objectives. An assessment of how these objectives are met by the Stage 1 and Stage 2 surveys is provided in **Table 1-1**.

Table 1-1 How the proposed assessments address the objectives of the brief

Objective from the brief	Stage assessed
Completion of winter and spring field surveys ¹ to determine the presence or likelihood of presence, location, habitat extent/quality and significance of, any individual/population of a species and/or ecological community protected under relevant State and Commonwealth legislation and local government environmental planning requirements within the B2G Project reference design disturbance footprint (temporary and permanent)	Stage 1 & 2
Verification and quantification of significant residual impacts on Matters of National, State and Local Government Environmental Significance (MNES, MSES and MLES)	Stage 2
Data to inform Inland Rail's Offset Strategy planning requirements and detail matters such as Project offset obligations for both State and Commonwealth requirements. Habitat quality assessment of impact areas is to be determined for the purpose of offset ecological equivalence.	Stage 2
Assessment of and management advice relating to Biosecurity matters within each Project area according to: <i>Biosecurity Act 2014</i> and subordinate legislation; ▪ <i>Goondiwindi Regional Council Biosecurity Management Plan</i>; ▪ <i>Toowoomba Region Pest Management Plan 2014-2018</i>; and ▪ <i>Draft Toowoomba Regional Council Biosecurity Plan for Invasive Plants and Animals 2020</i>	Stage 1 (weeds only) & Stage 2
Identify, if any, species, populations or communities where subsequent monitoring is anticipated to be required as part of a future management plan, and the appropriate means for this (including statistical analysis, where feasible and valid)	Stage 2
Sufficient field survey effort to support compliance and approvals including secondary approvals identified for geotechnical works	Stage 1 (for Geotech) & Stage 2
Preparation of a species management program and plans under the NC Act and EPBC Act	Informed by Stage 1 & Stage 2
Provision of baseline data to support site restoration, rehabilitation and landscaping practices; and	Stage 2
Mapping of approval trigger areas and ecological constraints at a suitable standard for inclusion in the ARTC GIS (ARTC /Inland Rail (IR) ArcGIS 10.7.1 and ArcGIS Server 10.7.1).	Stage 1 & Stage 2

¹ Gap analysis completed for the Project has identified that dry and post-wet season surveys are more appropriate for detection of the target species and to comply with relevant Commonwealth and State guidelines. No winter surveys are proposed in this field action plan. Stage 1 surveys are proposed in early spring (completed in September), and stage 2 surveys are proposed in the dry season (completed in October/November) and wet season (completed in February/March).

1.4 Study Area

1.4.1 Stage 1 Study area

For the purpose of this report, the Stage 1 Study area includes the following:

- > Priority 1 sites (5m buffer around infrastructure footprint, plus requirements of the Protected Plants Flora Survey which includes a 100m buffer of disturbance within 'high risk' areas);
- > Priority 2 sites (5m buffer around infrastructure footprint);
- > Access tracks (5m buffer around infrastructure footprint); and
- > Seismic survey (5m buffer around infrastructure footprint).

1.4.2 Stage 2 Study area

The Stage 2 Study area will include the following:

- > Rail footprint, and a 100m buffer; and
- > Construction compound, permanent and temporary construction impact zones, laydown, stockpile and storage areas, and a 100m buffer.

2 Matters considered

To inform this field action plan the following components of the Environmental Impact Statement (EIS) were reviewed:

- > Chapter 10 – *Flora and Fauna*;
- > Appendix J – *Terrestrial ecology report*;
- > Appendix K – *Aquatic ecology report*; and
- > Appendix L – *Matters of National Environmental Significance technical report*.

2.1 Stage 1

As the stage 1 surveys were completed to inform the impact assessment and approval requirements for geotechnical investigations, stage 1 surveys prioritised those matters likely to trigger approvals or requirement amendments to testing sites to avoid impacts to ecological matters. Specifically, the following matters were targeted during the Stage 1 Survey:

- > protected flora within areas mapped as 'high risk' by the *Nature Conservation Act 1992* (NC Act) Protected Flora Survey Trigger Map
- > protected Flora within those areas not mapped as high risk by the 'high risk' by the NC Act Protected Flora Survey Trigger Map, but for which ARTC identified adjacent 'known' records of threatened species;
- > TECs in areas which supported analogous regional ecosystems;
- > wildlife breeding habitat (e.g. nests, burrows, hollows etc.) for MNES, MSES, MLES and least concern fauna; and
- > restricted weeds listed under the *Biosecurity Act 2014*.

2.2 Stage 2

Stage 2 survey will cover MNES, MSES and MLES as documented below. All features will be assessed within the Stage 2 Study Area; being the project construction footprint and a 100 m buffer as identified in **Section 1.4.2**. The Stage 2 survey will refine the extent of impacts identified in the EIS based on ground-truthed data. It is intended this information will be used determination of significant residual impacts on MNES, MSES and MLES to guide environmental offset obligations, and to inform relevant environmental management plans and approvals for the Project.

2.2.1 MNES

The controlling provision for the Project is 'Listed threatened species and communities'. The following MNES will be targeted during the Stage 2 surveys:

- > TECs as identified in Section 4;
- > Listed threatened species (flora and fauna) as identified in Section 4 and associated habitat; and
- > Migratory species identified in the EIS Terms of reference.

The following status groups for listed threatened flora, fauna and ecological communities under the EPBC Act have been considered:

- > Vulnerable.
- > Endangered.
- > Critically Endangered.

2.2.2 MSES

The following MSES will be targeted during the Stage 2 surveys:

- > Threatened flora and fauna species listed under the NC Act and their habitat;
- > Regulated vegetation communities and essential habitat;

- > Wetlands in a wetland protection area;
- > Waterways that provide for fish passage under the *Fisheries Act 1994*.

The following status groups for flora and fauna under the *Nature Conservation Act 1992* (NCA) have been considered:

- > Special Least Concern.
- > Near Threatened.
- > Vulnerable.
- > Endangered.

2.2.3 MLES

A MLES is a matter that is prescribed under a local planning instrument as a prescribed environmental matter and cannot be the same or substantially the same as a MNES or MSES. The B2G alignment traverses two local government areas (LGAs); being, the Toowoomba Regional Council LGA and Goondiwindi Regional Council LGA.

Goondiwindi Regional Council does not identify any MLES within the Goondiwindi Regional Council Planning Scheme and as such no MLES will be subject to assessment within the portion of the Study area within the Goondiwindi LGA.

Whilst the Toowoomba Regional Planning Scheme does not refer to MLES directly, a number of environmental matters are prescribed and thus have been considered in this field action plan. The following MLES will be targeted during the Stage 2 surveys within portion of the Stage 2 Study area which falls within the Toowoomba LGA:

- > Waterways and wetlands that are not already protected as MNES or MLES;
- > Biodiversity corridors; and
- > Mapped areas of ecological significance' which are not mapped as MNES or MSES.

2.2.4 Biosecurity matters

Locations of weeds and pest animals declared under the *Biosecurity Act 2014* will be mapped.

3 Stage 1 Survey

3.1 Overview of survey requirements

A summary of the survey requirements for Priority 1, Priority 2 sites, and access tracks are shown in the decision tree in **Figure 3-1**. Sites and access tracks which do not meet the requirements for the survey will be excluded from the survey effort.

Priority 1 and Priority 2 sites were determined by ARTC. Priority 1 sites are those within a 'High Risk' area on an NC Act protected flora trigger map, or where threatened flora species were identified by ARTC as known to occur proximate to the site. Priority 1 sites are considered 'higher risk' from an ecological perspective. Priority 2 sites are those not within a high risk and not identified as having proximate records for threatened flora but might otherwise contain some ecological value.

Decision tree for survey effort of geotechnical sites

Sites and their associated access tracks are categorised as:

- Priority 1 Within a protected flora trigger map area (* a limited number of extra sites have been added where proximate records of threatened plants occur)
- Priority 2 (a) Outside of protected flora mapping and within an area that is a pre-clear grassland Threatened Ecological Community (TEC)
- Priority 2 (b) Outside of protected flora mapping and within an area that is any other pre-clear TEC
- Priority 2 (c) Outside of protected flora mapping and supporting woody vegetation that is not a TEC

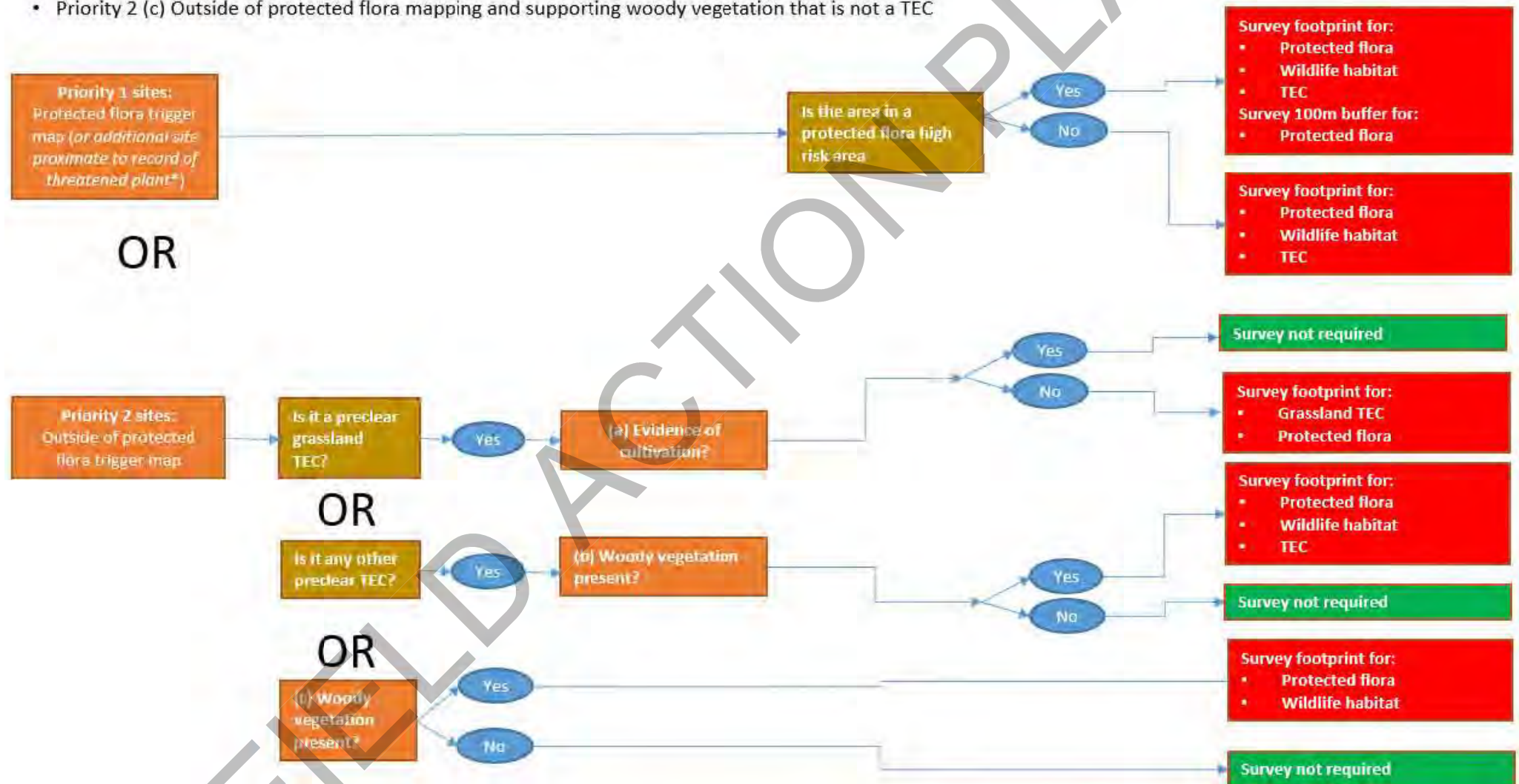


Figure 3-1 Summary of survey requirement for Priority 1, Priority 2 sites and access tracks

3.2 Priority 1 survey sites

As identified in **Figure 3-1** above, Priority 1 (P1) sites include the following:

- > Sites located within the High-Risk Area for protected plants on the Department of Environment and Science's (DES's) High Risk Area Trigger Map (P1(a) sites); and
- > Sites located outside of the High-Risk Area for protected plants but which are proximate to previous records of EVNT flora species (*information provided by ARTC*)).

Table 3-1 provides a list of all Priority 1 survey sites. Geotechnical investigation sites have been grouped into survey sites as per below where they have with overlapping clearing impact areas (i.e. Priority 1 site and a 100 m buffer) and shown in **Figure 3-2** below.

Table 3-1 Priority 1 survey sites

Survey site	Geotechnical investigation		Reason for inclusion in the survey	Site category
	Geotechnical aspect	Site reference		
1	Test site	310-03-BH3300	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
2	Test site	310-03-BH3301	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
3	Test site	310-03-TP3098	Adjoins protected plant record (<i>Homopholis belsonii</i>)	P1 (a) – survey of buffer not required
4	Test site	310-03-CP3212	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
5	Test site	310-03-CP3017	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
		310-03-BH3028		
		310-03-CP3214		
		310-03-BH3027		
		310-03-CP3213		
6	Test site	310-03-TP3137	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
7	Test site	310-03-CP3020	Adjoins protected plant record (<i>Digitaria porrecta</i>)	P1 (a) – survey of buffer not required
		310-03-CP3019		
8	Test site	310-03-TP3312	Adjoins protected plant records (<i>Picris barbarorum</i>)	P1 (a) – survey of buffer not required
9	Test site	310-03-TP3346	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
10	Test site	310-03-BH3334	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
		310-03-BH3336		
		310-03-BH3333		
		310-03-TP3155		
		310-03-BH3332		
	Seismic surveys	310-03-SR3028		
		310-03-SR3032		
		310-03-SR3031		
		310-03-SR3030		
11	Test site	310-03-BH3343	Within high risk trigger area for protected plants	P1 (a) – 100 m buffer
		310-03-BH3342		
		310-03-BH3340		
		310-03-BH3339		
	Seismic surveys	310-03-SR3037		

Survey site	Geotechnical investigation		Reason for inclusion in the survey	Site category
	Geotechnical aspect	Site reference		
		310-03-SR3038		
		310-03-SR3035^		
		310-03-SR3036		
12	Test site	310-03-BH3084	Adjoins protected plant record (<i>Digitaria porrecta</i>)	P1 (a) – survey of buffer not required
		310-03-TP3209		
	Access track	AT-310-03-BH3084		
13	Test site	310-03-TP3217	Adjoins protected plant record (<i>Rhaponticum australe</i>)	P1 (a) – survey of buffer not required
	Access track	AT-310-03-TP3209		

^NOTE: Survey of this site not required as test site located wholly on 'highly modified' existing road.

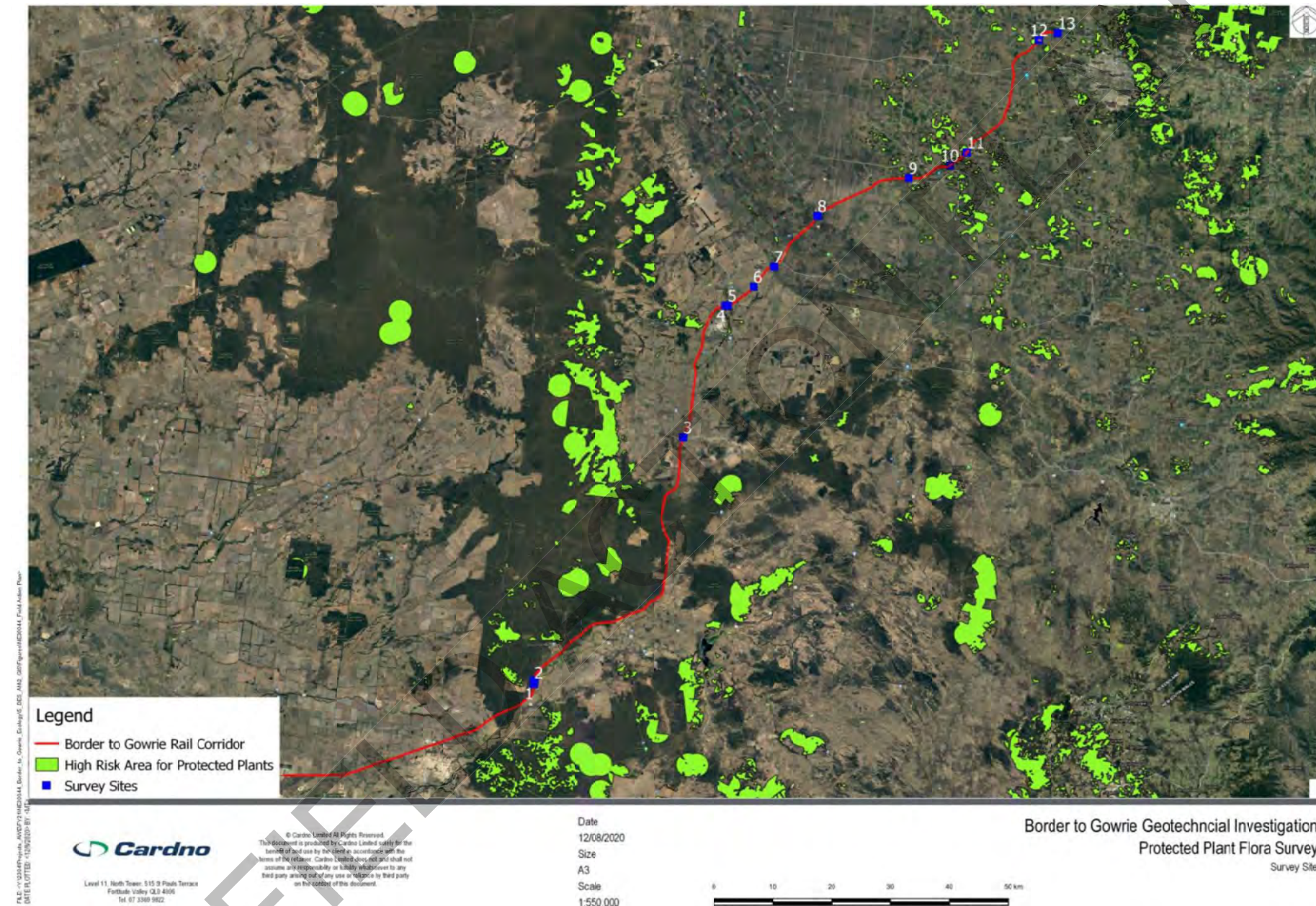


Figure 3-2 Priority 1 Survey Sites

3.3 Priority 2 survey sites and access tracks

As detailed in **Figure 3-2**, Priority 2 (P2) sites and access tracks included in the survey effort meet the following requirements:

- > Sites located outside of the High-Risk Area for protected plants (and / or no proximate known records for protected plants as identified by ARTC);
- > Sites located in a preclear grassland TEC with no evidence of cultivation;
- > Sites located in any other preclear TEC and woody vegetation is present; or
- > Sites with woody vegetation present (being defined as the presence of one or more tree within the proposed construction footprint as identified by aerial imagery).

The “preclear grassland TEC” refers to, the Critically Endangered *Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* which equates with two REs:

- > 11.3.21 *Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils; and
- > 11.3.24 *Themeda avenacea* grassland on alluvial plains. Basalt derived soils.

“Any other preclearing TEC” refers to the seven additional TECs which have the potential to occur within the Study area (refer to **Section 3.4.1** below) based on corresponding REs. The review of woody vegetation utilised current and historical areas from multiple sources including (Good Earth Pro. and Nearmap).

A total of 113 test sites are included in the P2 site categorisation. A summary of the categorised Priority 2 sites and access tracks is detailed in **Table 3-2** below. The detail of the categorisation of the Priority 2 sites and access tracks are enclosed in **Appendix C**. The location of the P2 Sites is shown on **Figure 3-3**.

Table 3-2 Summary of Priority 2 sites survey requirements

Priority 2 site and access tracks	Survey required
P2 (a) sites	14
P2 (b) sites	32
P2 (c) sites	24
Survey not required	43
Total P2 surveys	113



Figure 3-3 Priority 2 Sites

3.4 Stage 1 survey effort

3.4.1 Threatened Ecological Communities

The Stage 1 survey effort includes an assessment of the presence/absence of TECs within sites categorised as the following:

- > Priority 1 sites;
- > Priority 2 (a) sites; and
- > Priority 2 (b) sites.

TECs identified in the EIS (Section 4 of the MNES Technical Report) as occurring within 1km of the proposed rail corridor are based on desktop mapping and include five TECs shown in **Table 3-3** below.

Table 3-3 Threatened ecological communities identified within the EIS

TEC	EPBC Act Status
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	Endangered
Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered
Weeping Myall Woodlands	Endangered
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Endangered
Poplar Box Grassy Woodland on Alluvial Plains	Endangered

TEC were assessed against key diagnostic criteria and conditions thresholds within the conservation and listing advice for TECs including:

- > Conservation Advice for the Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community (DEWHA, 2013);
- > Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (TSSC, 2006);
- > Commonwealth Listing Advice on Weeping Myall Woodlands (TSSC, 2009);
- > Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (TSSC, 2006); and
- > Conservation Advice (including listing advice) for the Poplar box grassy Woodland on Alluvial Plains (DEWHA, 2019).

While TECs can be correlated with Regional Ecosystems, a direct correlation can rarely be made owing to the specific descriptions provided by the Commonwealth. The steps used to assess the presence/absence of the five TECs potentially present in the Study area are outlined in **Table 3-4**, **Table 3-5** and **Table 3-6** below.

Table 3-4 Key diagnostic criteria and condition thresholds

TEC	Key diagnostic characteristics	Condition thresholds
Brigalow (<i>Acacia harpophylla</i> dominant and codominant)	▪ The presence of <i>Acacia harpophylla</i> as one of the most abundant tree species in the patch. <i>A. harpophylla</i> is either dominant in the tree layer, or co-dominant with other species (Notably <i>Casuarina cristata</i>, other species of <i>Acacia</i> or <i>Eucalyptus</i>; <u>and</u>	▪ The patch is 0.5 ha or more in size; <u>and</u>
	▪ In Qld Brigalow Belt Bioregion and meets the description of one of the following REs: – 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21. <u>and/or</u>	▪ Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.
	▪ The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Qld REs (although species density may be reduced). This can be assumed to be the case	

TEC	Key diagnostic characteristics	Condition thresholds
	where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise.	
Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	▪ Distribution mainly in the Darling Downs of southern Queensland and the Liverpool Plains and Moree Plains of northern NSW. Occurrence is mainly associated with fine textured, often cracking clay soils derived from either basalt or alluvium. ▪ Occurrence on landforms that are typically flat to very low slopes (less than 5 percent/1 degree). ▪ Tree canopy usually absent to sparse, comprising less than 10% projective crown cover. ▪ The ground layer is typically dominated by perennial native grasses and contains 3 or more of the indicator native species listed below: – <i>Aristida leptopoda</i> – <i>Astrelba elymoides</i> – <i>Astrelba lappacea</i> – <i>Austrodanthonia bipartita</i> – <i>Austrostipa aristiglumis</i> – <i>Bothriochloa biloba</i> – <i>Bothriochloa erianthoides</i> – <i>Dichanthium sericeum</i> – <i>Digitaria divaricatissima</i> – <i>Elymus plurinervis</i> – <i>Eriochloa crebra</i> – <i>Eulalia aurea</i> Silky – <i>Panicum decompositum</i> – <i>Panicum queenslandicum</i> – <i>Thellungia advena</i> – <i>Themeda avenacea</i> – <i>Themeda triandra</i> (synonym. <i>T. australis</i>) – <i>Walwhalleya proluta</i>	Refer to condition thresholds detailed in Table 3-6 below.
Weeping Myall Woodlands	▪ The dominant overstory species, Weeping Myall, goes through regular cycles of senescence and regeneration. As such, percentage canopy cover will fluctuate from very sparse to 30 percent. The death of canopy trees is not considered to be an indicator of poor condition. ▪ Consequently, a patch must fit the following criteria in order to be included in the listed ecological community: – the tree canopy is dominated (at least 50% of trees present) by living, dead or defoliated Weeping Myall trees; and – the overstory must have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees/ha; and – the area is at least 0.5 ha in size; and – the patch has either: ▪ more than two layers of regeneration of Weeping Myall present; or ▪ the tallest layer of living, dead or defoliated Weeping Myall trees is at least 4 m tall and of the vegetative cover present, 50% is comprised of native species.	
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	▪ The White Box – Yellow Box – Blakely's Red Gum grassy woodlands that existed prior to European settlement now exists as remnants in three different states. The three states are: – An overstory of eucalypt trees exists, but there is no substantial native understorey. – A native understorey exists, but the trees have been cleared. – Both a native understorey and an overstory of eucalypts exist in conjunction. ▪ In order for an area to be included in the listed ecological community, a patch must have a predominantly native understorey.	
	Occurs in the Brigalow Belt North, Brigalow Belt South, Southeast Queensland, Cobar	

TEC	Key diagnostic characteristics	Condition thresholds
Poplar Box Grassy Woodland on Alluvial Plains	Penplains, Darling Riverine Plains, NSW South Western Slopes, Riverina and Murray Darling Depression IBRA bioregions - Associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, typically duplex soils or sodosols. This includes areas that may not be part of currently defined floodplains. - A grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale. - A tree canopy must be present that shows these features: - Canopy tree species are capable of reaching 10 m or more in height; - Poplar Box (<i>Eucalyptus populnea</i>) must be present in the canopy and is the dominant tree species; - Where hybrids of Poplar Box with other <i>Eucalyptus</i> spp. are present, they should be counted as part of the <i>Eucalyptus populnea</i> component of the tree canopy when assessing the previous criterion. - Mid layer (1-10 m) crown cover of shrubs to small trees is low, about 30% or less. - A ground layer (<1 m) mostly dominated across a patch by native grasses, other herbs and occasionally chenopods (during extended dry periods), ranging from sparse to thick (in response to canopy development, soil moisture, disturbance and/or management history). - A list of diagnostic native plant species and some of the key native fauna that make up the ecological community is provided as an appendix to the Conservation Advice (DEWHA, 2019).	The minimum condition thresholds (Moderate and High condition categories A, B, or C) are provided in Table 3-6 below.

Table 3-5 Condition thresholds for the Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ecological community (extract from TEC Listing Advice (TSSC, 2009))

	Best quality	Good quality
Patch size	Patch size Minimum patch size at least 0.5 ha AND	Minimum patch size at least 2 ha AND
Grasses	At least 4 native perennial grass species from the indicator species list AND	At least 3 native perennial grass species from the indicator species list AND
Tussock cover	At least 200 native perennial grass tussocks AND	At least 200 native perennial grass tussocks AND
Woody shrub cover ¹	Total projected canopy cover of shrubs is less than 30% AND	Total projected canopy cover of shrubs is less than 50% AND
Introduced species	Perennial non-woody introduced weed species are less than 5% of the total projected crown cover	Perennial non-woody introduced weed species are less than 30% of the total projected crown cover
¹ Shrubs are typically absent. When present, they are defined as woody plants more than 0.5 m tall that occupy the mid vegetation layer. The upper, tree canopy layer also is typically absent but may comprise scattered trees to less than 10% projective crown cover.		
Sampling should be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain.		

Table 3-6 Condition categories and thresholds for the Poplar Box Grassy Woodland on Alluvial Plains ecological community (extract from the TEC Conservation Advice (DEWHA, 2019))

Category and rationale	Native cover and diversity thresholds	Minimum patch size
Class A Highest Quality		
Category A1. Little to no perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is $\geq 10\%$ AND $\geq 90\%$ of perennial vegetation cover in the ground layer** is native AND ≥ 30 native plant species per patch in the ground layer	≥ 1 ha
Category A2. A large patch with low perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is $\geq 10\%$ AND $\geq 70\%$ of perennial vegetation cover in the ground layer** is native AND ≥ 30 native plant spp. per patch in the ground layer	≥ 5 ha
Class B Good Quality		
Category B. A large patch with good quality native understorey or with mature trees	The crown cover of canopy trees in the patch is $\geq 10\%$ AND $\geq 50\%$ of perennial vegetation cover in ground layer** is native AND EITHER ≥ 20 perennial native plant species per patch in the ground layer OR ≥ 10 mature trees+ per ha with $\geq 30\text{cm}$ dbh*** (and/or hollows)	≥ 5 ha
Class C Moderate Quality		
Category C A large patch with low native cover but retains good native understorey diversity and habitat features of mature trees	The crown cover of canopy trees in the patch is $\geq 10\%$ AND If $< 50\%$ of perennial vegetation cover in ground layer** is native, then the patch must have: ≥ 20 native plant spp. per patch in the ground layer AND ≥ 10 mature trees+ per ha with $\geq 30\text{cm}$ dbh*** (and/or hollows) AND smaller trees+, saplings or seedlings suggestive of periodic recruitment	≥ 5 ha

3.4.2 Protected plants flora survey

3.4.2.1 Survey timing and personnel

The Stage 1 geotechnical investigation ecological surveys were completed between 7 September and 18 September 2020. The survey was completed in spring and coincides with the preferred seasonal survey for threatened fauna and flora species and TECs targeted in the survey (**Appendix B**). In accordance with the *Protected Plants Flora Survey Guidelines – August 2020* (the Guidelines) the survey will be completed by Suitably Qualified Persons. Cardno's Suitably Qualified Persons who will lead the two field teams are:

- > David Francis (Senior Principal – Ecology); and
- > David Wassman (Principal Ecologist)

A self-assessment of the suitability of survey personnel has been provided below in **Table 3-7** and **Table 3-8**, demonstrating both exceed the minimum score of 100 to be regarded as a suitably qualified person. Detailed CVs of the two Suitably Qualified Persons are provided in **Appendix D**.

Table 3-7 Suitably Qualified Person Self-Assessment Grading: David Francis

COMPONENT 1: QUALIFICATION KNOWLEDGE AND ABILITY	Conditions	Points allocated	Comment	Score
A relevant qualification from a recognised institution (e.g. University, TAFE) that results in a thorough knowledge of plant identification and flora surveys.	General training (not Aust. or QLD focused); OR	30		
	Australian focused training; OR	40		
	Queensland focused training	50	David has a BSc from the University of Queensland majoring in Botany, Zoology and Ecology with Honours conducted in botanical taxonomy of a Queensland species.	50
Regional ecosystem training by a recognized and qualified institution, such as the Queensland Herbarium		5	David completed a training course called identifying Regional Ecosystem through NRM in 2003	5
Member of a recognised group / certificate program relevant to ecology/botany, where skills/knowledge are demonstrated to be granted membership. E.g. Certified Environmental Practitioner (CEnvP) Program		5	CEnvP	5
Lead author of articles/papers published in peer reviewed journals in relation to Qld flora surveys, Qld plant identification, or Qld EVNT plants.	10 points per paper to a maximum of 50 points	10	-	
COMPONENT 2: FIELD EXPERIENCE				
Experience within the last 2 years and a total of at least 5 years at leading flora surveys in a field-based environment at a rate of no less than 5 comprehensive botanical surveys that focus on locating and identifying EVNT plants, per year.	General (not Aust. based); OR	40		
	Australian based survey experience; OR	50		
	Qld based field flora surveys experience	60	Dave has over 23 years of experience in flora surveys, the past 17 of which have been in environmental consultancy in Qld. During which time he conducted >5 comprehensive botanical surveys per year that focus on EVNT plants. Dave, therefore, exceed the requisite experience.	60
Number of plant specimens you have collected that have been retained/incorporated into the Queensland Herbarium collection:	5 points per 5 plant specimens retained/incorporated, to a maximum of 40 points	5	David has 35 specimens in the Queensland Herbarium that identify me as the collector	40
TOTAL SCORE				160

Table 3-8 Suitably Qualified Person Self-Assessment Grading: David Wassman

COMPONENT 1: QUALIFICATION KNOWLEDGE AND ABILITY	Conditions	Points allocated	Comment	Score
A relevant qualification from a recognised institution (e.g. University, TAFE) that results in a thorough knowledge of plant identification and flora surveys.	General training (not Aust. or QLD focused); OR	30		

COMPONENT 1: QUALIFICATION KNOWLEDGE AND ABILITY	Conditions	Points allocated	Comment	Score
	Australian focused training; OR	40		
	Queensland focused training	50	David has a BSc. from the University of the Sunshine Coast majoring in Environmental Science with course in Australian Vegetation with a Queensland focus.	50
Regional ecosystem training by a recognized and qualified institution, such as the Queensland Herbarium		5	David has attended Queensland Herbarium regional ecosystem training including "BioCondition v2.1 Application, Assessment and Scoring" (2011), "Vegetation Structure and Remnant Status under the VMA 1999" (2005) and "Identifying Regional Ecosystems Training Course" (2003)	5
Member of a recognised group / certificate program relevant to ecology/botany, where skills/knowledge are demonstrated to be granted membership. E.g. Certified Environmental Practitioner (CEnvP) Program		5	CEnvP (registration number 1174)	5
Lead author of articles/papers published in peer reviewed journals in relation to Qld flora surveys, Qld plant identification, or Qld EVNT plants.	10 points per paper to a maximum of 50 points	10	-	
COMPONENT 2: FIELD EXPERIENCE				
Experience within the last 2 years and a total of at least 5 years at leading flora surveys in a field-based environment at a rate of no less than 5 comprehensive botanical surveys that focus on locating and identifying EVNT plants, per year.	General (not Aust. based); OR	40		
	Australian based survey experience; OR	50		
	Qld based field flora surveys experience	60	Dave has over 7 years of experience in flora surveys of which have been in environmental consultancy in Qld. During which time I conduct >5 comprehensive botanical surveys per year that focus on EVNT plants. David, therefore, exceeds the requisite experience.	60
Number of plant specimens you have collected that have been retained/incorporated into the Queensland Herbarium collection:	5 points per 5 plant specimens retained/incorporated, to a maximum of 40 points	5		
TOTAL SCORE				120

3.4.2.2 Areas excluded from the protected plants survey

In accordance with Section 5.2 of the Guidelines, the extent of the Survey Area incorporates the proposed clearing area (impact area) and a 100m buffer (clearing impact area) to same.

Several areas were excluded from the Survey Area under Section 5.2 of the Guidelines, specifically:

- > it is not reasonably practicable for a flora survey to be undertaken in an area of the buffer zone because landholder consent to access the area cannot be obtained despite all reasonable attempts (s 249(2)(a)); or
- > there is very low likelihood of EVNT plants being present in an area of the buffer zone because it is within a property of less than 1,000m² that has a permanent dwelling or building (s 249(2)(b)); or
- > an area of the buffer zone is a highly modified environment (s 249(2)(b)); or

- > an area of the buffer zone is highly unlikely to be impacted as it is separated from the area to be cleared by an area of highly modified environment that is at least 30 meters wide (s 249(2)(b)).

The guideline defines a highly modified environment as:

- a gravel or bitumen road;
- an impervious surface;
- land that is regularly being mowed, slashed or ploughed; or
- any combination of (a), (b) and (c) in this list.

In accordance with the Guidelines the following areas are excluded from the Survey Area:

- > Priority 1 geotechnical sites with no current land access as listed in **Table 3-9**.
- > Areas of the buffer zone within a highly modified environment, including gravel and bitumen roads and land that is regularly mowed, slashed and ploughed.

Additionally, areas of water that do not support vegetation (e.g. water within the middle of a creek) were similarly excluded given no survey by boat is proposed and survey participants will not physically traverse completely inundated areas due to associated safety risks. Riparian vegetation on the banks of these areas will be assessed.

Areas excluded from the Survey Area are detailed in **Table 3-9**.

Table 3-9 Areas excluded from the Stage 1 Survey area for the protected plants flora survey

Survey Site	Geotechnical test site reference	Excluded Area (ha)	Lot and Plan	Rationale
1	310-03-BH3300	0.4	2MH461	Highly modified unsealed road.
2	310-03-BH3301	0.2	58SP169187	Highly modified unsealed road.
3	310-03-TP3098	NA	NA	Site not in 'high risk area'. Only project footprint (and nominal buffer as per Section 1.4) will be assessed.
4	310-03-CP3212	0	NA	No excluded areas. Site and 100m buffer will be assessed.
5	310-03-TP3017 310-03-BH3028 310-03-CP3214 310-03-BH3027 310-03-CP3213	0.4	140DER34129 2SP260880	Area of water – no vegetation present in permanently inundated area.
6	310-03-TP3137	0.4	RD01RP124356	Highly modified bitumen road.
7	310-03-CP3020 310-03-CP3019	NA	NA	Site not in 'high risk area'. Only project footprint (and nominal buffer as per Section 1.4) will be assessed.
8	310-03-TP3312	NA	NA	Site not in 'high risk area'. Only project footprint (and nominal buffer as per Section 1.4) will be assessed.
9	310-03-TP3346	3.2	1RP7470	No access granted
10	310-03-BH3334 310-03-BH3336 310-03-BH3333 310-03-TP3155 310-03-BH3332 310-03-SR3028 310-03-SR3032 310-03-SR3031 310-03-SR3030	27.7	2RP205146	No access granted
11	310-03-BH3343 310-03-BH3342 310-03-BH3340	0.3	RD01A341307	Highly modified gravel road.
	310-03-BH3339 310-03-SR3037	7.0	2718A341307	No access granted

Survey Site	Geotechnical test site reference	Excluded Area (ha)	Lot and Plan	Rationale
	310-03-SR3038 310-03-SP3035^ 310-03-SR3036			
12	310-03-BH3084 310-03-TP3209 AT-310-03-BH3084	NA	NA	Site not in 'high risk area'. Only project footprint (and nominal buffer as per Section 1.4) will be assessed.
13	310-03-TP3217 AT-310-03-TP3209	NA	NA	Site not in 'high risk area'. Only project footprint (and nominal buffer as per Section 1.4) will be assessed.

^NOTE: Survey of this site not required as test site located wholly on 'highly modified' existing road

Habitat stratification

With respect to determining the number of habitat types within an overarching site, it is relevant to note that the term "habitat type" is not defined in the Flora Survey Guidelines. Habitat types can be stratified by multiple approaches, for example, vegetation condition or regional ecosystem type. Some specific examples of stratification and the advantages and disadvantages of same have been presented in **Table 3-10**.

Table 3-10 Summary of stratification methods for habitat types

Stratification Method	Advantages	Disadvantages
Regional ecosystem mapping	- Readily available mapping product. - Allows for landzone differences and similarities. - Refined vegetation community descriptions available.	- Sometimes too coarse to capture subtle differences in habitat types (e.g. large rocky outcrops or deeply incised gullies). - Sometimes too fine to justify stratification (e.g. there is sometimes little difference between the floristics of the same Eucalypt growing on two different land zones).
Broad Vegetation Group Mapping	- Readily available mapping product. - Allows for broad grouping based on vegetation structure.	- Can have very broad distribution – therefore may be too coarse to capture site specific differences. - A single BVG can occur across a wide variety of land forms and landzones.
Vegetation Condition	Can sometimes be readily distinguished by aerial imagery.	- In the absence of site reconnaissance is not likely to provide fine enough resolution. - Generally, need to be considered in combination with other methods.
Site reconnaissance	Can account for site specific variability not detectable at desktop level.	Not always practicable depending on size of site.

For the Stage 1 protected plant flora survey, the method of stratification is based on the Pre-clear Broad Vegetation Group (BVG) mapping at a scale of 1:2,000,000 (i.e. state level). This method is considered suitable as it allows for a broad grouping of vegetation based on structure.

Table 3-11 identifies the different habitat types within the Survey Area.

Table 3-11 Habitat Type Stratification

BVG1:2M	Structural Description	Typical Landform	Typical Soil	Habitat type
11	Moist to dry eucalypt open forests to woodlands mainly on basalt areas (land zone 8)	Predominantly low basaltic ranges and rolling hills	Red Ferrosols and Black Vertosols	HT1
12	Dry eucalypt woodlands to open woodlands, mostly on shallow soils in hilly terrain (mainly on sandstone and weathered rocks, land zones 7 and 10)	Mainly on sandstone scarps, tablelands and ranges, and lateritic duricrusts	Shallow Rudosols and Tenosols	HT2

BVG1:2M	Structural Description	Typical Landform	Typical Soil	Habitat type
16	<i>Eucalyptus</i> spp. dominated open forest and woodlands drainage lines and alluvial plains.	Fringing drainage lines on alluvial plains	Rudosols and Tenosols	HT3
17	<i>Eucalyptus populnea</i> (poplar box) or <i>E. melanophloia</i> (silver-leaved ironbark) (or <i>E. whitei</i> (White's ironbark)) dry woodlands to open woodlands on sandplains or depositional plains.	Flat to gently undulating plains	Red Sodosols and Chromosols	HT4
25	<i>Acacia harpophylla</i> (brigalow) sometimes with <i>Casuarina cristata</i> (belah) open forests to woodlands on heavy clay soils.	Predominantly gently undulating to rolling plains	Grey and Black Vertosols	HT5
30	<i>Astrebla</i> spp. (mitchell grass), <i>Dichanthium</i> spp. (bluegrass) tussock grasslands.	Flat alluvial plains	Grey to Brown Vertosols	HT6

3.4.2.3 Timed meander

The guidelines detail flora survey includes the timed meander survey method. The timed meander survey requires sampling of each habitat type as per the following steps:

- > Choose a starting point within a habitat type and record the time. The choice of starting point is determined by the suitably qualified person based on their experience.
- > Traverse the habitat type in a random manner so as to maximise the coverage of habitat and the encounter rate of different species.
- > Record the identities of any EVNT plants observed and collect specimens and locational data. Also collect specimens and locational data for any possible EVNT plants.
- > Record the time every two to five minutes. If the survey needs to be interrupted, do not include this time in the results.
- > Continue searching a habitat type until no new plant species has been recorded for 30 minutes or when the entire area of habitat type is surveyed, whichever happens sooner.
- > Meanders must be undertaken (at a minimum) at the following rate per area of habitat type:
 - o <2ha, one meander;
 - o between 2ha and 10ha, two meanders;
 - o between 10ha and 100ha, four meanders; and
 - o >100ha, six meanders.

Table 3-12 details the habitat types and number of timed meanders required for each protected plant flora survey site.

Table 3-12 Survey sites and timed meanders

Survey Site	Geotechnical investigation site reference	Habitat Type	Total survey area	Excluded area	Residual survey area (Ha)	Timed Meanders Required
1	310-03-BH3300	HT2	5.6	0.4	5.2	2
2	310-03-BH3301	HT2	5.7	0.2	5.5	2
3	310-03-TP3098	HT5	NA^	NA^	NA^	NA^
4	310-03-CP3212	HT4	5.7	0	5.7	2
	310-03-TP3017					
	310-03-BH3028					
5	310-03-CP3214	HT4	11.4	0.4	11	4
	310-03-BH3027					
	310-03-CP3213					

Survey Site	Geotechnical investigation site reference	Habitat Type	Total survey area	Excluded area	Residual survey area (Ha)	Timed Meanders Required
6	310-03-TP3137	HT4	5.7	0.4	5.3	2
7	310-03-CP3020 310-03-CP3019	HT3	NA^	NA^	NA^	NA^
8	310-03-TP3312	HT6	NA^	NA^	NA^	NA^
9	310-03-TP3346	HT1	5.7	3.2	2.5	2
10	310-03-BH3332 310-03-BH3333 310-03-BH3334 310-03-BH3336 310-03-TP3155 310-03-SR3028 310-03-SR3030 310-03-SR3031 310-03-SR3032	HT1	27.4	27.1	0.3	1
	310-03-SR3030 310-03-SR3032	HT6	0.7	0.6	0.1	1
11	310-03-BH3343 310-03-BH3342 310-03-BH3340 310-03-BH3339 310-03-SR3037 310-03-SR3038 310-03-SR3035^ 310-03-SR3036	HT1	25.8	7.3	18.5	4
12	310-03-BH3084 310-03-TP3209 AT-310-03-BH3084	HT1	NA^	NA^	NA^	NA^
13	310-03-TP3217 AT-310-03-TP3209	HT6	NA^	NA^	NA^	NA^
Total					62.4	20

NOTE: Site not within high risk area but proximate threatened flora records. Survey will be limited to footprint and 5m buffer. NO requirement for 'meanders' in accordance with NC Act Flora Survey guidelines

3.4.3 Wildlife habitat assessment

Section 4.2 provides the methodology for species-specific fauna survey techniques that will be utilised in the Stage 2 surveys. This level of survey effort proposed for the Stage 2 surveys is disproportionate for the geotechnical sites given the scale and low impact nature of the proposed works. However, the works may still have an impact on the habitat for those species outlined in **Table 4-8** and as such the ecological assessment must consider the likely presence of habitat and identify the areas where this occurs. The proposed approach to survey of wildlife habitat for the Stage 1 surveys will focus on identifying notable habitat features which may constitute breeding places to ensure these features are, where possible, avoided by the geotechnical works.

An animal breeding place is a bower, burrow, cave, hollow, nest or other thing that is commonly used by the animal to incubate or rear the animal's offspring'. As per Section 335 of the *Nature Conservation (Animal) Regulation 2020*, an animal breeding includes any place where:

- > the animal is preparing, or has prepared, the place for incubating or rearing the animal's offspring; or

- > the animal is breeding, or is about to breed, and is physically occupying the place; or
- > the animal and the animal's offspring are physically occupying the place, even if the occupation is only periodical; or
- > the animal has used the place to incubate or rear the animal's offspring and is of a species generally known to return to the same place to incubate or rear offspring in each breeding season for the animal.

The DES Information sheet: *Species Management Program Requirements for tampering with a protected animal breeding place in Queensland* provides additional guidance relating to SMPs, and makes note that an SMP is required for any proposed activity that will impact on breeding places of protected animals that are classified as extinct in the wild, endangered, vulnerable, near threatened (EVNT), special least concern, colonial breeder or least concern under the NC Act. That is, if a breeding place that is permanently or intermittently used by any native fauna species is being cleared then a SMP is required. Where it is determined that an SMP is required, a breeding place survey must be undertaken by a 'suitably qualified' person and an application must be made in writing to DES for the approval of the SMP to tamper with an animal breeding place.

Breeding places identified within the Priority 1 and 2 survey sites will be mapped using a hand-held GPS and the following details will be collected:

- > Lot and plan details.
- > Breeding place description:
 - Hollow-bearing limb:
 - Tree species; and
 - Hollow size.
 - Nest;
 - Timber stockpile;
 - Burrow; or
 - Other (as determined in the field)
- > Status (active/inactive).
- > Conservation status of species utilising breeding habitat.

Koala are not included in DES's Species Management Program (SMP) documentation, as Koalas do not habitually use a breeding place. Notwithstanding, potential koala habitat will be identified in the field survey through identification of scats and scratches, and recording of koala food trees. Any recommended avoidance and mitigation measures will be detailed following the field survey.

The disturbance of a flying-fox roosts is also managed separately under the NC Act. The EIS did not indicate roosts located within the corridor, however, if roosts are identified which will likely be disturbed the works, the restrictions relating to flying-foxes and roosts under the NC Act will apply to the works. Should flying fox roosts be detected during the field assessment the location of these will be recorded.

3.4.4 Land access

The land access for the Stage 1 geotechnical investigation survey includes the Priority 1 sites, Priority 2 sites and access tracks and associated buffers. At the date of this report, ARTC has negotiated access arrangements for the majority of sites, however additional land access parcels have been identified due to the addition of protected plant survey buffers and access tracks. The status of the existing land access includes the following:

- > Land Access Agreement (LAA Received) (i.e. access granted);
- > Open access (i.e. road and water parcels);
- > Potential negotiation unlikely (i.e. no current access);
- > Hard no (i.e. no current access); and
- > Queensland Rail (QR) access required (i.e. rail corridor).

The land access status for Priority 1, Priority 2 sites and access tracks is enclosed in **Appendix E**.

3.4.5 Survey schedule

Based on the proposed survey effort for the Stage 1 Geotechnical investigation the survey schedule is detailed in **Table 3-13**. The schedule assumes two teams of two and allows for the surveys to be completed within the proposed two-week timeframe.

Table 3-13 Proposed survey schedule

Survey sites	Total sites	Sites/day
Priority 1 survey sites	20 timed meanders	2 -3 meanders per day.
Priority 2 (a) sites	14 sites	4-5 site per day over 3 days
Priority 2 (b) sites	32 sites	Approx. 6 sites per day over 10 days
Priority 2 (c) sites	24 sites	

3.4.6 Limitations

Additional ecological surveys will be completed as part of Stage 2 ecological assessment including detailed terrestrial and aquatic fauna and flora surveys. Environmental impacts associated with the geotechnical investigation are to be managed in accordance with the Geotechnical Construction Environmental Management Plan (CEMP), excluding aquatic fauna. The CEMP will incorporate the results of Stage 1 ecological surveys and associated permits and SMPs.

The protected plant flora survey requires a survey of the impact area and a 100 m buffer area, however, land access restrictions for several Priority 1 sites do not allow survey of several areas and are excluded from the survey effort under the Guidelines. The timed meander survey method advocated in the Flora Survey Guidelines is a risk-based survey method that does not require every part of the corridor to be traversed. As such it is possible, that a threatened species may occur on the Survey Area in an area not physically traversed or otherwise visible.

Hazards and/or risks identified during the Health, Safety and Environment (HSE) Risk Management Process and incidents, have the potential to delay the survey or extend the survey.

Notwithstanding the above, the survey effort, methodology and proposed timing are deemed appropriate for detecting TECs, protected plants and wildlife habitat within the Survey Area.

4 Stage 2 survey

4.1 Gap analysis

Following a review of the NSW/Qld Border to Gowrie Environmental Impact Statement (EIS) (ARTC, 2019), Cardno propose additional flora and fauna survey efforts targeting threatened species that are known, likely or have the potential, to occur within the Stage 2 Study area.

The process of identifying species that are known, or have the potential, to occur within the Stage 2 Study area involved:

- > Identifying those species listed in the Initial Advice Statement (IAS) Inland Rail – Border to Gowrie as potential, likely, or known to occur (ARTC, 2018).
- > Comparing those listed in the IAS with those presented in the EIS to identify whether all species have been considered in the EIS and / or whether the likelihood of presence was adjusted between the IAS and EIS. Specifically, the following sections of the EIS were considered:
 - Appendix J of the EIS (Terrestrial Ecology Technical Report) in Table 4.2, Table 4.5 and Appendix A (Tables 2.1 & 2.2) ('possible', 'likely' and 'known' species only); and
 - Appendix L of the EIS (Matters of National Environmental Significance Technical Report) in Appendix A (Table 2.1)
- > A review of contemporary information (i.e. Commonwealth's Protected Matters Search Tool (PSMT) and the Department of Environment and Science's WildNet database) consistent with the impact assessment area (i.e. 1 km radius from Project footprint) as defined in the EIS (Chapter 10 – Flora and Fauna) to determine whether additional species require assessment. Noting the searches were expanded to include 1 km buffer from laydown areas and the construction footprint to ensure species captured include those impacted by additional infrastructure not previously addressed in the EIS.

No additional species were added to the species list to be targeted in the Stage 2 surveys based on the review of contemporary databases (i.e. PMST and Wildlife online) as no additional confirmed records occurred within the search limits.

One species, the Grey snake (*Hemiaspis damelii*), has been added to the list of target species for the Stage 2 surveys, based on a potential observation made during the Stage 1 surveys, presence of suitable habitat within the Stage 2 Survey area and confirmed records within 10 km of the Study Area.

Table 4-1 and **Table 4-2** list the species considered in the Initial Advice Statement (IAS), EIS, and contemporary databases as possible, likely or known to occur. The likelihood of presence listings from both the IAS and EIS are tabulated along with an assessment of the level of survey effort conducted for the EIS using the following categories:

- > **Not assessed** – not assessed in the EIS.
- > **Survey unnecessary** – the EIS Likelihood of Assessment indicated that it is unlikely that the species or habitat for the species is present. This also applies to species that are Presumed Extinct.
- > **Sufficient survey effort** – targeted surveys have been conducted and no further effort is required.
- > **Limited survey effort** – while some survey effort has been conducted, the survey does not conform with guidelines and/or does not extend to the full extent of the Study area.
- > **No survey effort** – no targeted surveys have been conducted for the species.

This report has identified species requiring further assessment during the Stage 2 surveys through a gap analysis which has identified gaps in species data and the survey efforts to-date with respect to requisite guidelines. Species that are regarded as 'data deficient' and thus requiring targeted survey during the Stage 2 surveys are those in **Table 4-1** and **Table 4-2** that:

- > Had "Limited survey effort" as part of EIS surveys; or
- > Had "No survey effort" as part of EIS surveys and the contemporary PMST search indicates the species is "Known" or "Likely" Or the contemporary WildNet search indicates the species has been recorded.

Specific survey guidelines have been identified for species which will be targeted in the Stage 2 surveys (refer to **Section 4.3.2** and **Appendix B**).

Table 4-1 Fauna species assessment

Species	Common Name	Status		IAS likelihood	EIS likelihood	EIS Survey	2020 PMST Search	2020 WildNet Search	To be Targeted in Stage 2?
		NCA	EPBC Act						
Birds									
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	CE	Likely	Possible	Limited survey effort	Likely	-	Yes
<i>Botaurus poiciloptilus</i>	Australasian bittern	-	E	Unlikely	Likely	Limited survey effort	May occur	-	Yes
<i>Calidris ferruginea</i>	Curlew sandpiper	E	CE, M	Potential	Possible	Limited survey effort	May occur	-	Yes
<i>Calyptrorhynchus lathamii</i>	Glossy Black Cockatoo	V	-	Likely	Possible	Limited survey effort	-	✓	Yes
<i>Erythroriorchis radiatus</i>	Red Goshawk	E	V	Likely	Possible	Limited survey effort	Likely	-	Yes
<i>Falco hypoleucos</i>	Grey Falcon	V	-	Potential	Not Assessed	No survey effort	Likely	-	Yes
<i>Geophaps scripta</i>	Squatter Pigeon (Southern Subspecies)	V	V	Likely	Possible	Limited survey effort	Known	-	Yes
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Likely	Possible	Limited survey effort	Known	-	Yes
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	V, M	Likely	Likely	Limited survey effort	Known	-	Yes
<i>Lathamus discolor</i>	Swift Parrot	E	CE	Likely	Possible	Limited survey effort	May occur	-	Yes
<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo	V	-	Unlikely	Possible	Limited survey effort	-	-	Yes
<i>Ninox strenua</i>	Powerful Owl	V	-	Likely	Not Assessed	No survey effort	-	-	No
<i>Poephila cincta</i>	Southern black-throated finch	E	E	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Rostratula australis</i>	Australian painted snipe	V	E	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Turnix melanogaster</i>	Black-breasted button-quail	V	V	Potential	Possible	Limited survey effort	Known	-	Yes
Butterflies									
<i>Hypochrysops piceata</i>	Bullock Jewel butterfly	E	-	Likely	Unlikely	Survey unnecessary	-	-	No
<i>Jalmenus eubulus</i>	Pale Imperial Hairstreak	V	-	Likely	Possible	Limited survey effort	-	✓	Yes
Mammals									
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Dasyurus hallucatus</i>	Northern quoll	-	E	Unlikely	Unlikely	Survey unnecessary	Likely	-	No
<i>Dasyurus maculatus</i>	Spot-tailed Quoll, Tiger Quoll (SE mainland population)	V	E	Likely	Possible	Limited survey effort	May occur	-	Yes

Species	Common Name	Status		IAS likelihood	EIS likelihood	EIS Survey	2020 PMST Search	2020 WildNet Search	To be Targeted in Stage 2?
		NCA	EPBC Act						
<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	V	V	Likely	Possible	Limited survey effort	Likely	-	Yes
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	-	-	Possible	Limited survey effort	-	-	No
<i>Petauroides volans</i>	Greater Glider	V	V	Likely	Possible	Limited survey effort	May occur		Yes
<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Pseudomys novaehollandiae</i>	New Holland mouse	V	V	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Phascolarctos cinereus</i>	Koala	V	V	Known	Likely	Limited survey effort	Known	✓	Yes
<i>Potorous tridactylus</i>	Long-nosed potoroo	V	V	Potential	Unlikely	Survey unnecessary	-	-	No
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	-	V	Likely	Likely	Limited survey effort	Likely	-	Yes
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	-	-	Known	Limited survey effort	-	✓	Yes
Molluscs									
<i>Adclarkia cameroni</i>	Brigalow Woodland Snail	V	E	Likely	Possible	No survey effort	Likely	-	Yes
<i>Adclarkia dulacca</i>	Dulacca woodland snail	E	E	Potential	Unlikely	Survey unnecessary	May Occur	-	No
Fish									
<i>Maccullochella mariensis</i>	Mary river cod	-	E	-	Unlikely	Survey unnecessary	-	-	No
<i>Maccullochella peelii</i>	Murray Cod	-	V	Likely	Likely	Sufficient survey effort – Known	Known	-	No
<i>Bidyanus</i>	Silver perch	-	CE	Likely	Unlikely	Sufficient survey effort - Unlikely	-	-	No
Reptiles									
<i>Acanthophis antarcticus</i>	Common Death Adder	V	-	Likely	Known	Limited survey effort	-	✓	Yes
<i>Anomalopus mackayi</i>	Five-clawed Worm-skink	E	V	Likely	Likely	Limited survey effort	Known	✓	Yes
<i>Delma torquata</i>	Collared Delma	V	V	Likely	Possible	Limited survey effort	May Occur	-	Yes
<i>Egernia rugosa</i>	Yakka Skink	V	V	Likely	Possible	Limited survey effort	May Occur	-	Yes
<i>Furina dunmali</i>	Dunmall's Snake	V	V	Likely	Likely	Limited survey effort	May Occur	✓	Yes
<i>Hemiaspis damelii</i>	Grey Snake	E	-	Likely	Not Assessed	Survey unnecessary	-	-	Yes [#]
<i>Tympanocryptis condaminensis</i>	Condamine (Darling Downs) earless dragon	E	E	Known	Likely	Limited survey effort	Likely	-	Yes
<i>Uvidicolus sphyrurus</i>	Border thick-tailed gecko	-	V	Unlikely	Unlikely	Survey unnecessary	Likely	-	No

Species	Common Name	Status		IAS likelihood	EIS likelihood	EIS Survey	2020 PMST Search	2020 WildNet Search	To be Targeted in Stage 2?
		NCA	EPBC Act						
<i>Wollumbinia belli</i>	Bell's turtle	V	V	Unlikely	Unlikely	Sufficient survey effort - Unlikely	-	-	No

Notes: V= Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory, SLC = Special Least Concern

Notes # Whilst this species was not identified as requiring assessment in the EIS and is not identified as requiring assessment by the Terms of Reference for the EIS, a suspected identification of this species was made during the Stage 1 surveys, the Project area supports potentially suitable habitat for this species, and records are known within 10km of the Study area. As such this species has been included for further assessment.

Table 4-2 Flora species assessment

Species	Common Name	Status		IAS Likelihood	EIS Likelihood	EIS Survey	2020 PMST Search	2020 WildNet search	Target?
		NCA	EPBC Act						
<i>Acacia laeta</i>	Tara Wattle	V	V	Likely	Possible	Limited survey effort	May occur	-	Yes
<i>Androcalva procumbens</i>	-	-	V	-	Unlikely	Survey unnecessary	Likely	-	No
<i>Aristida forsteri</i>	-	E	-	Potential	Not Assessed	Survey unnecessary	-	-	No
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Bertya opposens</i>	-	-	V	Likely	Possible	Limited survey effort	-	-	Yes
<i>Bothriochloa bunyensis</i>	Satin-top Grass	V	V	Likely	Unlikely	Survey unnecessary	-	-	No
<i>Bulbophyllum globuliforme</i>	Miniature moss-orchid	NT	V	Does not occur	Unlikely	Survey unnecessary	-	-	No
<i>Cadellia pentastylis</i>	Ooline	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Calotis glabrescens</i>	-	PE	-	Likely	Not Assessed	Survey unnecessary	-	-	No
<i>Clematis fawcettii</i>	Stream clematis	V	V	Potential	Possible	Limited survey effort	May occur	-	No
<i>Commersonia ingleswoodensis</i>	-	E	-	Potential	Not Assessed	Survey unnecessary	-	-	No
<i>Cymbonotus maidenii</i>	-	E	-	Likely	Unlikely	Limited survey effort	-	-	Yes
<i>Cyperus clarus</i>	A sedge	V	-	-	Possible	Limited survey effort	-	✓	Yes
<i>Dichanthium queenslandicum</i>	King Bluegrass	V	E	Likely	Likely	Limited survey effort	May occur	✓	Yes
<i>Dichanthium setosum</i>	-	-	V	Likely	Possible	Limited survey effort	Likely	-	Yes
<i>Digitaria porrecta</i>	Finger Panic Grass	NT	E	Likely	Known	Limited survey effort	-	✓	Yes
<i>Eucalyptus curtisii</i>	Plunkett Mallee	NT	-	Potential	Not Assessed	Survey unnecessary	-	-	No
<i>Eucalyptus infera</i>	Durikai mallee	V	V	Does not occur	Unlikely	Survey unnecessary	-	-	No
<i>Eucalyptus virens</i>	Shiny-leaved ironbark	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Homopholis belsonii</i>	-	E	V	Known	Likely	Limited survey effort	May occur	✓	Yes

Species	Common Name	Status		IAS Likelihood	EIS Likelihood	EIS Survey	2020 PMST Search	2020 WildNet search	Target?
		NCA	EPBC Act						
<i>Lepidium monoplacoides</i>	-	-	E	Likely	Likely	Limited survey effort	-	✓	Yes
<i>Lepidium peregrium</i>	-	-	E	Likely	Possible	Limited survey effort	May occur	-	Yes
<i>Leucopogon sp. Coolmunda</i> (D. Halford Q 1635)	Coolmunda leucopogon	E	E	Potential	Possible	Limited survey effort	-	-	Yes
<i>Microcarpaea agonis</i>	-	E	E	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Macrozamia conferta</i>	-	V	V	Potential	Unlikely	Survey unnecessary	-	-	No
<i>Macrozamia machinii</i>	-	V	V	Known	Possible	Limited survey effort	Likely	-	Yes
<i>Macadamia integrifolia</i>	Macadamia nut	V	V	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Microcarpaea agonis</i>	-	-	E	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Picris barbarorum</i>	-	E		Known	Known	Limited survey effort	-	✓	Yes
<i>Picris evae</i>	Hawkweed	V	V	Known	Likely	Limited survey effort	Likely	✓	Yes
<i>Phebalium distans</i>	Mt Berryman phebalium	E	CE	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Philotheca sporadica</i>	-	NT	V	Likely	Not Assessed	Survey unnecessary	-	-	No
<i>Pomaderris coomingalensis</i>	-	-	E	Unlikely	Not Assessed	Survey unnecessary	-	-	No
<i>Prostanthera sp. (Dunmore D.M. Gordon 8A)</i>	-		V	Likely	Possible	Limited survey effort	-	-	Yes
<i>Rhaponticum australe</i>	Austral Cornflower	V	V	Known	Likely	Limited survey effort	Likely	✓	Yes
<i>Sarcophilus hartmannii</i>	Waxy sarcophilus	V	V	Unlikely	Unlikely	Survey unnecessary	-	-	No
<i>Sarcophilus weinthalii</i>	Blotched sarcophilus	E	V	Unlikely	Unlikely	Survey unnecessary	Likely	-	No
<i>Sophora fraseri</i>	-	V	V	Known	Possible	Limited survey effort	Known	-	Yes
<i>Solanum papaverifolium</i>	-	E		Likely	Unlikely	Survey unnecessary	-	-	No
<i>Solanum stenopterum</i>	-	V		Likely	Unlikely	Survey unnecessary	-	-	No
<i>Thesium australe</i>	Toadflax	V	V	Likely	Possible	Limited survey effort	Likely	-	Yes
<i>Tylophora linearis</i>	-	V	V	Likely	Possible	Limited survey effort	May occur	-	Yes
<i>Westringia parvifolia</i>	-	V	V	Potential	Possible	Limited survey effort	Likely	-	Yes
<i>Xerothamnella herbacea</i>	-	E	E	Likely	Possible	Limited survey effort	Likely	-	Yes

Notes: NT = Near Threatened, V= Vulnerable, E = Endangered, PE = Presumed extinct

4.2 Vegetation and flora surveys

4.2.1 Optimal timing

4.2.1.1 Target flora species

The optimal survey timing for the flora survey is based on the seasonal presence of reproductive plant material for the identification of targeted flora species. Optimal flora survey timing is following summer rainfall which is usually late March to late May, however, this is dependent on local seasonal conditions (Eyre *et al.*, 2015). Further, the Queensland Herbarium details flora surveys located south of the Tropic of Capricorn, should generally occur in May or June following the wetter summer months with exception of spring surveys which may follow an unseasonably wet winter when many plant species are flowering. A review of the Bureau of Meteorology rainfall data for Inglewood (located centrally within the alignment) indicates low to average rainfall at Inglewood during June 2020, noting monthly data for July and August were not available at the date of this advice. A review of flora species that require additional survey is enclosed in **Appendix B**. The optimal survey season and/or timing has been detailed based on Commonwealth, State guidelines, industry standards and journal articles. Species which require reproductive material for identification include:

- > Hairy-joint Grass (*Arthraxon hispidus*)
- > King Bluegrass (*Dichanthium queenslandicum*)
- > Bluegrass (*Dichanthium setosum*)
- > Finger panic grass (*Digitaria porrecta*)
- > Belson's Panic (*Homopholis belsonii*)
- > Winged Pepper-cress (*Lepidium monoplacoides*)
- > Wandering Pepper-cress (*Lepidium peregrinum*)
- > Coolmunda leucopogon (*Leucopogon* sp. *Coolmunda* (D. Halford Q 1635))
- > Hawkweed (*Picris evae*)
- > *Prostanthera* sp. *Dunmore* (D.M.Gordon 8A)
- > Austral Cornflower (*Rhaponticum australe*)
- > *Xerothamnella herbacea*

The review of survey effort for threatened flora species broadly indicates spring and summer as the optimal flora survey season.

4.2.1.2 Targeted Threatened Ecological Communities

The EIS indicates five threatened ecological communities (TECs) are likely to occur within the Study area. Of these, the following require identification of ground layer elements in order to confirm the presence of the community:

- > Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland.
- > Poplar Box Grassy Woodland on Alluvial Plains.
- > White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands.

Optimal survey timing for these TECs are described shown in **Table 4-3**.

Table 4-3 Recommended survey timing for TECs

TEC	Season/survey timing	Notes	Source
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Within two months of effective rain.	> Unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain .	> A guide to the identification, assessment and management of nationally threatened ecological communities, Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland, (DEWHA, 2012).

TEC	Season/survey timing	Notes	Source
			> Commonwealth Listing Advice on Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Threatened Species Scientific Committee, 2009).
Poplar Box Grassy Woodland on Alluvial Plains	Spring to early summer within two months of effective rain.	> The Conservation Advice recommends surveys spanning multiple years, but acknowledges that there may be instances where this is not possible and, in these instances, surveys should be conducted in spring to early summer . > Ideally, to maximise the assessment of understory condition, sites should be assessed during a good season, six months after cessation of disturbance fire/flood/grazing /mowing/slashing) and within two months of effective rain .	> Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains. (DEE, 2019).
White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands TEC	Late autumn (see note)	> The best time of year to determine if 50% of the ground layer is made of perennial native species is late autumn. However, this can also be determined at other times of year.	> White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands TEC Policy Statement (DEH, 2006)

4.2.2 Flora and vegetation survey methods

The survey methods for vegetation communities and protected flora is shown in **Table 1-1** below and are in accordance with Commonwealth and State guidelines and are considered sufficient to identify many cryptic threatened communities and species.

The flora survey will be completed across the entire Stage 2 Study area divided by two seasons (i.e. dry season and post-wet season survey). The post-wet season survey will target those species and communities which can only be confidently detected following effective rain (e.g. grassland communities and grass species). The flora species to be targeted in the survey are shown in **Table 4-5** and reflect those species regarded as 'data deficient' as per gap analysis results in **Section 4.1**. **Appendix B** identifies those flora species which will be targeted in each of the survey periods.

The survey will exclude highly modified environments; being, areas of cultivation and existing sealed and unsealed roads but will aim to survey all other areas.

Other portions of the Stage 2 Study area are not able to be surveyed due to landholder access not being secured prior to commencement of the surveys.

The portions of the alignment and wet season flora proposed for dry and wet season survey are illustrated in **Figure 4-1**.

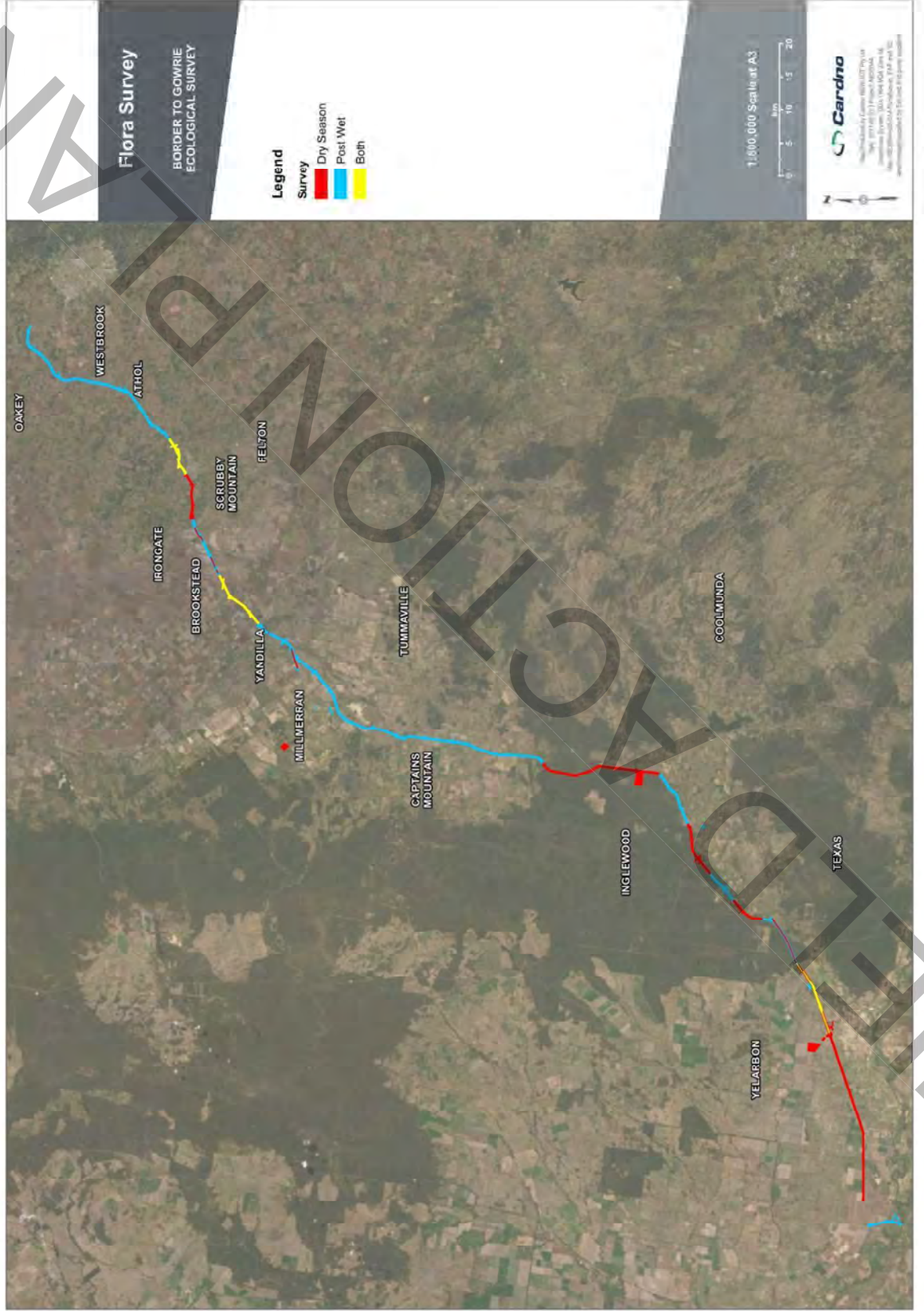


Figure 4-1 Flora survey locations

Table 4-4 Vegetation communities and protected flora survey

Value	Equivalent REs	Survey method	Reference
TECs	- Brigalow (Acacia harpophylla dominant and codominant (11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21.); - Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (11.3.21 and 11.3.24); - Weeping Myall Woodlands (11.3.2, 11.3.28, 11.3.2a, 11.3.2b, 11.3.2c); - White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (11.8.2a, 11.8.8, 11.9.9a and 11.3.23); and - Poplar Box Grassy Woodland on Alluvial Plains (11.3.2, 11.3.2a, 11.3.2b, 11.3.2c, 11.3.17, 11.4.7, 11.4.12)	Diagnostic criteria and condition threshold assessment. There is not a 1:1 relationship between the TECs that are predicted to be present and REs. In particular TECs can constitute regrowth, be more disturbed and/or can occupy much smaller patch sizes than mapped remnant REs. As such pre-clearing RE mapping will be used as a flag to identify potential locations of TECs.	> As described by the Commonwealth for each TEC > Pre-clearing RE mapping
REs		Quaternary and / or tertiary plots to confirm vegetation community	Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (Version 5.1)
Habitat Quality	All REs, but primarily Endangered (11.3.21, 11.4.3 & 11.9.5) and Of Concern (11.3.2, 11.3.4 & 11.9.7)	Habitat will be assessed and scored in accordance with required number of plots and methodology contained within the 'Guide to determining terrestrial habitat quality'. Habitat plots will primarily be positioned within the construction footprint, with some extending into the 100m buffer. A total of 36 plots will be assessed within the Stage Survey area. No assessments will be made of potential 'receiving sites' in the broader area.	Guide to determining terrestrial habitat Quality - A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy, Version 1.2 April 2017
Protected flora	Not applicable	Flora surveys are only valid for 12 months after the flora survey was completed, and clearing needs to be undertaken within two years of submitting the flora survey report to the Queensland Department of Environment and Science. Given the date of construction is not yet known, flora surveys will be completed generally in accordance with the <i>Flora Survey Guidelines - Protected Plants</i> (i.e. surveys but not involve targeted meanders separated by habitat type. Instead, surveys for threatened species will target habitat for threatened species, and involve mapping threatened species where identified within the construction footprint and 100m. Tracklogs of meanders, or separation of the Study area by habitat type will not be completed.	Flora Survey Guidelines - Protected Plants - Nature Conservation Act 1992 (version 2.01)
Declared weeds	Not applicable	Restricted weeds will be mapped within the construction footprint only. General abundance of weeds will be noted within the 100m buffer.	Abundance will be mapped in accordance with Appendix 1 of the Spatial Pest Attributes Standard Queensland (July 2012, V7)

Value	Equivalent REs	Survey method	Reference
Habitat features / Breeding Places	Not applicable	Habitat features which may constitute animal breeding places (e.g. hollow-bearing trees, nests, burrows, roosts etc.) will be mapped within the construction footprint only. General notes on habitat will be made for areas within the 100m buffer.	Information sheet - Species Management Program, Requirements for tampering with a protected animal breeding place in Queensland
Wetlands and waterways	Not applicable	Wetlands and waterways mapped within the Study Area will be ground-truthed and general comments will be made on extent, condition etc.	NA
MLES	Not applicable	Areas mapped as MLES within the Toowoomba Regional Council LGA will be ground-truthed and general comments will be made on the condition of these areas.	NA

Table 4-5 Threatened flora species targeted in survey

Species	Common Name	Status	
		NCA	EPBC Act
<i>Acacia lauta</i>	Tara Wattle	V	V
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V
<i>Bertya oppositifolia</i>	-		V
<i>Cadellia pentastylis</i>	Ooline	V	V
<i>Clematis fawcettii</i>	Stream clematis	V	V
<i>Cymbonotus maidenii</i>	-	E	
<i>Cyperus clarus</i>	A sedge	V	
<i>Dichanthium queenslandicum</i>	King Bluegrass	V	E
<i>Dichanthium setosum</i>	-		V
<i>Digitaria porrecta</i>	Finger Panic Grass	NT	E
<i>Eucalyptus virens</i>	Shiny-leaved ironbark	NT	
<i>Homopholis belsonii</i>	-	E	V
<i>Lepidium monophloeoides</i>	-	-	E
<i>Lepidium peregrinum</i>	-	-	E
<i>Leucopogon</i> sp. Coolmunda (D. Halford Q 1635)	Coolmunda leucopogon	E	E
<i>Macrozamia machinii</i>	-	V	V
<i>Picris barbarorum</i>	-	E	
<i>Picris euae</i>	Hawkweed	V	V
<i>Prostanthera</i> sp. (Dunmore D.M. Gordon 8A)	-		V
<i>Rhaponticum australe</i>	Austral Cornflower	V	V
<i>Sophora fraseri</i>	-	V	V
<i>Thesium australe</i>	Toadflax	V	V
<i>Tylophora linearis</i>	-	V	V
<i>Westringia parvifolia</i>	-	V	V
<i>Xerothamnella herbacea</i>	-	E	E

4.3 Fauna surveys

4.3.1 Optimal survey timing

Optimal survey timing has been reviewed for the fauna survey with consideration of the peak times of detection. **Table 4-6** below describes the recommended survey timing for field surveys in the Brigalow Belt Bioregion as described in Eyre *et al.* (2018). A full list of species-specific fauna and flora survey timings requirements as detailed in the Commonwealth, state and industry-standard survey guidelines for threatened species is enclosed in **Appendix B**.

Table 4-6 Recommended Survey Timing for Terrestrial Vertebrate Fauna Surveys within the Brigalow Belt Bioregion (Eyre *et al.*, 2018)

Recommended survey timing	Rationale
Spring to early summer (September - mid November)	As temperatures begin to warm up after winter there is a peak in vertebrate activity with the commencement of breeding activity in many species. Exact timing is dependent on the timing of the onset of spring when temperatures begin to warm but before summer temperatures become too high as many species, especially reptiles, become less active. Rainfall is also a major trigger for increased activity in many species. This period can be very dry so conducting a second survey during moist periods is critical.
Autumn (March - mid May)	A second survey should be undertaken after summer as the temperatures decrease but before the onset of cold winter nights. This coincides with another active period including dispersal and migration of many species. It is also more likely to be moist than during the spring-early summer period, and also coincides with grass seeding and growing season (important for granivores).

4.3.2 General fauna survey methods

A total of 12 targeted terrestrial trapping sites will be visited in the dry season surveys. While some of these will be revisited in the post-wet season survey some of the sites will be relocated to target other fauna species and provide broader coverage of the alignment. Each of the fauna survey sites comprise a 1 km buffer around a mid-point centred on the alignment. Surveys will be completed by two fauna survey teams each comprised of two Cardno ecologists. Each trapping site will be surveyed over five days and four nights, and each fauna survey team (i.e. fauna survey team 1 and fauna survey team 2) will each complete two full targeted trapping sites over each five day and four-night period. Days to pack-up and set-up will occur in-between. Cumulatively, the proposed survey effort will result in over 1,200-person hours of active survey across project area. The locations of proposed fauna trapping sites are provided in **Figure 4-2**.

A further five 'Additional Sites' will be targeted over the duration of the survey period. These locations will only be surveyed over a single day each and all surveys will be 'passive' (i.e. will not involve trapping of fauna). The focus of these Additional Sites will be to:

- > conduct rapid searches for threatened fauna and their habitat;
- > map habitat features and weeds in close proximity to the proposed alignment; and
- > increase the overall coverage of the survey footprint.

Table 4-7 identifies the general survey techniques that will be utilised at each site, noting that a number of techniques can be completed concurrently. The general survey techniques have been drawn from the relevant Commonwealth Fauna Survey Guidelines for various fauna groups and aim to maximise detection across the broadest number of species. Additionally, targeted fauna survey techniques will be completed within areas of suitable habitat for those species for which additional effort or techniques are required. **Table 4-8** identifies where this is the case.

A full assessment of required techniques and effort for each of the threatened fauna species to be targeted during the fauna surveys, and justification for any alternatives proposed is provided as **Appendix B**.

A fauna survey day will generally consist of the following schedule:

- Dawn chorus at first light to sunrise and active searches (alternating sites such that each site has a min. 2 dawn surveys);
- Check traps and ID any captured fauna;
- Complete active searches;
- Break in middle of day

- Set traps
- Dusk chorus at sunset to last light and active searches (alternating sites such that each site has a min. 2 dusk surveys)
- Spotlighting (min 45mins each site / night).

FIELD ACTION PLAN



Figure 4-2 Proposed fauna trapping sites

Table 4-7 Survey effort for generic fauna survey methods

Method	Fauna group targeted by method and proposed survey effort per site [^]	Proposed duration per site
Call playback	Birds: 5 hours Mammals: 1 hour	5 days 4 nights
Spotlighting	Mammals: 2 x 200m transects Reptiles: min. 6 hours over 4 nights	4 nights
Stag watching	Mammals - 40mins before dusk & 40 mins after dusk	2 nights
Dawn survey	Birds and Butterfly: min 4 hours	2 days
Dusk survey	Birds and Butterflies: min 4 hours Bats (fly-out): min 4 hours	2 days
Habitat assessment	All groups - 4 hours	n/a
Indirect detection (scats, tracks) / area searches / incidental flushing	All groups - 8 hours	5 days
Active diurnal searches (searches for individuals and habitat, raking leaves for reptiles)	Mammals - 2 x 100m transects Reptiles - 3 hours Birds: 4 hours	5 days
Camera traps	All: 10 traps	4 nights
Hair tube traps	Mammals: 20 traps	4 nights
Pitfall traps	Reptiles: 6 pitfalls along a 30m drift fence	4 nights
Elliot traps (a)*	Mammals: 20 traps	4 nights
Cage traps / elliot traps (b)	Mammals: 10 traps	4 nights
Unattended bat detector	Microbats: 1 x Anabat or Songmeter	4 nights
Attended bat detector	Microbats: 4 hours	4 nights
Harp traps	Microbats: 1 x harp trap	4 nights
Funnel traps	Reptiles – min. 2 traps (1 on either end of pitfall drift fence)	4 nights
Pest animal assessment	Methods as per above.	5 days / 4 nights
Wildlife corridors	Opportunistic assessment	5 days

NOTE: ^ effort reflects total 'person hours' as each site will be assessed by two Cardno ecologists. * will be deployed where presence of Yakka skink burrows within a site is known or suspected.

4.3.3 Species-specific fauna survey methods

The general survey methods identified above are collectively suitable for maximising detection across the largest number of fauna species and groups. **Table 4-8** identifies the fauna survey techniques that will be used to maximise detection of target species listed under the EPBC Act and NC Act. A full assessment of possible techniques and effort for each of the threatened fauna species to be targeted during the fauna surveys, and justification for any alternatives proposed is provided as **Appendix B**.

The fauna species identified in **Table 4-8** are those to be targeted for Stage 2 Surveys as they regarded as data deficient as per **Section 4.1**, being those species which had "Limited survey effort" as part of EIS surveys, or had "No survey effort" as part of EIS surveys and the contemporary database record searches indicate the species is known or likely to occur and reflect those identified in **Table 4-1**.

Table 4-8 Threatened species targeted in the terrestrial and aquatic fauna survey

Faunal group	Scientific Name	Proposed Survey Techniques	Proposed survey intensity / duration [^]
Mammals	Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	Unattended bat detectors, attended bat detectors and harp traps as per Table 4-7 .	As per Table 4-7 .
	South-eastern Long-eared Bat <i>Nyctophilus corbeni</i>	Harp traps as per Table 4-7 . Also attended and unattended bat detectors (noting species can only be identified to genus level using these techniques)	As per Table 4-7 .

Faunal group	Scientific Name	Proposed Survey Techniques	Proposed survey intensity / duration [^]
	Spot-tailed Quoll <i>Dasyurus maculatus maculatus</i>	Indirect detection (latrines, scats, tracks), hair tubes, cage traps, and camera traps as per Table 4-7 .	As per Table 4-7 .
	Koala <i>Phascolarctos cinereus</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Indirect detection (scats, scratches) - Area searches for individuals - Spotlighting - Call playback - Camera trapping. Additionally, the Koala Rapid Assessment Methodology (KRAMs) and / or Spot Assessment Technique (SAT) will be completed in larger tracts of suitable habitat.	As per Table 4-7 . A minimum of 20 KRAMs and / or SATs will be completed within the Project footprint (10 in the dry season and 10 in the wet season).
	Greater glider <i>Petauroides Volans volans</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Spotlighting; - Indirect detection (scats); - Camera trapping.	As per Table 4-7 .
	Grey-headed flying-fox <i>Pteropus poliocephalus</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Spotlighting; - Dusk survey; - Diurnal area searches (for camps); - Habitat assessments. Additionally, the known flying-fox camp at Inglewood (3km from the Project footprint) will be visited during the survey period.	As per Table 4-7 .
	Brush-tailed rock-wallaby <i>Petrogale penicillata</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches; - Camera trapping.	As per Table 4-7 .
	Echidna <i>Tachyglossus aculeatus</i>	Active searches / area searches and searches for diggings and scats as per Table 4-7.	As per Table 4-7 .
	Brigalow Woodland Snail <i>Adclarkia cameroni</i>	Active searches will be completed in targeted trapping sites that occur within suitable habitat in brigalow woodland. Active searches will include turning logs and raking accumulated leaves and searches for dead shells.	The survey includes five sites mapped by the EIS as habitat for Brigalow Woodland snail (being Sites 7-11), and one site within a mapped Brigalow TEC (being Site 5). Targeted searches for this species will be completed within these sites.
Molluscs	Common Death Adder <i>Acanthophis antarcticus</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Nocturnal spotlighting (vehicle transects); and - Pitfall and funnel trapping. Spotlighting vehicle transects will also be completed opportunistically within the Project footprint when moving between sites.	As per Table 4-7 .
Reptiles	Five-clawed Worm-skink <i>Anomalopus mackayi</i>	The following techniques as per Table 4-7 are suitable for detection of this species: Active diurnal searches Pitfall/funnel traps	As per Table 4-7 .
	Collared delma <i>Delma torquata</i>	The following techniques as per Table 4-7 are suitable for detection of this species:	As per Table 4-7 .

Faunal group	Scientific Name	Proposed Survey Techniques	Proposed survey intensity / duration [^]
		- Diurnal searches - Pitfall trapping - Funnel trapping	
	Yakka skink <i>Egernia rugosa</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches (searching for burrows/latrines sites), and distance observation with binoculars - Spotlighting (in burrows) - Elliot trapping around burrows	As per Table 4-7 .
	Dunmall's snake <i>Furina dunmali</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches - Spotlighting (and nocturnal vehicle searches) - Pitfall trapping - Funnel trapping	As per Table 4-7 .
	Grey snake <i>Hemiaspis damelii</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches - Spotlighting (and nocturnal vehicle searches) - Pitfall trapping - Funnel trapping	As per Table 4-7 .
	Condamine earless dragon <i>Tympanocryptis condaminensis</i>	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches - Spotlighting (and nocturnal vehicle searches) - Pitfall trapping - Funnel trapping Pitfall trapping and funnel trapping as per Table 4-7. - Post-wet season surveys will also incorporate specific pitfall trapping using species specific traps as per national guidelines for earless dragon species.	As per Table 4-7 .
	Regent honeyeater <i>Anthochaera phrygia</i>	Targeted searches in areas of suitable habitat, targeting areas of heavily flowering trees and flocks of other blossom feeders.	Total 20hrs completed over each seasonal survey period.
Birds	Australasian bittern <i>Botaurus poiciloptilus</i>	Areas searches in suitable habitat.	One dawn targeted survey in morning, and area search for feathers, footprint, nests etc. will be completed in suitable habitat.
	Swift parrot <i>Lathamus discolor</i>	Targeted surveys in areas of heavily flowering eucalypts.	Areas searches within targeted trapping sites as per Table 4-7 .
	Major Mitchell's cockatoo <i>Lophochroa leadbeateri</i>	Diurnal bird survey, areas searches, incidental detection within targeted trapping sites as per Table 4-7 .	Areas searches within targeted trapping sites as per Table 4-7 .
	Red goshawk <i>Erythrorhynchus radiatus</i>	Area searches for nests and individuals will be completed by vehicle and foot in areas of suitable habitat at targeted trapping sites.	Min. 4hr over 5 days per site (128hrs total over 40 days). Significant watercourses will also be searches for nests and individuals.
	Curlew sandpiper <i>Calidris ferruginea</i>	Spotlighting and areas searches in suitable habitat.	As per Table 4-7 , searches will be completed in suitable habitat.
	Australian painted snipe <i>Rostratula australis</i>	Targeted stationary searches at suitable wetlands and watercourses during wet season survey	Total of min. 10 hours across 5 days.
	Painted honeyeater <i>Grantia picta</i>	Area searches as per Table 4-7 .	As per Table 4-7 .
	White-throated Needle-tail <i>Hirundapus caudacutus</i>	Area searches as per Table 4-7 .	As per Table 4-7 .

Faunal group	Scientific Name	Proposed Survey Techniques	Proposed survey intensity / duration [^]
	Glossy black-cockatoo <i>Calyptrorhynchus lathamii</i>	Searches for individuals and ort searches will be completed within suitable habitat within each of the targeted trapping sites. Habitat assessment will be used to refine habitat mapping for this species.	Min. 4hr over 5 days per site (128hrs total over 40 days)
	Squatter pigeon <i>Geophaps scripta scripta</i>	Area searches and flushing surveys as per Table 4-7 at targeted trapping sites.	8hrs over 5 days per site.
	Black-breasted button-quail <i>Turnix melanogaster</i>	Area searches and flushing surveys as per Table 4-7 at targeted trapping sites.	8hrs over 5 days per site.
	Grey falcon <i>Falco hypoleucos</i>	No species-specific guidelines. Refer Table 4-7 . Relevant techniques include: - Dusk and dawn survey - Habitat assessment - Area searches Active diurnal searches	Refer Table 4-7 .
	Pale Imperial Hairstreak <i>Jalmenus eubulus</i>	No species-specific guidelines. Refer Table 4-7 . Relevant techniques include: - Dusk and dawn survey - Habitat assessment - Area searches - Active diurnal searches	Refer Table 4-7 .
Butterflys			

NOTE: [^] effort reflects total 'person hours' as each site will be assessed by two Cardno ecologists.

5 Workplace Health and Safety

5.1 Health and safety management plan

A Safety Management Plan for the project has been provided which outlines the risk management process for fieldwork including project inductions and includes the approved Safe Work Method Statement (SWMS). A SWMS has been developed for the project to manage identified hazards to an acceptable level, and has been approved by ARTC and QR. The SWMS will be updated regularly based on:

- > Feedback from field team members;
- > Outcomes of 'Take 5s' or 'Every Minute Risk Assessments' undertaken in the field;
- > Any new identified hazards (recorded in Shield, Cardno's hazard reporting app); and
- > Cardno's Project Self Assessments and Audits.

Sub-contractors will be inducted in accordance with the project SWMS or the contractor's policies, procedures and operational manuals.

The project team is familiar with working in the rail corridor. All field staff members that will work within an active rail corridor have completed Safely Access the Rail Corridor (SARC) training and have a valid Rail Industry Worker Card. Additionally, our team members have experience working in remote areas, having done so on numerous projects. The project team will be trained and familiar with the Health and Safety Management Plan and will be familiar with the project-specific protocols associated with this project. This will include travel, communication and work plans. Staff will be equipped with personal and vehicle safety equipment. Field staff have all been trained in first aid.

In accordance with the Safety Management Plan, hazards and/or risks identified during the Health, Safety and Environment (HSE) Risk Management Process, will be reported in the HSE Action Register and discussed with ARTC.

5.2 Covid-19 field work plan

Cardno has developed a COVID-19 Field Work Assessment and COVID-19 specific measures are incorporated into our SWMS. All team members will be required to operate under the COVID-19 Field Work Assessment and SWMS, which includes the requirement to complete a COVID-19 fitness for work assessments before travelling for fieldwork, measures for social distancing, protocols for safe travel, and requirements for disinfection of equipment and surfaces. All field members will be equipped with masks, gloves, antibacterial wipes and hand sanitiser.

5.3 Risk management

As part of Cardno's internal risk management Cardno will develop supporting documentation and processes around the field survey that would detail the process for:

- > Daily field team check-in designed as an opportunity to review prior days' work, issues, concerns and goals/targets for the next day, and expediently elevate any emerging project risks or unexpected finds. Any notable items will be shared with the ARTC B2G Project officer.
- > Detailed 'step by step' field methodologies – including identification of any critical aspects of the methodology and updated with lessons learnt or any agreed variations to methodology or effort.
- > Daily WHS procedures including Take 5 requirements and review / sign-off of SWMS.
- > Quick reference guide to GIS management and data capture.

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APPENDIX

A

OVERVIEW OF GEOTECHNICAL
INVESTIGATIONS

Attachment 1 – Overview of investigations

Access Tracks

We need to undertake a range of tests requiring a variety of different equipment. The equipment varies from a 4WD ute to a truck mounted drill rig. In some cases, to allow us to safely get to and from the test sites we may need to clear and level tracks and pads. ARTC will consult with you about the best route and obtain all the necessary permits and approvals for this work. Upon completion of the testing program the disturbed areas will be rehabilitated.

Reasonable precautions will be taken to limit disturbance to vegetation and existing tracks during access, setup and drilling, however, the ground surface may become rutted and some grasses or small saplings/bushes may be disturbed at the drilling sites and along the access routes.

About Borehole Drilling

Drilling is undertaken using a truck mounted drill rig. The drilling rigs require a relatively flat cleared pad around 20 by 20 metres to ensure a safe working area.

Along with the truck mounted drill rig, we expect up to three support vehicles will be required. The support vehicles may come and go but the rig will stay in place for the duration of drilling.

We will use water during the drilling process for cooling and lubrication. We will bring the water to the drilling site. During drilling the water will be contained in a purpose-built tank and recirculated until the hole is completed. If additional water is required, water will be drawn from an approved location. We will not source water from your property unless specific arrangements have been approved prior to drilling.



Borehole Drilling - Temporary Disturbance

The ground surface may become rutted and grasses or small saplings may be disturbed due to vehicle movements.

The early stages of the drilling process will involve a hammering noise as the soil and/or rock samples are recovered by hammering a metal sampling tool in to the ground. This will generally occur during the first two days of drilling. After the hammering, the most consistent noise disturbance in the area will be the sound of an idling diesel engine which may be slightly louder during sample retrieval and towards the completion of the borehole.

Borehole Drilling - Rehabilitation

When the borehole is completed, the drilling supervisor will determine the most appropriate backfill method for the location to comply with the relevant legislation, codes and safety protocols. Some boreholes will be used for ongoing groundwater monitoring (see below). Generally, boreholes will be backfilled with the soil removed during drilling. The borehole site will be left with a slightly raised or mounded surface as it will compact over time. No open holes will be left unfenced while unattended. All holes will be fully backfilled or covered if the hole will be used for ongoing ground water monitoring before leaving the work site.

Drill pads will be rehabilitated as soon as possible and reinstated to match the existing surrounding surface as close as practicable. The soil will be distributed and contoured evenly over the surface. The soil surface will be left rough and covered with surface litter, where possible to minimise the potential for erosion.



Pre Drilling – truck in position before drilling



Post Drilling – small cleared area and mounded soil at hole location

Borehole Drilling – Ongoing groundwater monitoring

In some boreholes we will install a device (called a piezometers) to monitor groundwater levels within the borehole. Once the device is installed, the borehole will be backfilled with a permeable cement grout and covered with a locking cover approximately 30cm in diameter. This cover will be flush with the ground surface.

An engineer will return to the site several times after installation to obtain data and maintain the data loggers - usually around 2 weeks, 6 weeks, then annually. The piezometer will be left in the location for at least 12 months, so we can understand seasonal groundwater changes.



At the end of the monitoring program the piezometer would be removed, and the borehole backfilled. The surface will be covered with topsoil to match the existing surrounding surface as far as practicable.

About Auger Hole Drilling

Auger holes will be drilled using a drill rig mounted on a four-wheel ute or small truck. Shallow auger holes are completed in an hour with deeper holes taking up to one day.

Auger Hole Drilling Temporary Disturbance

The area of disturbance is limited to the auger hole and does not exceed 1m².

Auger Hole Drilling Rehabilitation

Upon completion, the auger holes will be backfilled using the soil and/or rock that will come out of the hole during the drilling process. Not all the material removed from the hole will fit back down the hole. The remaining material will be spread out around the borehole location and mounded (approx. 10 to 20 cm) directly over the backfilled hole.



About Ground Vibration Testing

Ground vibration testing is non-intrusive. It involves hitting a metal plate on the ground with a sledgehammer to create sound waves (vibrations) which travel through the ground. The sound waves are bent at different angles when they meet different types of soil or rock. A string of receivers (called geophones) 'listen' to the waves when they return to the surface and send information about the wave length and speed to the recording device. This provides information about the soil and rock layers and how deep they are.



The geophysical survey team will usually drive a 4WD ute to the start of the testing line then walk along the line to space the geophones out 10cm to 20cm apart. There can be up to 100 geophones in a string. The geophones are around the size of a small solar garden light. The metal plate is around the size of a dinner plate.

Ground Vibration Testing - Temporary Disturbance

The primary noise disturbance associated with ground vibration testing is the hammer blows on the metal plate. The testing may involve up to 10 blows.

About Geological Mapping Survey (Geological Field Survey)

Geological surveys are non-intrusive. They are usually conducted by field geologists. The geologist will walk over the selected site and record observations and measurements of surface rocks and outcrops. Rock chip samples may be gathered for analysis.

About Trench Pit Soil Sampling

Trench pits will be excavated by machine (e.g. rubber tyred back hoe or small tracked excavator) to the required depth to allow the geologist to examine, record and/or sample the soil in its natural profile. Trench pits are usually around 2-3m deep, 2m long and 30-40cm wide.



We will backfill the trench pits as soon as possible after the studies are completed. Trench pits will be backfilled in the general order the material was removed and be compacted in layers of 300 mm to 500 mm (maximum) using the machine bucket. The soil will be distributed and contoured evenly to match the existing surrounding surface as close as practicable. The trench pit site will be left with a slightly raised or mounded surface as the soil will compact over time.

About Cone Penetration Testing (CPT)

The CPT (Cone Penetration Testing) consists of using a hydraulic rig to push an instrumented cone tip vertically into the ground through several rods. The cone continuously measures the resistance needed to penetrate the soil at a constant rate. Geotechnical Engineers use this information to understand the soils conditions under the proposed structure (embankments and /or bridges).

These test are generally undertaken along areas where soft soils are encountered, such as floodplains, marshlands, coastal plains, etc. The test is undertaken from a purposed build truck or tracked rig, with many different shapes and colours. The cone is pushed into the ground from the centre of the rig. This technique is of very low impact as it only leaves a 100 mm diameter hole in the ground that is backfilled at the end of the test. Each test is typically carried out to 15 m to 30m below the surface or until the cone encounter enough resistance to stop the progress. Each test takes approximately a couple of hours per site.



Types of CPT drill rigs in position for testing

Safety of people and livestock

While the borehole or auger hole is open (not yet complete), the rig will generally remain in place over the hole. This includes overnight if the hole is not completed in one day. This will prevent the feet and legs of livestock and people from going into the open hole. If an open hole needs to be left unattended, and the drill rig will not remain in place, safety fencing and all necessary lighting and signage determined by a specific risk assessment for that site, will be installed.

Typically, a trench pit will be completed within a day. If a trench pit needs to be left open when the crew is not at the site, safety fencing and all necessary lighting and signage determined by a specific risk assessment for that site, will be installed. Precautions will be taken to protect the trenches from the adverse effects of weather during this period. We will also create an egress ramp to allow small animals to escape the trench if they do get in there.

Once the hole is completed, the crew will fully backfill the hole or cover it with a locking cover approximately 30cm in diameter if it will be used for ongoing ground water monitoring. This cover will be flush with the ground surface, so it does not create a hazard. Landowners will be advised of the location of the groundwater monitoring device to ensure they are aware.

Drill pads and trench pits will be rehabilitated as soon as possible and reinstated to match the existing surrounding surface as close as practicable. The soil will be distributed and contoured evenly over the surface to reduce the risk of trips, slips and falls. The soil surface will be left rough and covered with surface litter, where possible to minimise the potential for erosion.

Spill Management

The drill rig and support vehicles are equipped with spill kits appropriate to the fuels, oils and chemicals used in the drilling process and carried on the drilling and support equipment. Spills will be promptly cleaned up and contaminated materials hauled to the appropriate disposal site in a manner consistent with regulatory requirements.

Waste Control

Bins will be provided at the work site for all waste types. The site will be maintained in a clean and orderly state daily. All waste produced will be collected and recycled where practical or disposed of at an approved disposal facility.

Fire

ARTC will take all reasonable precautions to minimise any fire hazard at the site including:

- No smoking on site.
- Fire extinguishers will be readily available.
- No hot works will be undertaken onsite
- All chemicals and dangerous goods will be stored correctly.
- No ignition sources will be exposed to potential fuel areas.

In the case of fire, the fire brigade shall be notified immediately. An attempt may be made to extinguish the fire if it is safe to do so, otherwise the area shall be evacuated immediately.

Erosion Sediment Control

As the disturbed area will be less than 2m² no physical erosion and sediment controls will be put in place. All water used during the drilling will be contained in a purpose-built tank and recirculated until the hole is completed to ensure drilling fluids will not enter any surrounding waterways. The work areas will be backfilled with excavated material as soon as practicable following completion of work in each location. No sediment laden run-off will be discharged directly or indirectly into drains or waterways.

Weed and Seed

At the start of the drilling project, independent of the property specific cleaning requirements, all vehicles that will access private property, outside of road and rail corridors will have a weed and seed wash-down to prevent the introduction of noxious weeds from outside of the study area into the study areas. Weed and seed categories and associated cleaning procedures are provided in the following sections.

Category 1 - Cleaning Level

As minimum the following procedures will be carried out on all field vehicles to help prevent the spread of weeds from one site to another:

- Prior to leaving a public corridor and entering private property, the operator will complete a visual assessment of their vehicle for loose soil and vegetation. Where present the loose soil and vegetation will be removed from exposed areas with a broom or brush;
- The same procedure of removing loose soil and vegetation from the vehicle will be completed before re-entering the public corridor;
- If a particularly pervasive type of noxious weed is identified by the environmental reconnaissance, the areas should be flagged and the investigation teams notified so the areas can be avoided where possible. It is best to avoid contaminated areas wherever practical; and
- A weed and seed inspection log book will be completed for each vehicle and retained in the vehicle to document that the vehicle was cleaned and inspected to the Category 1 level.

Category 2 - Cleaning Level

The Category 2 cleaning will include the use of a dedicated wash-down vehicle that will travel to the site and complete an on-site wash-down of all the site vehicles that entered the property. The Category 2 Cleaning level procedures and considerations will include the following:

- The same procedures described in the Category 1 Cleaning Level will be undertaken. The best preventative measure will again be to avoid contaminated areas wherever practical;
- Once the Category 1 cleaning is completed, the vehicles will drive to a location within the property that is outside of the contaminated area
- When selecting the wash-down location it will be important to select a location where runoff will not enter a water course or water body, a buffer of 50 m or more is preferred;
- Complete the wash-down at a position just outside of the area where weeds are to be contained so the runoff flows back toward the infested area;
- Avoid sensitive vegetation and habitat features;
- A well grassed area which slopes gently away from the wash-down area is preferred;
- Once the wash-down is complete, the vehicles will be inspected on site by a team member who has completed the Greening Australia (or similar course) and record the inspection in log book for each vehicle and retained in the vehicle to document that the vehicle was cleaned and inspected to the Category 2 level;
- For the procedure described, all weeds and debris will remain on site.

APPENDIX

B

SURVEY EFFORT FOR THREATENED FLORA
AND FAUNA SPECIES

Table 6-1 Survey effort for threatened fauna species know or likely to occur within the impact assessment area

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
BIRDS												
<i>Anthochaera phrygia</i>	Regent honeyeater	Preferably spring	D	Preferably mornings within breeding season May to March and mostly September to November	a) Area searches b) Targeted searches	a) 20 hrs. b) 20 hrs.	a) 10 days b) 5 days	a) for areas <50ha b) Targeting areas of heavily flowering trees and flocks of other blossom feeders.	Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010)	NA	Targeted searches in areas of suitable habitat, targeting areas of heavily flowering trees and flocks of other blossom feeders. Total 20hrs completed over each seasonal survey period.	Complies with guideline.
<i>Botaurus poiciloptilus</i>	Australasian bittern	No season specified	D / PW	Early morning or early evening.	a) Habitat observation b) Area searches	Not specified	Not specified	a) Observation of targeted foraging habitat within wetlands in the early morning or early evening. Detection by sightings and unsolicited calls. b) Area searches in suitable habitat for sightings, nests, indicative footprints and feathers.	Recommended survey methods for wetland birds: bitterns in Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010)	-	One dawn targeted survey in morning, and area search for feathers, footprint, nests etc. will be completed in suitable habitat.	Complies with guidelines.
<i>Calidris ferruginea</i>	Curlew sandpiper	Early August - March	D	a) Nocturnal b) Diurnal	a) Nocturnal survey b) Aerial surveys of foraging habitat	Not specified	Not specified	a) Nocturnal area or transect spotlight surveys in suitable habitat either on foot or from a slow-moving vehicle. b) Aerial surveys of foraging habitat in large or remote study areas.	Recommended survey methods for shorebirds in Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010) Conservation Advice Calidris ferruginea (DEWHA, 2015)	-	Spotlighting and areas searches in suitable habitat as per Table 4-7.	Complies with guidelines.
<i>Calyptorhynchus lathami</i>	Glossy black-cockatoo	Anytime of year (breeding March to August)	D / PW	Not specified	a) Land based searches b) Search for foraging and nesting signs	a) 5 hrs. b) 20 hrs	a) 1 day. b) 4 days.	a) For each area of 50 ha or less (one day's search and morning/evening watch for breeding birds sufficient to check for feeding sign or breeding in a 50-ha patch, b) Search for signs of feeding or nests(4hr/day over 4 days).	Glossy black-cockatoo, Calyptorhynchus lathami. Targeted species survey guidelines (Hourigan, 2012)	The EIS identifies that the Project footprint supports 480.56ha of suitable habitat for this species which would require 48hrs of area searches and 192hrs of foraging surveys searches to comply with the State Guidelines.	Searches for birds and orts will be limited to suitable habitat within and proximate to targeted trapping site, and will include active diurnal, dusk and dawn survey. Min. 4hr over 5 days per site (128hrs total over 40 days). Habitat assessment will be used to refine habitat mapping for this species.	Techniques comply with guideline. Due to the large project area total survey effort may not be fully met, however coverage across the Project and habitat assessments are considered sufficient to detect this species. The precautionary principal will be applied as necessary in refining resulting habitat mapping.
<i>Erythrorhynchus radiatus</i>	Red goshawk	Not specified	D / PW	Not specified	a) Area searches	a) 80 hrs.*	a) 10 days*	Area searches for individuals and/or distinctive nests. *effort for 50 ha area is 50 hrs. over 8 days	Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010)	The EIS identifies the project footprint supports 339.34ha of habitat for this species, records for this species are concentrated in the north of the project area. Require 339hrs of searches to	Area searches for nests and individuals will be completed by vehicle and foot in areas of suitable habitat at targeted trapping sites. Min. 4hr over 5 days per site (128hrs total over 40 days). Significant watercourses will also be searches for	Survey effort will not fully comply with guideline owing to the large size of the project area. Given spread of sites across project area, and targeted assessment along watercourses, survey effort considered sufficient. The

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
										fully comply with guideline.	nests and individuals.	precautionary principal will be applied as necessary in refining resulting habitat mapping.
<i>Falco hypoleucos</i>	Grey falcon	Not specified	D / PW	Not specified	Not specified	Not specified	Not specified	Note specified	Consultation Document on Listing Eligibility and Conservation Actions <i>Falco hypoleucos</i> (DEWHA, 2019)	No species-specific guidelines for this species.	Refer Table 4-7. Relevant techniques include: - Dusk and dawn survey - Habitat assessment - Area searches - Active diurnal searches	NA
<i>Geophaps scripta</i>	Squatter pigeon	Not specified	D / PW	Not specified	a) Areas searches or transect surveys b) Flushing surveys	a) 15 hrs. b) 10 hrs.	a) 3days b) 3 days	for areas <50ha	Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010)	The EIS identified 339.34ha of suitable habitat for this species in the project footprint, which will require at least 102hrs of survey.	Area searches and flushing surveys as per Table 4-7. Min 8hrs over 5 days per site., resulting in mon. 256hrs of total survey across dry and wet season surveys.	Complies with guidelines.
<i>Grantiella picta</i>	Painted honeyeater	Early spring to late summer	D	During daylight hours and preferably in the early morning (< 2 hrs after sunrise) and late afternoon (<2 hrs before sunset) and avoid inclement weather (i.e. rain and wind)	a) Area searches	a) 4 hrs (per 50ha of suitable habitat)	a) 4 days	For example, at least 1 hour of surveying per day for a minimum of 4 days.	Painted honeyeater, <i>Grantiella picta</i> . Targeted species survey guidelines (Rowland, 2012)	The EIS identifies 432.99ha of habitat for this species in the Project footprint.	Area searches within habitat at each targeted trapping site will result in Min 8hrs over 5 days per site., resulting in mon. 256hrs of total survey across dry and wet season surveys.	Complies with guidelines.
<i>Hirundapus caudacutus</i>	White-throated Needletail	Summer	D	Observations should be made as late as possible in the evening of birds coming into roost in tall trees along ridge tops.	NA - No species-specific guidelines.	NA - No species-specific guidelines.	NA - No species-specific guidelines.	NA - No species-specific guidelines.	Referral guideline for 14 birds listed as migratory species under the EPBC Act, (DoE, 2015)	The EIS identifies 3,203.8 of habitat for this species in the Project footprint.	Area searches as per Table 4-7., searching for roost sites.	NA – no species-specific guidelines.
<i>Lathamus discolor</i>	Swift parrot	Autumn to early winter (March-July) In mainland Australia for non-breeding season (arriving between February and March), returns to Tasmania September – October.	PW	Not specified	a) Areas searches or transect surveys* b) Targeted surveys**	a) 20 hrs. b) 20 hrs.	a) 8 days b) 8 days	* In areas of less than 50 ha. ** Targeting areas of heavily flowering eucalypts.	Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010)	The EIS identifies 286.39ha of habitat for this species in the Project footprint.	Targeted surveys in areas of heavily flowering eucalypts during area searches as per Table 4-7. Min 8hrs over 5 days per site., resulting in mon. 128hrs of total survey during wet season surveys.	Complies with guidelines.
<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo	NA – No species-specific guidelines	D / PW	NA – No species-specific guidelines	NA – No species-specific guidelines	NA – No species-specific guidelines	NA – No species-specific guidelines	NA – No species-specific guidelines	Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Queensland Herbarium, 2018)	The EIS identifies 387.77 ha of habitat for this species in the Project footprint.	Diurnal bird survey, areas searches, incidental detection.	Complies with guidelines.
<i>Rostratula australis</i>	Australian painted snipe	Not specified	PW	Not specified	a) Targeted stationary observations b) Land-based areas searches or line transects for sites of less than	a) 10 hrs. b) 10 hrs.	a) 5 days b) 3 days	Difficult to detect even when present. Thought to be mainly crepuscular but can be detected during the day. Secretive but	Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010)	Suitable habitat for this species within the project area comprises wetlands and watercourses.	Targeted searches will be completed within area of suitable habitat in the wet season surveys. Total of	Complies with guidelines.

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
					50 ha when wetland holds water but is not flooded.			conspicuous when in the open.			min. 10 hours across 5 days.	
<i>Turnix melanogaster</i>	Black-breasted button-quail	Not specified	D / PW	Not specified	a) Land-based areas searches or line transects	a) 15 hrs.	a) 3 days	Shy and inconspicuous. Highly cryptic. Usually detected by observation of birds that flush or walk away after being disturbed. May also be detected by their scratching when foraging in the leaf litter. Platelets may indicate presence of this taxon but is not conclusive as these are also made by other button quail. Call playback has been used to survey for black-breasted button quail, but the effectiveness of this method is uncertain.	Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010)	The EIS does not identify any habitat for this species within the Project footprint.	Area searches and flushing surveys as per Table 4-5 at targeted trapping sites.	Complies with guideline.
MAMMALS												
<i>Chalinolobus dwyeri</i>	.Large-eared Pied Bat	Mid spring through to early autumn (October through to March)	D / PW	Not specified	a) Unattended bat detectors b) Attended bat detectors c) Harp traps	a) 16 detector nights b) 6 detector hrs. c) 16 trap nights	a) 4 nights b) 3 nights c) 4 nights	a), b), c) for project area <50ha	Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010)	The EIS identified 54,95ha of potential habitat for this species within the Project footprint.	Unattended bat detectors, attended bat detectors and harp traps as per Table 4-7 .	Whilst only 4 nights of trapping are proposed at each targeted trapping site, all survey techniques will be utilised at each of the proposed 32 trapping sites resulting in a total of 128 trap nights per technique. Survey effort considered to comply with guidelines given area of habitat within Project area.
<i>Dasyurus maculatus maculatus</i>	Spot-tailed Quoll, Tiger Quoll (SE mainland population)	Ecologically no reason for seasonal surveys, however cage trapping should not be conducted between August – mid November. Surveys conducted between April and September may detect males in areas of unsuitable habitat.	PW	Not specified	a) Habitat Transects b) Indirect detection (latrines, scats, tracks) c) Hair tubes d) Remote camera traps	a) Cover entire area, spaced at 50-100 m intervals b) Cover entire area, spaced at 50-100 m intervals c) 20 d) 10 traps/ha	a) 2hr /ha (for a 5ha area) b) 2hr /ha (for a 5ha area) c) 4 nights d) 14 nights	Spotted-tailed quolls have home ranges that span hundreds of hectares, surveys conducted at a small scale (5ha) are not considered appropriate. Sampling units of 100 hectares are recommended.	Survey Guidelines for Australia's Threatened Mammals (DEWHAa, 2011a)	The EIS identified 81,42ha of potential habitat for this species within the Project footprint.	Indirect detection (latrines, scats, tracks), hair tubes, and camera traps as per Table 4-7 . 20 hair tubes will be deployed at each of the 32 targeted trapping sites for 4 nights, 10 camera traps will be deployed at each site for 4 nights. Habitat and indirect detection methods will be completed within each survey site for a total of 8hrs each site (256hrs total).	Generally complies with guidelines. Effort associated with hair tubes compliant with guideline. Camera traps will only be deployed at each targeted trapping site for 4 nights which is below survey effort guidelines. However, given all survey techniques will be utilised across all sites within the Project area, coverage and overall effort considered

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
												adequate. Targeted trapping will be supplemented by habitat assessments.
<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	Not specified	D / PW	Not specified	a) Harp traps b) Mist nets	a) 20 trap nights b) 20 net nights	a) 5 nights b) 5 nights	a), b) for project area <50ha	Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010)	The EIS identified 344.10 of potential habitat for this species within the Project footprint, a total of 138 trap nights required.	Harp trapping as per Table 4-7 . One harp trap will be deployed in each of the 32 proposed targeted trapping sites for a period of 4 nights resulting in a total 128 trap nights.	Does not comply with survey guidelines. Owing to the large survey area and logistics associated with trapping multiple appropriate flyways, the total survey effort is slightly less than recommended in the survey guidelines given the availability of potential habitat for this species. However, sites will be well-spaced across the project area to give greater coverage, and surveys completed over two seasons. Additionally, whilst only able to detect to the level of genus, attended and unattended bat detectors will be used and all survey results will be supplemented by a habitat assessment. Collective survey effort is considered sufficient for detection of species and mapping of habitat.
<i>Petauroides volans volans</i>	Greater Glider	Not specified	D / PW	Nectar availability and monthly lunar phases (i.e. bright moon can reduce detectability).	a) Spotlight survey b) Scat and Sign search c) Incidental	a) 1 per generic survey site b) & c) not specified	a) 30 minutes b & c) not specified	Not specified	Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2018)	The EIS identified a total of 198.42ha of potential habitat for this species within the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: - Spotlighting; - Indirect detection (scats); - Camera trapping.	Complies with guidelines.
<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	Not specified	D / PW	Not specified	a) Diurnal searches b) Scat plots c) Camera traps	Not specified	Not specified	Ensure desktop is completed to understand records and survey habitat (i.e. rocky outcrops)	Survey Guidelines for Australia's Threatened Mammals (DEWHAa, 2011a)	No habitat for this species is identified by the EIS as potentially present within the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: Diurnal searches;	Complies with guidelines.

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
											Camera trapping.	
<i>Phascolarctos cinereus</i>	Koala	Not specified	D / PW	In the inland context, there may be seasonal variation in koalas' use of different habitat types. Presence/absence surveys in the inland context, conducted during dry periods, should be centred on riparian areas, upper/mid-slope areas and other dry-period refugia in order to maximise detectability.	a) Strip transects b) Nocturnal spotlighting c) Call playback d) Camera trap e) Mark resight/mark recapture f) Detection dogs g) Radio/satellite collars h) Indirect methods i) Scratches j) Scats (SAT) k) Scats regulated grid l) Scats (KRAM) m) Faecal standing	Not explicitly stated	Not explicitly stated	None specified	EPBC Act referral guidelines for the vulnerable koala (DoE, 2014)	The EIS identifies 493.06ha of potential habitat for this species within the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: - Indirect detection (scats, scratches) - Area searches for individuals - Spotlighting - Call playback - Camera trapping. Additionally, a total of 20 Koala Rapid Assessment Methodology (KRAMs) and / or Spot Assessment Technique (SAT) plots will be completed in larger tracts of suitable habitat.	Complies with guideline for chosen techniques.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Spring, summer and early autumn	D / PW	Flowering and fruiting season	a.) Active diurnal searches (for day roosts, and to detect droppings, odour) b.) dusk surveys for flying individuals c.) comprehensive surveys of vegetation communities and food plants d.) Night surveys - walking transects (100m apart)	Refer notes	None specified	Survey effort guide "Consultants should demonstrate that they have sought information about the location of historic camps from the appropriate authoritative sources as outlined above. It should also be demonstrated that a comprehensive vegetation survey has been completed for the survey area, and a clear assessment of the contribution of the project area in terms of food plants, especially in relation to the broader region, is provided." DEWHA, 2010. The National Flying-fox Monitoring Viewer indicates a Grey-headed flying-fox (GHFF) camp is located in Toowoomba. The camp has a population of GHFF estimated to be between 500-2,500.	Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010)	A known flying-fox roost is present in Inglewood (approximately 3 km south of the Project footprint).	The following techniques as per Table 4-7 are suitable for detection of this species: - Spotlighting; - Dusk survey; - Diurnal area searches (for camps); - Habitat assessments. Additionally, the known flying-fox camp at Inglewood (3km from the Project footprint) will be visited during the survey period.	Complies with guidelines
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	NA- no species-specific guidelines	D / PW	NA- no species-specific guidelines	a) Active searches b) Searches for diggings and scats	NA- no species-specific guidelines	NA- no species-specific guidelines	NA	No species-specific guidelines. https://keyserver.lucidcentral.org/key-server/data/080e0e0d-0b01-4405-8e0c-0805000f0308/media/Html/Tachyglossus_aculeatus.htm	-	Active searches / area searches and searches for diggings and scats as per Table 4-7	NA- no species-specific guidelines

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
Molluscs												
<i>Adclarkia cameroni</i>	Brigalow Woodland Snail	Mid spring to early autumn (October to March)	D / PW	Not specified	a) Turning logs and raking accumulated leaves b) Searches for dead shells	a) & b) 2 persons	a) & b) 2 hours	Survey to target areas of preferred snail microhabitat.	Conservation Advice Adclarkia cameroni brigalow woodland snail (TSSC, 2016)	The EIS identifies 131.46ha of potential habitat for this species in the Project footprint.	Active searches will be completed in targeted trapping sites that occur within suitable habitat in brigalow woodland. The survey includes five sites mapped by the EIS as habitat for Brigalow Woodland snail (being Sites 7-11), and one site within a mapped Brigalow TEC (being Site 5). Targeted searches for this species will be completed within these sites. Active searches will include turning logs and raking accumulated leaves and searches for dead shells.	Complies with guidelines.
REPTILES												
<i>Acanthophis antarcticus</i>	Common Death Adder	Spring to early autumn (September to March)	D / PW	Not specified	a) Nocturnal vehicle transect b) Pitfall and funnel trapping	a) 2 surveys b) > 100 pitfall and 100 funnel trap nights per ha	a) 2 nights b) extended period required	~500 km (or all suitable roads surveyed multiple times) Pitfall and funnel trapping could be used in addition to nocturnal vehicle transects. The survey effort is considerable given the highly cryptic nature of the species and possible genuine rarity over much of their distribution. Therefore, based on the precautionary principle, if it is not feasible to invest this quantity of survey effort, with suitable habitat present in the survey area, then A. antarcticus should be assumed to be present.	Common death adder, Acanthophis antarcticus. Targeted species survey guidelines (DES, 2012)	The EIS identified 540.87ha of potential habitat for this species in the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: - Nocturnal spotlighting (vehicle transects); and - Pitfall and funnel trapping	Generally complies with guidelines. Whilst required survey effort for pitfall and funnel trapping will not be met given the large size of the project area, spotlighting will be completed via nocturnal vehicle transects and on foot extensively within the Project area to supplement trapping effort.
<i>Anomalopus mackayi</i>	Five-clawed Worm-skink	Spring to early autumn (September to March)	D / PW	Coolest part of the day > 25°C	a) Diurnal searches b) Pitfall/funnel traps c) Artificial shelter sites	a) 1.5-person hours per hectare b) 6 20L buckets along 30m drift fencing c) Hay bales- 4X4m fenced plots Tiles-50 tiles placed at 5m intervals in suitable habitat-1 grid per 2 ha for sites up to	a) 3 days b) 2 replicates per habitat type	Diurnal searched are not suitable within floodplain habitat as species hides deep in clay cracks Pitfall traps have marginal effectiveness for this species Artificial shelter sites- only possible over a longer survey timeframe.	Survey guidelines for Australia's threatened reptiles (DEWHA, 2011b) / Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DEWHA, 2011c)	The EIS identifies 178.26ha of habitat for this species in the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: - Active diurnal searches - Pitfall/funnel traps	Generally complies with guidelines. Owing to the large size of the project area and total amount of potentially suitable habitat for these species, the proposed survey will not strictly comply with the survey guidelines. Notwithstanding active diurnal searches and

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
						40ha. 2 grids if site less than 2 ha. 20 grids for sites > 40ha						pitfall / funnel trapping will occur at the 32 trapping sites accounting for a total survey effort of 96hrs of active searching, and 128 trap nights per pitfall line (x 6 buckets = 768 total trap nights). Targeted survey techniques will be supplemented by habitat assessments and the precautionary principal applied to mapping habitat.
<i>Delma torquata</i>	Collared Delma	Spring to early autumn (September to March)	D / PW	Coollest part of the day/>25°C	a) Diurnal searches b) Pitfall lines c) Artificial shelter (tiles grids)	a) 1.5-person hours per hectare b) 6 x 4—10L buckets and funnel traps spread along a 15 metre fence c) Tiles-50 tiles placed at 5m intervals in suitable habitat-1 grid per 2 ha for sites up to 40ha. 2 grids if site less than 2 ha. 20 grids for sites > 40ha	a) 3 days	Artificial shelter-tile grids are supplementary for this species	Survey guidelines for Australia's threatened reptiles(DEWHA, 2011b) / Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DEWHA, 2011c)	The EIS identifies a total of 295,76ha of habitat for this species within the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches; - Pitfall trapping; - Funnel trapping.	Complies with guidelines.
<i>Egernia rugosa</i>	Yakka Skink	Spring to early autumn (September to March)	D / PW	Coollest part of the day/>25°C	a) One-off diurnal searches b) Transects c) Spotlighting d) Elliot and cage traps	a) 1.5-person hours per hectare c) 1.5-person hours per ha d) 1 Elliot and 1 cage trap placed as close as possible to burrow network-check every morning and evening.	a) 3 days c) 3 nights d) 4 days/nights	Diurnal searches- searches for burrows or latrine sites. Yakka skinks can be watched using binoculars or a telescope, focusing on burrow systems or latrine sites. Transects should be strategically designed/positioned in large habitat patches (>10ha) Spotlighting-targeting water inundated gilgais, wetlands, riparian habitat. More effective on warm and humid nights.	Survey guidelines for Australia's threatened reptiles(DEWHA, 2011b) /Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DEWHA, 2011c)	The EIS identifies a total of 364.47ha of habitat for this species within the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches (searching for burrows/latrine sites), and distance observation with binoculars - Spotlighting (in burrows) - Elliot trapping around burrows	Generally complies with guidelines. Owing to the large size of the project area and total amount of potentially suitable habitat for these species, the proposed survey will not strictly comply with the survey guidelines with respect to total effort. Notwithstanding active diurnal searches for suitable habitat and burrows, latrine sites etc, spotlighting and Elliott trapping will occur at the 32 trapping sites. Targeted survey techniques will be supplemented by habitat assessments and the precautionary

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
												principal applied to mapping habitat.
<i>Furina dunmalli</i>	Dunmall's Snake	Spring to early autumn (September to March)	D / PW	Cooler part of the day/>25°C	a) Diurnal searches b) Transects c) Spot lighting d) Opportunistic road surveys e) Pitfall/funnel traps	a) 1.5-person hours per hectare c) 1.5-person hours per hectare e) 6 20 L buckets over 30 of drift fencing-funnel traps placed at either end	a) 3 days b) 3 nights e) 2 replicates per habitat type over 4 days	Opportunistic road surveys are most effective following heavy rain and during warm evenings. Transects should be strategically designed/positioned in large habitat patches (>10ha)	Survey guidelines for Australia's threatened reptiles (DEWHA, 2011b) Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DEWHA, 2011c)	The EIS identifies a total of 295.76ha of habitat for this species within the Project footprint.	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches - Spotlighting - Pitfall trapping - Funnel trapping	Generally complies with guidelines. Owing to the large size of the project area and total amount of potentially suitable habitat for these species, the proposed survey will not strictly comply with the survey guidelines with respect to total effort. Notwithstanding active diurnal searches, spotlighting, and pitfall/funnel trapping will occur at the 32 trapping sites. Targeted survey techniques will be supplemented by habitat assessments and the precautionary principal applied to mapping habitat.
<i>Hemiaspis damelii</i>	Grey Snake	Spring/summer months and also targeted during breeding season (January to March)	D / PW	Not specified	a) Passive nocturnal search b) Nocturnal vehicle transect c) Active diurnal search d) Pitfall and funnel trapping	a) 60 min per 100 x 100 m plot, 2 plots per 5 ha b) ~250 km (or all suitable roads surveyed multiple times) c) 60 minutes per plot, 2 plots per 5 ha	a) 2 x 30min search across 2 surveys b) 2 surveys across 2 nights c) 2 x 30min search across 2 surveys	Active searches of 30 minutes (1 person) or 15 minutes (2 people) per survey site within the survey period.	Hemiaspis damelii. Targeted species survey guidelines (DES, 2012)	Whilst no habitat for this species is identified in the EIS, a suspected identification of this species was made during field assessments, and there is record of this species within Kurumbul, within 8km of the Study Area.	The following techniques as per Table 4-7 are suitable for detection of this species: - Diurnal searches - Spotlighting (and nocturnal vehicle searches) - Pitfall trapping - Funnel trapping	Generally complies with guidelines. Owing to the large size of the project area and total amount of potentially suitable habitat for these species, the proposed survey will not strictly comply with the survey guidelines with respect to total effort. Notwithstanding active diurnal searches, spotlighting, and pitfall/funnel trapping will occur at the 32 trapping sites. Targeted survey techniques will be supplemented by habitat assessments and the precautionary principal applied to mapping habitat.

Scientific name	Common name	Season (Month)	^Survey Targeted	Time of day / Temperature	Technique	Intensity	Duration	Notes on Survey Techniques	Source	Comments	Proposed Technique	Justification
<i>Tympanocryptis condaminensis</i>	Condamine (Darling Downs) earless dragon	Late spring to early autumn	D / PW	Diurnal - active during the warmer parts of the day, from mid-morning to late afternoon.	a) Pitfall trapping b) Arthropod traps	a) Six 10 litre buckets spread along a 15 metre drift fence b) grids of 56 (i.e. 7 x 8) traps placed at 10 metre intervals.	a) 20 weeks b) 5 weeks	Little difference in detection rate between pitfall traps and arthropod traps.	Grassland earless dragon (<i>Tympanocryptis pinguicollis</i> ²) in Survey guidelines for Australia's threatened reptiles (DEWHA, 2011)		The following techniques as per Table 4-7 are suitable for detection of this species: ▪ Pitfall trapping ▪ Funnel trapping Post-wet surveys will also incorporate the use of Arthropod traps set in a grid pattern across two areas of suitable habitat.	
FISH												
<i>Maccullochella peelii</i>	Murray Cod	a) March to May (<i>no direct physical disturbance to occur June-Dec</i>) b) As above c) Any time of year d) As above e) As above f) As above g) As above h) Early Sept – early Jan i) As above	N/A	Most active at dawn and dusk, sight-based assessments best during the day	a) Habitat Assessment b) Electrofishing c) Catch & release d) Daytime snorkelling e) Spot lighting at night f) Underwater camera g) Doppler imaging h) Fyke nets i) Larval drift net	NA	NA	NA	Survey guidelines for Australia's threatened fish (DSEWPaC, 2011) Draft Referral Guidelines for the vulnerable Murray cod (<i>Maccullochella peelii</i>), (DoE, 2016.)		Not targeted by these surveys. Aquatic surveys completed for EIS deemed appropriate	Complies with guidelines.
INVERTEBRATES												
<i>Jalmenus eubulus</i>	Pale imperial hairstreak	Not specified	D / PW	Not specified	NA – No species-specific guidelines	NA – No species-specific guidelines	NA – No species-specific guidelines	Only known to breed in old-growth brigalow forest or woodland and does not appear to colonise regrowth habitats following clearing or other major disturbance.	NSW Office of Environment and Heritage (2020)	EIS identifies habitat for this species within the Project footprint.	Active searches / area searches. Habitat searches	Complies with guidelines

[^]NOTE: D = dry season; PW = post-wet season survey

Table 6-2 Survey effort for threatened flora species known or likely to occur within the impact assessment area

Scientific name	Common name	Month / Season	^Survey Targeted	Notes	Source
<i>Acacia lauta</i>	Tara wattle	Flowers during August-September	D / PW	Sets fruit in December	Queensland Government (2020), Species profile— <i>Acacia lauta</i> s266B EPBC Act 1999, Approved Conservation Advice for <i>Acacia lauta</i>
<i>Arthraxon hispidus</i>	Hairy-joint Grass	Flowering March to July and summer to autumn	PW	<i>A. hispidus</i> was once considered an annual, but is now thought to be a perennial that tends to die down in winter	Conservation advice <i>Arthraxon hispidus</i> (DEWHA, 2008b) Queensland Government (2020), Species profile— <i>Arthraxon hispidus</i>
<i>Bertya opposens</i>		Flowering has been recorded from June to November, January and March and fruits between June, August and November	D / PW	The inflorescences occur as a single flower or umbelliform with 2 or 3 flowers on 2 mm long peduncles.	Queensland Government (2020), Species profile— <i>Bertya opposens</i>
<i>Cadellia pentastylis</i>	Ooline	Flowers mainly from October to December in Queensland (October to November in New South Wales), but occasionally flowering extends through to early April	D / PW	Ooline occurs in a range of vegetation types including semi-evergreen vine thicket, brigalow-belah, poplar box and bendee communities Fruiting records are from November to December	Queensland Government (2020), Species profile— <i>Cadellia pentastylis</i> Pollock, A.B. (1999). <i>Cadellia pentastylis</i> , in Species Management Manual. Department of Natural Resources, Brisbane

² "At the time when the grassland earless dragon (*T. pinguicollis*) was included in the EPBC Act list of threatened species, on 16 July 2000, the species was believed to occur in the Darling Downs in Queensland. This part of the species range is now described as a new species, the Condamine earless dragon (*T. condaminensis*). As provided by section 184(d) of the EPBC Act, the Delegate of the Minister of the Environment amended the EPBC Act list of threatened species by updating the name of *T. pinguicollis* to *T. pinguicollis* and *T. condaminensis*, effective from 5 May 2016" (DAWE, 2020).

Scientific name	Common name	Month / Season	^Survey Targeted	Notes	Source
<i>Clematis fawcettii</i>	Clematis	Flowers from October to December.	D	Recorded in Queensland forest SF 151, Lamington National Park, Mount Barney National Park, 4,8,9 Bunya Mountains National Park, Main Range National Park and Mount Dumaesq Conservation Park in Queensland	Queensland Government (2020), Species profile— <i>Cadellia Clematis</i> Wang J (1997). <i>Clematis fawcettii</i> . Botanical Research. Queensland Department of Natural Resources.
<i>Cymbonotus maidenii</i>		Flowers throughout the year, but most commonly is spring.	D / PW	Probably germinates, grows and flowers in response to rain Grows in isolated patches, mainly north of the Darling and Barwon Rivers, and in inland Queensland	Queensland Government (2020), Species profile— <i>Cymbonotus maidenii</i>
<i>Cyperus clarus</i>		Flowers from spring to summer	D / PW	It is Tufted perennial. It is found from near Emerald in central Queensland to near Delungra on the New South Wales north-west slopes.	Queensland Government (2020), Species profile— <i>Cyperus clarus</i>
<i>Dichanthium queenslandicum</i>	King Bluegrass	Flowers have been recorded throughout the year, particularly from March	PW	None specified	Queensland Government (2020), Species profile— <i>Dichanthium queenslandicum</i>
<i>Dichanthium setosum</i>	Bluegrass	Flowers appear mostly during summer	PW	None specified	Listing Advice <i>Dichanthium setosum</i> (TSSC, 2010)
<i>Digitaria porrecta</i>	Finger panic grass	Flowers appear in late summer	PW	None specified	Conservation Advice <i>Digitaria porrecta</i> (finger panic grass) (TSSC, 2013)
<i>Eucalyptus virens</i>	Shiny-leaved ironbark	Flowering has been recorded November - February	D / PW	The inflorescences are axillary and simple, or terminal and compound. The peduncles are slender, growing to 1.4 cm long and bearing 7 white flowers. It has a very limited distribution in southern Queensland and is currently known from 5 locations include near Inglewood, Tara, north-east of Eidsvold and the scarp on approach to the Maranoa River near Mt Moffatt, 10 km East South East of Brovinia, north of Binjour and North West of Injun scattered over a distance of approximately 500 km	Queensland Government (2020), Species profile— <i>Eucalyptus virens</i>
<i>Homopholis belsonii</i>	Belson's Panic	Flowering February – May and possibly November – December as fruiting has been recorded in February.	PW	None specified	Ausgrass (Sharp, D. & Simon (2001); The MacMillan Company of Australia PTY Ltd and World Wildlife Fund (Leigh <i>et al</i> , 1984)
<i>Lepidium monoplacoides</i>	Winged Pepper-cress	August to October	D	None specified	Specifies Profile <i>Lepidium monoplacoides</i> (DEWHA, 2020)
<i>Lepidium peregrinum</i>	Wandering Pepper-cress	Flowers from January to April	PW	Knowledge of the species' lifecycle and ecology is incomplete, and the species may naturally experience boom and bust cycles. Known to occur along watercourses in riparian open forest.	Listing advice <i>Lepidium peregrinum</i> (TSSC, 2003); PlantNET Flora Online Species Profile - <i>Lepidium peregrinum</i>
<i>Leucopogon sp. Coolmunda</i> (D. Halford Q 1635)	Coolmunda leucopogon	Flowering in <i>Leucopogon sp. Coolmunda</i> is known to occur in the latter half of the year between June and January.	D / PW	None specified.	Conservation Advice <i>Leucopogon sp. Coolmunda</i> (DEWHA, 2008a)
<i>Macrozamia machinii</i>		Mature cones have been recorded from September to December. Ripe seeds are present between February and April. Cones may not be annual when conditions are unfavourable	D / PW	It is distinguished by the strongly spirally twisted leaves with dark green leaflets with flat margins and more or less glaucous undersides, and cones that are held above the soil surface.	Queensland Government (2020), Species profile— <i>Macrozamia machinii</i> ; PlantNET Flora Online Species Profile - <i>Macrozamia machinii</i>
<i>Picris barbarorum</i>		Flowering from July to November	D	Erect annual herb 5–60 high, much-branched, with sparse simple to bifid hooked hairs Occurs on riverbanks and floodplains	PlantNET Flora Online Species Profile - <i>Picris barbarorum</i>
<i>Picris evae</i>	Hawkweed	Flowering spring to summer	D / PW	None specified	PlantNET Flora Online Species Profile - <i>Picris evae</i>
<i>Prostanthera sp. Dunmore</i> (D.M. Gordon 8A)		Spring	D	None specified	Conservation Advice <i>Prostanthera sp. Dunmore</i> (DEWHA, 2008c); Stanley, TD & Ross, EM 1986, Flora of south-eastern Queensland, vol. 2, p. 396. Reprinted with updates 2002, Department of Primary Industries, Queensland
<i>Rhaponticum australe</i>	Austral Cornflower	Flowers between spring and late summer to autumn	D / PW	The dead flowering stems can remain on the plant for several months after the seeds have dispersed.	SPRAT, <i>Rhaponticum australe</i> - Austral Cornflower (DEWHA, 2020)
<i>Sophora fraseri</i>	Brush sophora	Flowering has been recorded in April and from late August to mid-November	D	Fruiting has been recorded in January, April, July-August and November Most collections are from the Conondale, D'Aguilar and Taylor Ranges, and the Great Dividing Range south of Toowoomba in southeast Queensland	Queensland Government (2020), Species profile— <i>Sophora fraseri</i>
<i>Thesium australe</i>	Toadflax	Flowers from October through to April	D / PW	It is a short-lived erect herb with wiry stems up to 40 cm high. It is parasitic on the roots of other plants, particularly kangaroo Grass (<i>Themeda australis</i>).	Queensland Government (2020), Species profile— <i>Thesium australe</i>
<i>Tylophora linearis</i>		Flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later	D	Vegetatively this species is difficult to distinguish from <i>Rhyncharrhena linearis</i> and <i>Marsdenia viridiflora</i> .	Office of Environment and Heritage (2020) <i>Tylophora linearis</i> – profile PlantNET Flora Online Species Profile - <i>Tylophora linearis</i>
<i>Westringia parvifolia</i>		Flowers in November and February	D / PW	Has been confused with <i>Westringia cheelli</i> , but has smaller elliptic-obovate leaves (to 2 mm long and to 1 mm wide)	PlantNET Flora Online Species Profile - <i>Westringia parvifolia</i>
<i>Xerothamnella herbacea</i>		Flowers January, February, April, July, September and October. Fruits in April and October	D / PW	None specified	State Herbarium of South Australia (Barker, R.M, 1986)

^NOTE: D = dry season; PW = post-wet season survey

APPENDIX

C

STAGE 1 SURVEY SITE
CATEGORISATION

Priority 2 site categories

Item	Test Site ID	Grassland TEC	Pre-Clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
1	310-03-TP3053	Absent	11.5.1/11.5.4/11.7.4	No	Absent	Present	Yes	P2 (c)	No
2	310-03-GM3001	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	No
3	310-03-BH3307	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	No
4	310-03-TP3500	Absent	11.3.2/11.3.4	No	PBGWAP	Present	Yes	P2 (b)	Yes
5	310-03-BH3602	Absent	11.3.2/11.3.4	No	PBGWAP	Present	Yes	P2 (b)	Yes
6	310-03-GM3002	Absent	11.3.2/11.3.4	No	PBGWAP	Present	Yes	P2 (b)	Yes
7	310-03-BH3308	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	Yes
8	310-03-GM3003	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	No
9	310-03-TP3501	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	No
10	310-03-BH3603	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	No
11	310-03-BH3309	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	No
12	310-03-TP3054	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Present	Yes	P2 (c)	No
13	310-03-GM3004	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (a)	Yes
14	310-03-BH3604	Absent	11.3.2/11.3.4/11.3.25	Yes	PBGWAP	Absent	No	N/A	Yes
15	310-03-TP3056	Absent	11.5.4/11.5.1/11.7.7	No	Absent	Absent	No	N/A	Yes
16	310-03-BH3004	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (a)	Yes
17	310-03-CP3202	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (a)	Yes
18	310-03-BH3005	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (a)	Yes
19	310-03-CP3002	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Absent	Yes	P2 (a)	Yes
20	310-03-BH3006	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Absent	Yes	P2 (a)	Yes
21	310-03-TP3057	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Absent	No	N/A	Yes
22	310-03-TP3058	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	Yes
23	310-03-TP3059	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	Yes
24	310-03-TP3060	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	Yes
25	310-03-TP3061	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	Yes

Item	Test Site ID	Grassland TEC	Pre-Clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
26	310-03-TP3062	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	Yes
27	310-03-TP3063	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	Yes
28	310-03-TP3084	Absent	11.5.4/11.3.18/11.9.5	No	PBGWAP	Present	Yes	P2 (b)	Yes
29	310-03-GM3005	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
30	310-03-TP3085	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
31	310-03-TP3086	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
32	310-03-BH3009	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
33	310-03-CP3004	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
34	310-03-GM3008	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
35	310-03-CP3203	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
36	310-03-BH3010	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
37	310-03-TP3087	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
38	310-03-TP3710	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
39	310-03-TP3714	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
40	310-03-TP3711	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
41	310-03-TP3713	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	Yes
42	310-03-TP3712	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
43	310-03-TP3088	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
44	310-03-TP3131	Absent	11.3.2/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
45	310-03-CP3014	Absent	11.3.2/11.3.25	No	PBGWAP	Absent	No	N/A	Yes
46	310-03-BH3023	Absent	11.3.2/11.3.25	No	PBGWAP	Absent	No	N/A	Yes
47	310-03-CP3210	Absent	11.3.2/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
48	310-03-BH3025	Absent	11.3.2/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
49	310-03-CP3015	Absent	11.3.2/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
50	310-03-BH3605	Absent	11.3.2/11.3.25	Yes	PBGWAP	Present	Yes	P2 (b)	Yes
51	310-03-CP3212	Absent	11.3.2/11.3.25	No	PBGWAP	Present	Yes	P1 (duplicate)	Yes

Item	Test Site ID	Grassland TEC	Pre-Clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
52	310-03-CP3016	Absent	11.3.2/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
53	310-03-BH3026	Absent	11.3.2/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	Yes
54	310-03-CP3213	Absent	11.8.5	No	Absent	Present	Yes	P1 (duplicate)	Yes
55	310-03-BH3027	Absent	11.8.5	No	Absent	Present	Yes	P1 (duplicate)	Yes
56	310-03-CP3214	Absent	11.8.5	No	Absent	Present	Yes	P1 (duplicate)	Yes
57	310-03-BH3028	Absent	11.8.5	No	Absent	Present	Yes	P1 (duplicate)	Yes
58	310-03-CP3017	Absent	11.8.5	No	Absent	Present	Yes	P1 (duplicate)	Yes
59	310-03-BH3320	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
60	310-03-TP3338	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
61	310-03-BH3321	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
62	310-03-BH3322	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
63	310-03-BH3323	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
64	310-03-TP3340	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
65	310-03-BH3324	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
66	310-03-BH3325	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
67	310-03-TP3342	Absent	11.8.5	Yes	Absent	Absent	No	N/A	Yes
68	310-03-TP3343	Absent	11.8.5	Yes	Absent	Absent	No	N/A	Yes
69	310-03-BH3326	Absent	11.8.5	Yes	Absent	Absent	No	N/A	Yes
70	310-03-TP3344	Absent	11.8.5	Yes	Absent	Present	Yes	P2 (c)	Yes
71	310-03-TP3147	Absent (Adjoining RE)	11.8.5 (11.3.21 on the cusp)	No	Absent	Absent	No, however recommended.	P2 (c)	No
72	310-03-BH3063	Absent	11.8.5	Yes	Absent	Absent	No	N/A	No
73	310-03-BH3064	Absent	11.8.5	Yes	Absent	Absent	No	N/A	Yes

Item	Test Site ID	Grassland TEC	Pre-Clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
74	310-03-BH3337	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
75	310-03-TP3158	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
76	310-03-BH3342	Absent	11.8.5	No	Absent	Absent	No	P1 (duplicate)	Yes
77	310-03-BH3343	Absent	11.8.5	No	Absent	Absent	No	P1 (duplicate)	Yes
78	310-03-BH3348	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
79	310-03-BH3349	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
80	310-03-BH3350	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
81	310-03-BH3351	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
82	310-03-TP3179	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
83	310-03-TP3180	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
84	310-03-TP3181	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
85	310-03-BH3352	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
86	310-03-BH3353	Absent	11.8.5	Yes	Absent	Absent	No	N/A	Yes
87	310-03-TP3182	Absent	11.8.5	No	Absent	Absent	No	N/A	Yes
88	310-03-TP3183	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
89	310-03-BH3354	Absent	11.8.5	Yes	Absent	Absent	No	N/A	Yes
90	310-03-TP3184	Absent	11.8.5	Yes	Absent	Absent	No	N/A	Yes
91	310-03-BH3355	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
92	310-03-TP3185	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	Yes
93	310-03-TP3186	Absent	11.8.11	No	Absent	Absent	No	N/A	Yes
94	310-03-BH3606	Present	11.3.21/11.3.24	No	-	Absent	No	N/A	Yes
95	310-03-TP3187	Present	11.3.21/11.3.24	No	-	Absent	No	N/A	Yes
96	310-03-BH3607	Present	11.3.21/11.3.24	No	-	Absent	No	N/A	Yes
97	310-03-BH3071	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
98	310-03-BH3608	Absent	11.8.11	Yes	Absent	Absent	No	N/A	Yes

Item	Test Site ID	Grassland TEC	Pre-Clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
99	310-03-TP3188	Absent	11.8.11	Yes	Absent	Absent	No	N/A	Yes
100	310-03-TP3189	Absent	11.8.11	Yes	Absent	Absent	No	N/A	Yes
101	310-03-BH3072	Absent	11.8.11	Yes	Absent	Absent	No	N/A	Yes
102	310-03-TP3190	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
103	310-03-BH3073	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
104	310-03-BH3074	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
105	310-03-TP3191	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
106	310-03-BH3075	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
107	310-03-BH3076	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
108	310-03-TP3192	Present	11.3.21/11.3.24	No	-	Absent	Yes	P2 (a)	Yes
109	310-03-BH3609	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
110	310-03-TP3193	Absent	11.8.11	Yes	Absent	Absent	No	N/A	Yes
111	310-03-BH3077	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
112	310-03-TP3194	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
113	310-03-BH3078	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
114	310-03-TP3195	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
115	310-03-BH3079	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
116	310-03-TP3196	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
117	310-03-BH3080	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
118	310-03-TP3197	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
119	310-03-TP3198	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
120	310-03-BH3610	Present	11.3.21/11.3.24	Yes	-	Absent	No	N/A	Yes
121	310-03-BH3081	Absent	11.8.11	Yes	Absent	Absent	No	N/A	Yes

Note: PBGWAP = Poplar Box Grassy Woodland on Alluvial Plains, BGL = Brigalow (Acacia harpophylla dominant and co-dominant) ecological community

Access tracks clearing proposed site categories

Item	Test Site ID	Grassland TEC	Pre-clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
3224	AT-310-03-TP3501	Absent	11.5.4/11.5.1/11.7.7, 11.3.2/11.3.4	No	Absent	Present	Yes	P2 (c)	ARTC to Request Access
3227	AT-310-03-CP3202	Absent	11.5.4/11.5.1/11.7.7, 11.3.2/11.3.4/11.3.25	No	Absent	Present	Yes	P2 (c)	LAA Received
3234	AT-310-03-TP3061	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	LAA Received
3235	AT-310-03-TP3062	Absent	11.3.2/11.3.4/11.9.7	No	PBGWAP	Present	Yes	P2 (b)	LAA Received
5242	AT-310-03-TP3713	Absent	11.3.2/11.3.4/11.3.25, 11.5.20/11.9.5	No	PBGWAP	Present	Yes	P2 (b)	LAA Received
5243	AT-310-03-TP3712	Absent	11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	LAA Received
5640	AT-310-03-BH3010	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	LAA Received
5641	AT-310-03-BH3710	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	LAA Received
5643	AT-310-03-TP3501	Absent	11.5.20/11.9.5, 11.3.2/11.3.4/11.3.25	No	PBGWAP	Present	Yes	P2 (b)	LAA Received
5644	AT-310-03-TP3085	Absent	11.5.20/11.9.5	No	BGL	Present	Yes	P2 (b)	LAA Received
7282	AT-310-03-BH3064	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	LAA Received
7654	AT-310-03-BH3324	Absent	11.8.5	No	Absent	Present	Yes	P2 (c)	LAA Received
7689	AT-310-03-BH3066	Absent	11.8.5	Yes	Absent	Absent	No	N/A	See Land Access Table
7691	AT-310-03-BH3158	Absent	11.8.5	No	Absent	Absent	No	N/A	LAA Received
8895	AT-310-03-TP3310	Present	11.3.21	No	-	Present	Yes	P2 (a)	ARTC to Request Access

Item	Test Site ID	Grassland TEC	Pre-clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
8905	AT-310-03-BH3073	Present	11.3.21	No	-	Absent	Yes	P2 (a)	See Land Access table
8919	AT-310-03-BH3614	Present	11.8.11, 11.3.21/11.3.24	Yes	-	Absent	No	N/A	ARTC to Request Access
8920	AT-310-03-TP3213	Present	11.8.11, 11.3.21/11.3.24	Yes	-	Absent	No	N/A	ARTC to Request Access
9713	AT-310-03-TP3196	Present	11.3.21/11.3.24, 11.8.11	Yes	-	Absent	No	N/A	LAA Received
Note: PBGWAP = Poplar Box Grassy Woodland on Alluvial Plains, BGL = Brigalow (Acacia harpophylla dominant and co-dominant) ecological community									

Table 6-3 Access tracks clearing confirmed site categories

Item	Test Site ID	Grassland TEC	Pre-clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
4026	AT-310-03-TP3126	Absent	11.9.5/11.9.7/11.3.25	No	Absent	Present	Yes	P2 (c)	Open Access – road
4432	AT-310-03-BH3084	Absent	11.8.5	No	Absent	Absent	No	P2 (c)	Open Access – road
4842	AT-310-03-TP3209	Absent	11.8.5	Yes	Absent	Absent	No	P2 (c)	Open Access – road
7685	AT-310-03-TP3146	Absent	11.8.5	Yes	Absent	Absent	No	P2 (c)	Open Access – road
8084	AT-310-03-BH3037	Present	11.3.21 / 11.3.25/11.3.4/11.3.27b	No	-	Absent	No	P2 (a)	QR access
8086	AT-310-03-CP3024	Present	11.3.21	No	-	Absent	No	P2 (a)	QR access
8911	AT-310-03-CP3024	Absent	11.5.4/11.5.20/11.5.1	Yes	Absent	Present	Yes	P2 (c)	Open Access – road
8913	AT-310-03-TP3072	Absent	11.5.4/11.5.20/11.5.1	Yes	Absent	Present	Yes	P2 (c)	Open Access – road

Item	Test Site ID	Grassland TEC	Pre-clear RE	Evidence of cultivation	Any TEC	Woody Vegetation	Survey required	Site category	Land access
8914	AT-310-03-TP3071	Absent	11.5.4/11.5.20/11.5.1	Yes	Absent	Present	Yes	P2 (c)	Open Access – road
9727	AT-310-03-TP3073	Absent	11.5.4/11.5.20/11.5.1	Yes	Absent	Present	Yes	P2 (c)	Open Access – road

APPENDIX

D

SUITABLY QUALIFIED PERSON CVS



David Francis

Current Position

National Technical Director
Environmental Sciences &
Senior Principal Ecologist
Environmental Scientist

Profession

Ecology

Years' Experience

26

Joined Cardno

June 2000

Education

BSc(Hons), 1992, UQ

Professional Registrations

CEnvP

Affiliations

EIANZ

QELA

Australian Network for Plant
Conservation (ANPC)

Summary of Experience

David is an environmental scientist with over 26 years' experience in flora and fauna studies, vegetation mapping, ecological assessments, revegetation plans and environmental planning. He has an excellent botanical knowledge having undertaken studies in a geographical area spanning the Wet Tropics through to Victoria, and abroad in PNG. David has had considerable experience in Regional Ecosystem and wetland mapping and conservation significance assessments. He is an expert in nature conservation mapping systems and planning at a local and regional scale. His expertise also includes wildlife corridor planning, with particular knowledge of barrier mitigation measures for linear infrastructure such as roads. David's knowledge of Commonwealth, State and Local Government ecological statutory requirements enables him to provide sound planning advice.

David is actively involved in the environmental industry. This has included participation in DERM's Expert Panel for the SEQ Biodiversity and Planning Assessment and co-convening the EIANZ's 'Breaking the Barriers: Infrastructure Solutions to Ecological Problems' and organising participating in the organising of the Australasian Network for Ecology and Transportation (ANET) 2015 and 2018 conferences.

Professional expertise include:

- > Flora and fauna studies
- > Road Ecology
- > Ecological Restoration / Revegetation planning
- > EPBC Act threatened species and ecological community mapping
- > Vegetation mapping
- > Conservation Significance Mapping

Skills in:

- > Community Engagement
- > Project Management
- > GIS
- > Botany (Flora Studies/Vegetation Mapping)
- > Conservation Significance Mapping
- > Road Ecology
- > Ecological Restoration (Rehabilitation)

Significant Projects

State / Regional Planning

- > Independent review of the 15 Self-Assessable Codes (SACs) under the provisions of the Vegetation Management Act 1999 (2015)
- > SEQ Restoration Guidelines (2009-12)
- > SEQ National Reserve System Network Plan and Management Plan (2009)
- > Facilitation SEQ local government workshop on offsets

Flora Assessments

- > Iluka Resources, Baseline ecological assessments including Habitat Hectares assessment (>5,000ha) (2018)
- > Queensland Rail Eubenangee Swamp protected flora survey (2017)
- > Williamtown RAAF Base flora and fauna assessment, NSW (2016)
- > Saltash Air Weapons Range Vegetation Survey Report and Management Plan, NSW (2016)
- > Barry Beach Marine terminal vegetation assessment, Victoria (2016)
- > Kemmis SA4s2 Expansion - Flora & Habitat Survey (2013)
- > Pre-clearing surveys and other flora assessments for Saipem's GLNG pipeline between Roma and Gladstone (including searches for NCA and EPBC Act scheduled species and declared pests) (2012-13)
- > Bahrs Scrub Structure Plan for Logan City Council (included mapping of NCA and EPBC Act scheduled species and REs) (2010)
- > Sheraton Port Douglas - Flora assessments (2014)

Road Ecology

- > Deagon Wetlands macropod study (2017)
- > Green Camp Road upgrade fauna crossing advice (2016 and 2017)
- > Assisted in the development of the RMS Wildlife Connectivity Guidelines (2015) including workshops with RMS stakeholders
- > Wyaralong Dam Fauna Crossing Monitoring Plan (2010)
- > Flinders to Greenbank - Karawatha Corridor for the Queensland Department of Transport & Main Roads (preparation of mapping of fauna crossing locations along with crossing structure recommendations) (2010).
- > Ella Bay Access Road (design of fauna crossing structures) (2009)
- > Wongaling Corridors Fauna Crossings (conceptual design of crossing structures, largely targeted cassowary, in Mission Beach) (2008)
- > Conceptual Design of the Reedy Creek Fauna Crossings for Gold Coast City Council (2006)
- > Ecological Corridors and Edge Effects Project (literature review of world's best practice in fauna crossing structures. Preparation of a conceptual design for crossing structures within the Brisbane City Council component of the Greenbank Karawatha corridor) (2003)
- > Co-convenor of the EIANZ 2009 'Breaking the Barriers Symposium' - The event attracted a national audience of over 200 participants, 2 international keynote presentations and speakers from throughout Australia to discuss best practice in wildlife management around linear infrastructure

Commonwealth Assessments/Environmental Impact Assessments

- Lindeman Island EIS biosecurity chapters and native vegetation advice (2017)
- Curtis Island EPBC Act Preliminary Documentation migratory bird chapters (2017)
- Springview Estate EPBC Referral (2014)
- Gold Coast Quarry EIS flora and fauna studies (including mapping of EPBC Act & NCA threatened flora, REs & impact assessments) (2012-13)
- Great Keppel Island EIS flora and fauna studies (including mapping of EPBC Act threatened communities, REs & impact assessments) (2010-12)
- Nathan Dam & Pipeline Project Flora Studies EIS (including mapping of EPBC Act threatened ecological communities e.g. mound springs, brigalow, native grasslands & vine thicket; NCA & EPBC Act listed species; & REs) (2008-12)
- Clermont Coal EIS, riparian vegetation studies (2004)
- Coordinated flora and fauna studies for the Dent Island Golf Course EIS (2001)

Conservation Significance Mapping and Reporting

- Gold Coast Environmental Features mapping (2018)
- Gold Coast RLEP and RRLEP mapping (2017)
- Logan City expert panel facilitation for conservation significance mapping (2015)
- Townsville City Environment and Biodiversity Study (2010)
- Moreton Bay Regional Council Habitat and Biodiversity Study (2010)
- Amberley Air Base Natural Heritage Assessment for the Department of Defence (2010-2012)
- Mission Beach Biodiversity Significance Report (2007)
- Common Nature Conservation Classification System Mapping for Caloundra City Council (2005), Beaudesert Shire Council (2003), Gold Coast City Council (2003) and Caboolture Shire Council (2007)
- Redcliffe City Vegetation Mapping and Biodiversity Planning Study (2001)
- Mirani and Nebo Habitat and Biodiversity Planning Study (2002)

Broad Scale Regional Ecosystem / Vegetation Mapping / Ecological Inventories

- Gold Coast city-wide regrowth mapping for Council (2012 & 2018)
- Regional Ecosystem mapping for the Mt Lindesay area for Logan City Council (2006)
- Beaudesert Shire Council Vegetation Mapping (2007)
- Tamborine Mountain Flora and Fauna Report – Project management, mapping of remnant vegetation, regional ecosystems, threat analysis and prescription of mitigative measures (2000)
- Gold Coast City Council's Springbrook Conservation estate vegetation assessment (2005)

Environmental Planning

- Rockhampton Regional Council Natural Environment Study (2019)
- City of Gold Coast Environmental Covenant Study (2018)
- Waterway Corridor mapping review project for Logan City Council (2015)
- Brisbane City Council and Redland City Council Pest Management Plans (2011 & 2010)
- Townsville City Environment and Biodiversity Study (2010). The study included numerous recommendations to protect ecological features such as shorebird roosts, cassowary habitat and threatened ecosystems
- Western Downs Regional Council Environment and Biodiversity Study (2011)

- > Ecological planning studies for Beaudesert Shire's Whole of Shire Planning Project (2000)
- > Greater Flagstone (2008), Bromelton (2007) and Beaudesert (2005-06) Town outline structure plans
- > Richmond Valley Shire Council (NSW) Corridor and Wetland mapping (2007)
- > Maryborough – various ecological assessments for Council (2007)
- > Revision of the 'fire and biodiversity' section of the Gold Coast City Council Bushfire Strategy (2005)
- > Springbrook – Burleigh head corridor studies (including fauna crossing design in the Reedy Creek area) (2005)
- > Currumbin Sanctuary Environmental Constraints Study (2003)
- > Coomera Town Centre Environmental Management Strategy for Gold Coast City Council (2001)
- > Avatars Abode Vegetation mapping, Flora Assessment and Weed Management Strategy (2002)

Fauna Assessments

- > Mt Coot tha zip line fauna assessments and ecological studies (2017 - 2018)
- > Sgt Dan Stiller Reserve and Glider Reserve fauna and flora studies for Brisbane City Council (2017)
- > Canungra Field Training Area fauna monitoring (2015)
- > Brisbane Airport Corporation New Parallel Runway Wildlife Hazard Assessment Report (2015)
- > Tallowood Cemetery fauna assessment (2014)
- > Gold Coast Quarry fauna assessment (2012)
- > Maddison Estate fauna assessment (2009)
- > Koala Habitat mapping and conversation strategy for the Tinana area for Maryborough Shire Council (2005)

Rehabilitation Plans

- > Wivenhoe Dam rehabilitation planning for a 3,200ha study area (2015)
- > QCLNG Export Pipeline - Narrows Crossing mainland section rehabilitation plan (2011)
- > 'Viridian' Noosa rehabilitation plan (winner of the AILA 2008 National Awards for Landscape Architecture in the Conservation Division) (2004-08)
- > Rocklea Markets rehabilitation plan (including wetland design) (2008)
- > Redland Business Park (2006)
- > Burnett River Dam flora and fauna conservation strategy (2003)
- > Waterway Action and Rehabilitation Program (WASP) sites for Logan City Council (2005)

Environmental Offsets

- > Investigation of potential offset receive sites for impacts on koala habitat under the EPBC Act on behalf of Lockyer Regional Council (2015)
- > Assessment of receive sites under the Nature Conservation Act 1992 for impacts arising from an industrial development on behalf of Moreton Bay Regional Council (2015)
- > Identification of suitable Cassowary Habitat offsets under the EPBC Act in Mission Beach (2007)
- > Vegetation Management Act Offsets in Ormeau for Boral (2006)
- > Koala Plan net benefit 'offset' in Narangba for Boral (2006)
- > Identification of suitable Fisheries Offset under the Fisheries Act for Mackay Council (2002) and in Airlie Beach for Resort Corp (2005)

Expert Witness

Queensland Land Court

- > Byerwen Coal Pty Ltd v Colinta Holdings Pty Ltd (Land Court File Nos MRA 117-16, MRA 118-16 and MRA 119-16)
- > BHP Billiton Mitsui Coal Pty Ltd v Baulch & Anor and Chief Executive, Department of Environment and Heritage Protection [2014] QLC 43
- > Northeast Business Park Pty Ltd v Chief Executive, Dept. of Transport and Main Roads (AQL368/09)
- > Victor Leslie and Christine Angela Cumner v Chief Executive, Dept. of Transport and Main Roads (AQL308/09)
- > Alfred John Nucifora (as personal representative under the Will of Angelo John Nucifora) v Brisbane City Council (AQL1030-10)
- > Toan Van Pham & Others v Brisbane City Council (AQL455-10)
- > Cubdale Pty Ltd and Michelle Huang v Brisbane City Council (AQL433-13)

Planning and Environment Court

- > Stay Developments Pty Ltd v Brisbane City Council (No 3692 of 2019)
- > Cleanaway Solid Waste Pty Ltd v Ipswich City Council (No 4101 of 2019)
- > John Stuart Hofmann and Kathleen Mary Hofmann v Noosa Shire Council (No 3188 of 2017)
- > O'Hagan v Brisbane City Council (No 162 of 2017)
- > Boral Resources (QLD) Pty Ltd v Gold Coast City Council and Stop The Gold Coast Quarry Association Inc. (No 3084 of 2014)
- > Drywound Pty Ltd v Lockyer Valley Regional Council and others (No 2652 of 2015)
- > Tamborine Mountain Progress Association Inc. v Scenic Rim Regional Council (No 3796 of 2015)
- > Andrew Tanner v Moreton Bay Regional Council & others (No 2987 of 2010)

International

- > USAID Biodiversity workshop, Papua New Guinea (2019)
- > Predator Free Wellington, Miramar Peninsula fencing review, New Zealand (2019)
- > Brown-Naoro River Hydro, Papua New Guinea (included 4 weeks of intensive flora and fauna surveys) (2018-2019)
- > Biodiversity Risk Assessment Oil Search Limited Licence Areas & Residual Impact Assessment Strategy, Papua New Guinea (2017)
- > Highlands Highway (Asaro to Miunde), Papua New Guinea (2013)
- > Mendi Airport, Papua New Guinea (2015)
- > Taurama Barracks, Papua New Guinea (2015)
- > Brown-Naoro River, Papua New Guinea (included 2 weeks of intensive flora and fauna surveys in a 9,600ha area of remote rainforest) (2014)

Greening Australia, 1995 - 2000

Key Project Experience

- > Technical advice to Department of Main Roads on vegetation management, including trials, landscape design and species selection.
- > Community consultation and involvement in community based planting activities adjacent to road corridors. Involved over 2,000 volunteers in community based tree planting activities.

- > Initiation and organisation of “Transport Corridor Management Conference” (Brisbane, November 1999) with national and international speakers and a nation-wide audience of 265 people involved in the management of roadside vegetation.
- > Prepared preferred species manuals for the Department
- > Main Roads Metropolitan and Gympie Districts. Included maps of both districts based on broad vegetation categories and lists of commercially available native species suitable for roadways that were endemic to the broad categories

Publications/Papers and Posters

- > Mitigation hierarchy, EIANZ National Biodiversity Offsets Conference, 2019, Canberra
- > When is vegetation clearing truly necessary for the greater good? QELA 2019 Conference, Twin Waters
- > Are Offsets in Australia Fit Enough to Survive? International Association of Impact Assessment 2019, Brisbane
- > Driving vegetation management along transport corridors. 2018 Australasian Network for Ecology and Transportation Conference, Creswick
- > Will botanists be functionally extinct by 2050? EIANZ 2016 Conference, Brisbane.
- > Are ‘pay and go’ offsets under the Vegetation Management Act 1999 passé? QELA 2015, Gold Coast
- > The Australian legislative framework – Is it effectively addressing the impacts of linear infrastructure on wildlife? - 2014 Australasian Network for Ecology and Transportation Conference, Coffs Harbour
- > Understanding Resilience: an important principle of the SEQ Ecological Restoration Framework- The Hut 2013 Forum, Brisbane
- > Russell, M., Leiper, G., White, D. Francis, D., Hauser, J., McDonald, B. & Sims, S. (2013). Tamborine Mountain Flora and Fauna
- > The effectiveness of the Queensland statutory framework in mitigating road impacts on wildlife - The case example of the Flinders-Greenbank-Karawatha bioregional corridor. Infra Eco Network Europe (IENE) Conference, Potsdam, Germany, 2012
- > Planning corridors in an urbanising landscape - The Hut 2012 Forum, Brisbane
- > Breaking the Barriers: where have we come from and where are we going in the field of road ecology - EIANZ 2011 Conference, Sunshine Coast
- > Planning roads to protect Australia's Southern Cassowary (*Casuarius casuarius johnsonii*) - International Conference of Ecology and Transportation (ICOET), Seattle, USA, 2011
- > Fauna and Roads: What's the latest word on the street? - EIANZ 2010 Conference, Wellington, NZ
- > Wongaling Corridors Crossing Study. A case example in developing crossing options in a priority biodiversity area - Breaking the Barriers Symposium
- > Planting for Restoration - Gold Coast Bush Regeneration Fair, 2008
- > Sources and Resources - Australian Network for Plant Conservation Rehabilitation Workshops - Gatton and Mt Coot-tha, 2004
- > Use of Native Grasses for maintenance reduction in Road Verges - Shades of Green Conference PLA, 2003
- > Managing Flora and Fauna in Roadways - Northern Grassy Landscape Conference, 2000
- > Freeway Greening Project: a case example of vegetation management in transport corridors - Transport Corridor Management Conference, 1999
- > Greening Australia Activities Metropolitan District of Main Roads - Department of Main Roads South East Region Symposium, 1999
- > Roadways and Native Vegetation - Department of Main Roads Southern Region Symposium, 1998

- > Freeway Greening as a model for community involvement in tree planting - Managing and Growing Trees Conference, 1996

Awards and Offices

- > Co-convenor of the 2019 EIANZ National Biodiversity Offsets Conference, Canberra
- > Brisbane City Regional Ecosystem Benchmark Expert Workshop, Queensland Herbarium, 2017
- > Koala Expert Elicitation process panel member for EHP, 2017
- > Organising committee member for the 2014 and 2018 Australasian Network for Ecology and Transportation Conference
- > 2013 UDIA Enviro Development Technical Standards Taskforce: Ecosystems member
- > Co-convenor of the 2009 EIANZ Breaking the Barriers: Engineering Solutions to Ecological Problems Symposium
- > Expert Panel for DES's SEQ Biodiversity Planning Assessment in 2006 and 2016
- > Judge for the Ipswich City Environment Awards for Excellence 2006 - 2010
- > NRM's Vegetation Incentives Program southern region assessment panel member
- > Biodiversity Working Group for the 2003 Queensland State of the Environment Report
- > Member of the Greening Australia Queensland (Inc.) Board 2001-03
- > Finalist for the 1998 Young Australian of the Year Award for Outstanding Achievement in the Environment
- > Highly Commended Certificate at the Australasia Pacific Extension Network Awards for Excellence in Extension, 1999
- > Winner of the 1998 Queensland Arbor Day Awards in the Corporate Tree Planter Category, for the Freeway Greening Project (jointly with Department of Main Roads)
- > Golden Key National Honour Society, Griffith University Chapter 1999

Professional Development

- > Vegetation Quality Assessment (Victoria) competent assessor, 2017
- > Australasian Network for Ecology and Transportation Conference, Coffs Harbour, 2014
- > Infra Eco Network Europe (IENE) Conference, Potsdam, Germany, 2012.
- > International Conference of Ecology and Transportation (ICOET), Duluth, Minnesota, 2009 and Seattle, 2011
- > Identifying Regional Ecosystem Training Course (NRM, 2003)
- > Train the trainer (AIMS 1994)
- > Bush Tucker and Craft (Ithaca TAFE Adult Education 1994)
- > Community Extension, Gatton College 1995 Short Course
- > Botanical Illustration, Margaret Saul School of Botanical Illustration



David Wassman

Current Position

Principal Ecologist

Profession

Ecologist

Years' Experience

13

Joined Cardno

July 2010

Education

BSc (Environmental Management)

Affiliations

Certified Environmental Practitioner (CEnvP Registration 1174)

MEIANZ

Infrastructure Sustainability Council of Australia (IS Accredited Professional)

Summary of Experience

David Wassman is a CEnvP and ISAP and has been with Cardno since mid 2010. He has approximately 13 years experience in the environmental field working in both private and State Government sectors.

David qualifies as a suitably qualified person in accordance with Table 1 of the Protected Plants Flora Survey Guidelines - December 2016.

Attached to this CV are the following documents which support this SQP qualification:

- David's qualifications from the University of the Sunshine Coast (50 points).
- David's completion certificate for the Queensland Herbarium's RE Training (5 points).
- David's pre-existing Commonwealth Government Accreditation for flora surveys under the EPBC Act (30 Points).

In addition to the above evidence, below is a list of flora surveys recently led and/or co-ordinated by David.

Some relevant Protected Plants and Threatened flora projects that have benefited from David's experience include:

- > Maroochydore City Centre - Protected Plants Flora Survey.
- > Carnarvon Drive Upgrades, Beerwah - Protected Plants Flora Survey and Threatened Fauna Species Assessment.
- > Buderim Gardens Retirement Village - Protected Plants Flora Survey and Terrestrial fauna habitat assessments.
- > Pelican Waters Southern Lakes - Protected Plants Flora Survey (Phase 1 and Phase 2).
- > Ripley Valley PDA - Melaleuca irbyana surveys.
- > Telegraph Road Landfill Remediation - Protected Plants Flora Survey.
- > Simpson's Falls, Brisbane - Protected Plants Flora Survey.
- > Kewarra Beach Marina, Cairns - Targeted surveys for Myrmecodia beccarii.
- > Kewarra Beach Subdivision, Cairns - Targeted surveys for Myrmecodia beccarii and the Spectacled flying fox.
- > Tiger Brennan Drive Duplication, Darwin - Targeted surveys for Cycas armstrongii.
- > Burnett Highway Upgrades - Targeted surveys for Cadellia pentastylis and Acacia wardellii.
- > Gladstone Offshore Storage Dam - Targeted surveys for Cupaniopsis shirleyana and threatened fauna assessments.
- > Cairns Airport Business Park expansion - Targeted surveys for Myrmecodia beccarii.

Professional History

July 2010 to Current

Senior Ecologist - Cardno (Qld) Pty Ltd

David's position as an Environmental Scientist involves:

- > provision of environmental advice with respect to environmental constraints and approvals;
- > preparation of applications and supporting technical documentation for Commonwealth, State and Local government approvals;
- > undertaking environmental assessments (including fauna and flora surveys);
- > client liaison;
- > preparation of reports (including management plans and written advice);
- > co-ordination of tasks with other industry professionals; and
- > preparation of job proposals and detailed work cost estimates.

July 2008 to July 2010

Ecologist - Australian Wetlands

David's position as an ecologist involved:

- > Water quality monitoring and macroinvertebrate sampling.
- > Undertaking ecological assessments (including flora and fauna surveys).
- > Preparation of reports both scientific and management plan orientated.
- > Client liaison.
- > Preparation of fee proposals and cost estimates.

Sept 2006 to July 2008

Project Officer, Water Services - Department of Natural Resources and Water

David's role as Project Officer primarily involved service delivery and resource audits. This involved:

- > Providing advice to a variety of clients with respect to requirements under legislation. Particularly the Water Act 2000.
- > Undertaking catchment audits of the Lockyer and Mary Catchments to better determine resource demand and usage.
- > Creation of reporting and mapping products resulting from field work.

APPENDIX

E

STAGE 1 SURVEY LAND ACCESS
REQUIREMENTS

Land Access for Priority 1 Geotechnical Sites (including 100 m buffer area)

Site number	Test Site ID	Lot Plan	Protected Plant	Access
1	310-03-BH3300	2MH461	Yes	LAA Received
2	310-03-BH3301	2MH461	Yes	LAA Received
		58SP169187	Yes	LAA Received
3	310-03-TP3098	1RP100482	Proximate protected plant record	ARTC to request access
		27MH367	Proximate protected plant record	ARTC to request access
		37MH523	Proximate protected plant record	ARTC to request access
		168MH367	Proximate protected plant record	ARTC to request access
		RD01RP145435	Proximate protected plant record	Open access - road
		RD02MH367	Proximate protected plant record	Open access - road
		RD02MH367	Proximate protected plant record	Open access - road
4	310-03-CP3212	2SP260880	Yes	LAA Received
5	310-03-CP3213	2SP260880	Yes	LAA Received
	310-03-BH3027	140DER34129	Yes	LAA Received
	310-03-CP3214	3761DER34129	Yes	LAA Received
	310-03-BH3028 310-03-CP3017			
6	310-03-TP3137	3683DER34116	Yes	ARTC to request access
		1RP124356	Yes	ARTC to request access
		RD01RP124356	Yes	Open access - road
7	310-03-CP3020 310-03-CP3019	2RP99467	Proximate protected plant record	ARTC to request access
		3RP37102	Proximate protected plant record	ARTC to request access
		5RP16058	Proximate protected plant record	ARTC to request access
		1RP99467	Proximate protected plant record	ARTC to request access
		2RP61876	Proximate protected plant record	ARTC to request access
		WR04DER3493	Proximate protected plant record	Open access – river parcel
		132SP113908	Proximate protected plant record	QR Access required
		4RP16058	Proximate protected plant record	QR Access required
		201SP124721	Proximate protected plant record	QR Access required

Site number	Test Site ID	Lot Plan	Protected Plant	Access
		RD01DER3493	Proximate protected plant record	Open access - road
		RD01RP99465	Proximate protected plant record	Open access - road
8	310-03-TP3312	RD2RP14239A	Proximate protected plant record	LAA Received
		RD01AG1828	Proximate protected plant record	Open access - road
		1RP92662	Proximate protected plant record	LAA Received
		2RP14250	Proximate protected plant record	QR Access required
		91SP104978	Proximate protected plant record	QR Access required
		92SP104978	Proximate protected plant record	QR Access required
		2RP14241	Proximate protected plant record	QR Access required
9	310-03-TP3346	3546A341819	Yes	ARTC to request access
		1RP7470	Yes	LAA Received
10	310-03-BH3334	2RP205146	Yes	Potential Neg - Unlikely
	310-03-BH3336	2RP142680	Yes	ARTC to request access
	310-03-BH3333			
	310-03-TP3155			
	310-03-BH3332	RD01RP30865	Yes	Open access -road
	310-03-SR3032			
	310-03-SR3031			
11	310-03-BH3339 310-03-BH3340 310-03-BH3342 310-03-BH3343 310-03-SR3038 310-03-SR3037 310-03-SR3035 310-03-SR3036	2718A341307	Proximate protected plant record	HARD NO
		5RP841180	Proximate protected plant record	LAA Received
		9RP841180	Proximate protected plant record	ARTC to request access
		6RP203202	Proximate protected plant record	ARTC to request access
		4RP203202	Proximate protected plant record	ARTC to request access
		1789A34919	Proximate protected plant record	QR Access required
		RD3913044	Proximate protected plant record	ARTC to request access
		RD01RP203202	Proximate protected plant record	Open access - road
		RD01A341307	Proximate protected plant record	Open access - road
		BRP153393	Proximate protected plant record	ARTC to request access

Site number	Test Site ID	Lot Plan	Protected Plant	Access
		ARP153393	Proximate protected plant record	ARTC to request access
		ARP152985	Proximate protected plant record	ARTC to request access
12	310-03-BH3084 310-03-TP3209	3AG3669	Proximate protected plant record	ARTC to request access
		11SP285307	Proximate protected plant record	ARTC to request access
		9SP285304	Proximate protected plant record	ARTC to request access
		RD01SP285304	Proximate protected plant record	Open access - road
		2AG3599	Proximate protected plant record	
13	310-03-TP3217	2RP838203	Proximate protected plant record	ARTC to request access
		2RP76562	Proximate protected plant record	ARTC to request access
		33SP294200	Proximate protected plant record	ARTC to request access
		29SP294200	Proximate protected plant record	ARTC to request access
		10D3691	Proximate protected plant record	QR Access required
		RD01RP24609	Proximate protected plant record	Open access - road
		FSP294181	Proximate protected plant record	ARTC to request access

Land Access for Priority 2 Geotechnical Sites

Item	Test Site ID	Lot Plan	Access	Survey result/ exclusion
1	310-03-TP3053	245CP902340	Potential Neg	Excluded due to access
2	310-03-GM3001	143CP902340	Potential Neg	Excluded due to access
3	310-03-BH3307	143CP902340	Potential Neg	Excluded due to access
4	310-03-TP3500	142MH193	LAA Received	
5	310-03-BH3602	142MH193	LAA Received	
6	310-03-GM3002	142MH193	LAA Received	
7	310-03-BH3308	142MH193	LAA Received	
8	310-03-GM3003	141MH193	Potential Neg	Excluded due to access
9	310-03-TP3501	141MH193	Potential Neg	Excluded due to access
10	310-03-BH3603	141MH193	Potential Neg	Excluded due to access
11	310-03-BH3309	93MH819	Potential Neg	Excluded due to access
12	310-03-TP3054	93MH819	Potential Neg	Excluded due to access
13	310-03-GM3004	87MH16	LAA Received	

Item	Test Site ID	Lot Plan	Access	Survey result/ exclusion
14	310-03-BH3604	87MH16	LAA Received	
15	310-03-TP3056	87MH16	LAA Received	
16	310-03-BH3004	250MH270	LAA Received	
17	310-03-CP3202	250MH270	LAA Received	
18	310-03-BH3005	250MH270	LAA Received	
19	310-03-CP3002	97MH38	LAA Received	
20	310-03-BH3006	97MH38	LAA Received	
21	310-03-TP3057	97MH38	LAA Received	
22	310-03-TP3058	1RP156957	LAA Received	
23	310-03-TP3059	2RP156957	LAA Received	
24	310-03-TP3060	2SP109525	LAA Received	
25	310-03-TP3061	2SP109525	LAA Received	
26	310-03-TP3062	2SP109525	LAA Received	
27	310-03-TP3063	124MH79	LAA Received	
28	310-03-TP3084	10MH737	LAA Received	
29	310-03-GM3005	10MH737	LAA Received	
30	310-03-TP3085	10MH737	LAA Received	
31	310-03-TP3086	10MH737	LAA Received	
32	310-03-BH3009	10MH737	LAA Received	
33	310-03-CP3004	10MH737	LAA Received	
34	310-03-GM3008	10MH737	LAA Received	
35	310-03-CP3203	10MH737	LAA Received	
36	310-03-BH3010	10MH737	LAA Received	
37	310-03-TP3087	10MH737	LAA Received	
38	310-03-TP3710	10MH737	LAA Received	
39	310-03-TP3714	10MH737	LAA Received	
40	310-03-TP3711	10MH737	LAA Received	
41	310-03-TP3713	10MH737	LAA Received	
42	310-03-TP3712	31SP118699	LAA Received	
43	310-03-TP3088	31SP118699	LAA Received	
44	310-03-TP3131	3RP233820	LAA Received	
45	310-03-CP3014	3RP233820	LAA Received	
46	310-03-BH3023	3RP233820	LAA Received	
47	310-03-CP3210	3RP233820	LAA Received	
48	310-03-BH3025	2SP260880	LAA Received	
49	310-03-CP3015	2SP260880	LAA Received	
50	310-03-BH3605	2SP260880	LAA Received	
52	310-03-CP3016	2SP260880	LAA Received	
53	310-03-BH3026	2SP260880	LAA Received	
59	310-03-BH3320	3RP7480	LAA Received	

Item	Test Site ID	Lot Plan	Access	Survey result/ exclusion
60	310-03-TP3338	3RP7480	LAA Received	
61	310-03-BH3321	3RP7480	LAA Received	
62	310-03-BH3322	3RP7480	LAA Received	
63	310-03-BH3323	3RP7480	LAA Received	
64	310-03-TP3340	3RP7480	LAA Received	
65	310-03-BH3324	3RP7480	LAA Received	
66	310-03-BH3325	3RP7480	LAA Received	
67	310-03-TP3342	3A341936	LAA Received	
68	310-03-TP3343	3A341936	LAA Received	
69	310-03-BH3326	3A341936	LAA Received	
70	310-03-TP3344	3A341936	LAA Received	
71	310-03-TP3147	62SP146089	Potential Neg	Excluded due to access
72	310-03-BH3063	62SP146089	Potential Neg	Excluded due to access
73	310-03-BH3064	61SP146089	LAA Received	
74	310-03-BH3337	21RP913044	LAA Received	
75	310-03-TP3158	21RP913044	LAA Received	
78	310-03-BH3348	1RP194766	LAA Received	
79	310-03-BH3349	2RP155499	LAA Received	
80	310-03-BH3350	2RP155499	LAA Received	
81	310-03-BH3351	863A34637	LAA Received	
82	310-03-TP3179	863A34637	LAA Received	
83	310-03-TP3180	863A34637	LAA Received	
84	310-03-TP3181	12SP228312	LAA Received	
85	310-03-BH3352	15RP36572	LAA Received	
86	310-03-BH3353	15RP36572	LAA Received	
87	310-03-TP3182	16RP36572	LAA Received	
88	310-03-TP3183	250D35274	LAA Received	
89	310-03-BH3354	250D35274	LAA Received	
90	310-03-TP3184	250D35274	LAA Received	
91	310-03-BH3355	250D35274	LAA Received	
92	310-03-TP3185	250D35274	LAA Received	
93	310-03-TP3186	2RP149961	LAA Received	
94	310-03-BH3606	2RP149961	LAA Received	
95	310-03-TP3187	2RP149961	LAA Received	
96	310-03-BH3607	2RP149961	LAA Received	
97	310-03-BH3071	2AG3200	LAA Received	
98	310-03-BH3608	2AG3200	LAA Received	
99	310-03-TP3188	2AG3200	LAA Received	
100	310-03-TP3189	5RP47487	LAA Received	
101	310-03-BH3072	5RP47487	LAA Received	

Item	Test Site ID	Lot Plan	Access	Survey result/ exclusion
102	310-03-TP3190	5RP47487	LAA Received	
103	310-03-BH3073	WR06RP48192	LAA Received	
104	310-03-BH3074	2RP48192	LAA Received	
105	310-03-TP3191	2RP48192	LAA Received	
106	310-03-BH3075	2RP48192	LAA Received	
107	310-03-BH3076	2RP48192	LAA Received	
108	310-03-TP3192	2RP48192	LAA Received	
109	310-03-BH3609	1RP48192	LAA Received	
110	310-03-TP3193	2RP48191	LAA Received	
111	310-03-BH3077	2RP48191	LAA Received	
112	310-03-TP3194	WR02RP48191	LAA Received	
113	310-03-BH3078	1RP155674	LAA Received	
114	310-03-TP3195	1RP155674	LAA Received	
115	310-03-BH3079	1RP155674	LAA Received	
116	310-03-TP3196	1RP155674	LAA Received	
117	310-03-BH3080	1RP155674	LAA Received	
118	310-03-TP3197	1RP155674	LAA Received	
119	310-03-TP3198	1RP155674	LAA Received	
120	310-03-BH3610	1RP155674	LAA Received	
121	310-03-BH3081	1RP155674	LAA Received	

Land access for access tracks clearing confirmed

Object ID	Test Site ID	Lot Plan	Access
Access tracks clearing confirmed			
4026	AT-310-03-TP3126	RD32SP126840	Open Access – road
9727	AT-310-03-TP3073	RD04SP214649	Open Access – road
4432	AT-310-03-BH3084	RD01SP285304	Open Access – road
4842	AT-310-03-TP3209	RD01SP285304	Open Access – road
7685	AT-310-03-TP3146	RD31SP256680	Open Access – road
		4RP208562	ARTC to request access
8084	AT-310-03-BH3037	6RP37102	QR access
		2RP37103	
		9RP37102	
		5RP37103	
8086	AT-310-03-CP3024	201SP124721	QR access
8911	AT-310-03-TP3802	RD02SP129536	Open Access – road
		RD01SP129536	
8913	AT-310-03-TP3072	RD04SP214649	Open Access – road
8914	AT-310-03-TP3071	RD01MH643	Open Access – road

Object ID	Test Site ID	Lot Plan	Access
Access tracks clearing confirmed			

Land access for access tracks clearing proposed

Object ID	Test Site ID	Lot Plan	Access
3224	AT-310-03-TP3501	141MH193	ARTC to request access
5644	AT-310-03-TP3085	10MH737	LAA Received
7282	AT-310-03-BH3064	61SP146089	LAA Received
		R06SP146089	Open Access – road
7654	AT-310-03-BH3324	3RP7480	LAA Received
7689	AT-310-03-BH3066	6RP212368	ARTC to request access
		RD01AG3984	Open Access – road
7691	AT-310-03-BH3158	21RP913044	LAA Received
8895	AT-310-03-TP3310	2RP37133	ARTC to request access
8905	AT-310-03-BH3073	2RP48192	LAA Received
		1RP24606	ARTC to request access
		2AG3200	LAA Received
		2RP24615	ARTC to request access
		1RP24615	ARTC to request access
		WR03RP48192	River
		RD01AG1982	Open Access – road
		RD06RP24615	Open Access – road
8919	AT-310-03-BH3614	44AG109	ARTC to request access
		RDAG109	Open Access – road
8920	AT-310-03-TP3213	44AG109	ARTC to request access
		RDAG109	Open Access – road
9713	AT-310-03-TP3196	1RP155674	LAA Received
		RD01RP24067	Open Access – road
3227	AT-310-03-CP3202	250MH270	LAA Received
		87MH16	LAA Received
3234	AT-310-03-TP3061	2SP109525	LAA Received
3235	AT-310-03-TP3062	2SP109525	LAA Received
5242	AT-310-03-TP3713	10MH737	LAA Received
5243	AT-310-03-TP3712	31SP118699	LAA Received
5640	AT-310-03-BH3010	10MH737	LAA Received
5641	AT-310-03-BH3710	10MH737	LAA Received
5643	AT-310-03-TP3714	10MH737	LAA Received