

Australia Pacific LNG Project

Volume 2: Gas Fields

Chapter 8: Terrestrial Ecology

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8. Terrestrial ecology

8.1 Introduction

8.1.1 Purpose

This chapter presents an assessment of the terrestrial ecology values of the study area and the potential impacts associated with the proposed development of the coal seam gas fields (the gas fields) and associated infrastructure, for the Australia Pacific LNG Project (the Project). It seeks to bring together existing information regarding the terrestrial ecology of the area, provide the results of field assessment and data analyses, assess potential impacts and provide an informed ecological basis for project planning and implementation with the aim of mitigating impacts and achieving ecological sustainability. The study area adopted for this assessment is illustrated in Figure 8.1.

Australia Pacific LNG's sustainability principles will be applied to the planning, design, construction and operation of the gas fields to encourage management and mitigation of any adverse impacts to ecological values across the landscape.

Of Australia Pacific LNG's 12 sustainability principles, the relevant sustainability principles to terrestrial ecology in the gas fields include:

- Minimising adverse environmental impacts and enhancing environmental benefits associated with Australia Pacific LNG's activities, products or services; conserving, protecting, and enhancing where the opportunity exists, the biodiversity values and water resources in its operational areas
- Working cooperatively with communities, governments and other stakeholders to achieve positive social and environmental outcomes, seeking partnership approaches where appropriate
- Identifying, assessing, managing, monitoring and reviewing risks to Australia Pacific LNG's workforce, its property, the environment and the communities affected by its activities.

Under these principles, sustainability will be reflected in a number of ways, from the siting of facilities in the gas fields to avoid impacts to ecological and biodiversity values, through to the identification of potential offset areas. The assessment reflects the landscape-scale perspective adopted, which promotes habitat integrity and connectivity over a broader area than that just covered by this Project.

This chapter describes the existing terrestrial ecology values that may be affected by the proposed gas fields' development in terms of:

- Terrestrial ecosystems
- Biological diversity, including habitats of rare and threatened species
- Integrity of ecological processes, including habitats of rare and threatened species and ecological communities.

The terrestrial ecology assessment was conducted by Biodiversity Assessment and Management (BAAM) and is presented in Volume 5 Attachment 14.

8.1.2 Scope of work

The Project's terms of reference presents issues to be addressed by the terrestrial ecology investigations:

- Identify key flora and fauna values of the proposed gas fields through desktop and field studies. These values include ecological and vegetation communities, flora and fauna species, fauna habitat types and movement corridors, weeds and animal pest species and other areas of ecological significance
- Identify potential impacts on these ecological features and values that may result from activities associated with the proposed gas field activities
- Identify appropriate mitigation measures to avoid and minimise potential impacts on these ecological features and values.

In simple terms, terrestrial ecology refers to those components of the living environment that occur on land, including amphibious fauna such as frogs, turtles, platypus and wetland birds.

This chapter deals specifically with the gas fields element of the Project, encompassing the Walloons coal seam gas fields (tenements) and associated infrastructure. It includes the high pressure gas pipelines that extend beyond the tenement boundaries.

8.1.3 Legislative and policy framework

Documentation of existing terrestrial ecological values of the study area has drawn upon those values recognised under relevant State and Commonwealth legislation, as well as taking account of regional planning instruments. Key components of the legislative framework include:

- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in relation to the significance of impacts on matters of national environmental significance (MNES) – in terms of terrestrial ecology, these include internationally recognised wetlands, listed threatened species and ecological communities, and listed migratory species (and their habitats)
- Queensland's *Environmental Protection Act 1994* (EP Act) in relation to listed environmentally sensitive areas within/adjacent to proposed activities
- Queensland's *Nature Conservation Act 1992* (NC Act) in relation to listed rare, near threatened, threatened, or culturally significant species (and their habitats), and protected areas such as national parks
- Queensland's *Vegetation Management Act 1999* (VMA) in relation to regional ecosystems (REs), high-value regrowth vegetation and associated essential habitat for species listed under the NC Act
- Queensland's *Land Protection (Pest and Stock Route Management) Act 2002* in relation to the management of declared pest species
- Regional Biodiversity Planning Assessments (BPAs) produced by Queensland's Department of Environment and Resource Management (DERM) in relation to areas of State or regional significance
- Queensland's Biodiversity Assessment and Mapping Methodology (BAMM) and 'back on track' species prioritisation frameworks in relation to regionally significant species.

Assessment of the viability of both threatened and non-threatened species within the landscape is addressed through consideration of environmentally sensitive areas, REs, habitat tract size, and habitat connectivity through bioregional wildlife corridors.

8.2 Methodology

8.2.1 Existing environment

The terrestrial ecological assessment of the 1,470,000ha study area is one of the largest assessments of its type undertaken in Queensland, and required the development of a unique assessment process. The methodology adopted for the assessment included:

- Desktop review of relevant data sources, including publicly available databases, and environmental mapping and planning documentation
- Comprehensive review of available literature relevant to the terrestrial ecology of the study area
- Ground surveys, including targeted searches for significant terrestrial flora and fauna species undertaken between 22 April and 8 May 2009, and subsequent surveys undertaken between 27 July to 28 September 2009 for the verification of existing vegetation mapping and associated habitat values for terrestrial flora and fauna – a total of 180 tertiary vegetation sites, 697 quaternary vegetation sites and 283 fauna habitat sites. Full details of the ground surveys are provided in Volume 5 attachment 14 Appendix A .
- Vegetation, wetland and riparian communities mapped based on existing Queensland Herbarium mapping, recent, high-resolution, aerial photography (2009), known locations of endangered, vulnerable, rare and near threatened flora, Queensland Herbarium data, and site data collected during the Project-specific field survey work (2009)
- Identification of available habitat for significant flora and fauna species based on associated vegetation communities and determined via consultation with an expert panel convened specifically for the Project.

8.2.2 Sensitivity mapping

The terrestrial ecology information was mapped to inform an ecologically sensitive infrastructure layout. A series of sensitivity maps for the study area and individual gas field tenements were developed following the detailed methodology described in Volume 5 Attachment 14 Appendix A. A revised infrastructure layout was prepared following consideration of this sensitivity mapping, subsequently forming the basis of the impact assessment as presented in Section 8.4.2.

8.2.3 Impact assessment

Impacts can be direct or indirect, varying in their potential to occur, intensity (scale) and duration and may be either positive or negative. These impacts and their species-specific consequences are assessed both as unmitigated impacts and with consideration of mitigation actions or, where mitigation may not be possible or does not completely mitigate the impact, with appropriate and practical offset actions. Impacts subsequent to the implementation of mitigation measures are referred to as residual impacts.

For the purposes of this assessment, a direct impact is any impact that affects a species/community directly, such as the removal of vegetation or the loss habitat for a species due to the Project. An indirect impact is any impact that affects a species/community indirectly, which may be as a result of ongoing edge-effects following clearing, or a direct impact on another species whose life history is interrelated with the species in question. For example, the loss of certain hollow-bearing trees may directly reduce potential sheltering and breeding sites for arboreal mammals, which in turn may reduce prey availability for a predator foraging over a large area.

The study area has varying importance for an enormous range of flora and fauna. Each community and species (or groups of communities and species) responds differently to a range of impact mechanisms. Each community and species has been assessed on the basis of an understanding of the significance of the study area for each, and the types of activities that will occur for each phase of the Project. This approach is required by the terms of reference to predict the potential impacts, as accurately as possible, on communities and species listed under State and Commonwealth legislation.

For flora, assessment of the nature and scale of impacts are assessed on the known distribution and rarity of the ecosystem and the proportion and absolute area affected, the presence or likely presence of significant species, and the likely environmental changes resulting from project activities.

For fauna, assessment of the nature and scale of predicted impacts are based on known or likely occurrence, reproductive characteristics, dispersal abilities, home range, habitat specialisation, resilience to disturbance, and mobility. The tables in Volume 5 Attachment 14 Appendix M, further clarify the impact assessment process, including definitions of impact types and scales, ranging from negligible through to major.

Prediction reliability

Predictions of impacts on known quantities, such as regional ecosystems, are reasonably straight forward and the reliability of assessment is high. Predictions on the potential impacts of poorly known or cryptic species are more difficult, and unless previous research has provided sufficient insight into the life history and distribution of these species, impact prediction reliability is based on existing evidence and expert opinion, and is allocated a low reliability.

A species whose life history is poorly known and has a prediction reliability index of low may, however, be assessed as having a residual impact assessment that is low or negligible based on the considered importance of the study area to the species. Further detail regarding the assumptions and limitations of this flora and fauna assessment is provided in Volume 5 Attachment 14.

8.3 Existing environment

This section draws together results of existing terrestrial ecology information for the study area, and results from field investigations. The overall picture is one of a highly modified landscape, through which large, remnant tracts of vegetation persist. These larger remnant areas are primarily associated with higher altitude, less fertile lands supporting ecosystems that are well-represented regionally and are mostly incorporated within the State forest network.

The more fertile, lower altitude lands are intensively grazed, with smaller, isolated patches of remnant vegetation remaining. This is a pattern repeated throughout the bioregion and is largely responsible for the endangered status of brigalow vegetation communities that formerly occupied now cleared and grazed lands. Remaining patches are subject to grazing and changed fire regimes, facilitated by the invasion of introduced pasture grasses. Fauna species reliant on these ecosystems are also affected by their fragmentation, cattle damage, and fire regimes. As a result, many of these species share the threatened status of the vegetation communities.

There are several areas that require particular attention and further investigation, specifically in locations known to support conservation significant species that are geographically restricted and, therefore, potentially more at risk from activities within the study area. Some areas identified for further investigation are:

- Riparian communities that may support the Dulacca woodland snail
- Brigalow communities that may support the brigalow woodland snail

- Extent and habitat preferences of endangered, vulnerable or rare (EVR) flora and fauna on the Gurulmundi plateau.

8.3.1 Environmentally sensitive areas

Relevant environmentally sensitive areas are defined as:

- Significant areas proclaimed under the NC Act (such as national parks), Queensland's *Forestry Act 1959* (Forestry Act) (such as state forests) and international treaties/agreements (such as Ramsar wetlands)
- Threatened ecological communities listed under the EPBC Act
- Remnant vegetation listed under the VMA
- Wetlands and riparian vegetation
- Important habitats for endangered, vulnerable, rare and near threatened flora and fauna species (including corridors).

Figure 8.1 and finer scale mapping provided in Volume 5 Attachment 14, shows the locations of currently recognised environmentally sensitive areas within the study area as mapped by DERM. No national parks are affected by the proposed gas fields and there are no wetlands of international or national significance within the gas fields' study area (refer Volume 2 Chapter 9 – Aquatic Ecology). However, there are 22 state forests, one resource reserve and one nature refuge within the study area.

Additional areas regarded as sensitive with respect to terrestrial flora and fauna are:

- Areas of high biodiversity value under DERM's Regional Biodiversity Planning Assessment (BPA) for the Brigalow Belt South (BBS) bioregion, including important local, regional and state habitat corridors which have also been adopted at the local government planning level
- Endangered ecological communities listed under the EPBC Act, REs listed under the VM Act and considered under the EP Act, important habitats for endangered, vulnerable, rare and near threatened flora species and important areas of regrowth vegetation.

All environmentally sensitive areas, incorporating those with significance at state, regional and local levels, have been incorporated into the impact assessment analysis.

8.3.2 Biodiversity planning assessment (landscape-scale values)

The study area falls within the Brigalow Belt South (BBS) bioregion, for which a BPA was initially prepared in 2002, and revised and updated in 2008 (Environmental Protection Agency (EPA) 2008a,b,c).

As Queensland Herbarium RE mapping provides the basis for much of the BPA criteria and associated mapping, the study area-scale assessment of REs undertaken for the Project replaces the need to examine the broad-scale results of the BPA. However, there are two exceptions where criteria provide useful information about broad-scale habitat value and movement opportunities for native fauna that cannot necessarily be obtained from other sources. These two criteria are:

- *Tract size*, which indicates long-term habitat viability as 'larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna' (EPA 2002)

- *Corridors*, which provide particularly useful information on broad-scale wildlife habitat, movement and dispersal opportunities.

Figure 8.2 provides a summary of the results of these two criteria for the study area. As noted in Volume 5 Attachment 14 Appendix A, all BPA results were used in the first instance to help prioritise sites included within the 2009 ground surveys, as well as determine the relative importance of terrestrial ecological values across the study area.

8.3.3 Terrestrial flora results

Existing desk top information

EPBC Act – protected matters

The EPBC Act online protected matters search tool results (Department of Environment, Water, Heritage and the Arts 2009a) indicates six threatened ecological communities and 33 terrestrial flora species of special conservation significance listed under the EPBC Act may occur within the study area. This includes two critically endangered and four endangered ecological communities, five endangered species, and 28 vulnerable species. The actual or potential occurrence of these communities and species within the study area is discussed following consideration of findings from recent ground surveys and vegetation mapping refinements.

Several wetlands of national importance occur within the Condamine-Balonne river catchment, of which two – Lake Broadwater (located 25km south-west of Dalby) and the Balonne River Floodplain complex, including the Ramsar listed Narran Lakes in the lower Balonne (approximately 500km downstream of the proposed gas fields) – are relevant to the study area. Whilst Lake Broadwater is located outside of the gas fields' tenements, a small component of the proposed Gilbert Gully gas field is located within the catchment and may be connected to the lake via the floodplain during flood periods.

While not assessed as part of this study, the ecological significance of these areas (including the provision of habitat for terrestrial species such as migratory birds) has been well documented in available literature and on the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) website. No hydrological, water quality, and/or aquatic ecological impacts on these areas have been reported from the water management studies (Volume 2 Chapter 9 – Aquatic ecology, Volume 2 Chapter 10 – Groundwater, and Volume 2 Chapter 11 – Surface water and watercourses).

The study area is also located within one of 12 Great Artesian Basin spring Supergroup complexes – specifically the Springsure Supergroup, Brigalow Belt Complex (refer to Volume 5 Attachment 17, Section 4.5.3.2). Numerous artesian springs are known to occur in the vicinity of the study area and have been assessed for potential impacts from the proposed gas fields' development (refer to Volume 2 Chapter 9 – Aquatic ecology, and Volume 2 Chapter 10 – Groundwater).

Certified mapping of remnant vegetation

Endangered regional ecosystems are protected by provisions of the *Vegetation Management Act, 1999* (VMA). A regional ecosystem (RE) is a term used by the Queensland DERM to describe relationships between major floral species and the environment at a bioregional scale.

The mapped REs cover an area of approximately 535,000ha, or around 36% of the study area. The certified RE mapping (DERM 2009a) indicates 47 REs are currently mapped as occurring within the study area, as listed in Table 8.1. This includes nine of concern REs and nine endangered REs under the VMA. Table 8.2 provides a summary of the current extent of each of the REs within the relevant provinces (or sub-regions) within areas protected under the NC Act and within the study area.

The existing certified RE mapping also indicates the study area supports approximately 15,500ha (around 1% of the study area) of essential habitat for species listed under the provisions of the NC Act. These records and the essential habitat factors assigned for each species have been considered as part of the refined assessment of habitat for significant species.

Table 8.1 Regional ecosystems within the study area identified on 1:100,000 RE mapping (DERM 2009a)

RE	Management status ¹			EPBC Act description	Short RE description (REDD ²)
	EPBC Act	VM Act	EP Act		
11.3.1	E	E	E	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	Brigalow <i>Acacia harpophylla</i> and/or belah <i>Casuarina cristata</i> open forest on alluvial plains
11.3.2	E ³	OC	OC	Weeping myall Woodlands ³	Poplar box <i>Eucalyptus populnea</i> woodland on alluvial plains
11.3.3		OC	OC		Coolibah <i>Eucalyptus coolabah</i> woodland on alluvial plains
11.3.4		OC	OC		Queensland blue gum <i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains
11.3.14		LC	NC		<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains on sandy soils
11.3.17		OC	E		Poplar box <i>Eucalyptus populnea</i> woodland with brigalow <i>Acacia harpophylla</i> and/or belah <i>Casuarina cristata</i> on alluvial plains
11.3.18		LC	NC		Poplar box <i>Eucalyptus populnea</i> , white cypress pine <i>Callitris glaucophylla</i> , bulloak <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium
11.3.19		LC	NC		White cypress pine <i>Callitris glaucophylla</i> , <i>Corymbia</i> spp., and/or silver-leaved ironbark <i>Eucalyptus melanophloia</i> woodland on Cainozoic alluvial plains
11.3.25		LC	OC		Queensland blue gum <i>Eucalyptus tereticornis</i> or river red gum <i>E. camaldulensis</i> woodland fringing drainage lines
11.3.26		LC	NC		Gum-topped box <i>Eucalyptus moluccana</i> or inland grey box <i>E. microcarpa</i> woodland to open forest on margins of alluvial plains
11.3.27b		LC	OC		Palustrine wetland

RE	Management status ¹			EPBC Act description	Short RE description (REDD ²)
	EPBC Act	VM Act	EP Act		
11.3.39		LC	NC		Silver-leaved Ironbark <i>Eucalyptus melanophloia</i> ± Baradine red gum <i>E. chloroclada</i> woodland on undulating plains and valleys with sandy soils
11.4.3	E	E	E	Brigalow (<i>A. harpophylla</i> dominant and co-dominant)	Brigalow <i>Acacia harpophylla</i> and/or belah <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains
11.4.3a	E	E	E	Brigalow (<i>A. harpophylla</i> dominant and co-dominant)	Black tea-tree <i>Melaleuca bracteata</i> woodland fringing swamp associated with brigalow <i>Acacia harpophylla</i> communities
11.4.7	E	E	E	Brigalow (<i>A. harpophylla</i> dominant and co-dominant)	Open forest to woodland of poplar box <i>Eucalyptus populnea</i> with brigalow <i>Acacia harpophylla</i> and/or belah <i>Casuarina cristata</i> on Cainozoic clay plains
11.4.10	E	E	E	Brigalow (<i>A. harpophylla</i> dominant and co-dominant)	Poplar box <i>Eucalyptus populnea</i> or narrow-leaved box <i>E. pilligaensis</i> , brigalow <i>Acacia harpophylla</i> , belah <i>Casuarina cristata</i> open forest to woodland on margins of Cainozoic clay plains
11.4.12		E	E		Poplar box <i>Eucalyptus populnea</i> woodland on Cainozoic clay plains
11.5.1		LC	NC		Narrow-leaved red ironbark <i>Eucalyptus crebra</i> , white cypress pine <i>Callitris glaucophylla</i> , smooth-barked apple <i>Angophora leiocarpa</i> , bullock <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and remnant surfaces
11.5.1a		LC	NC		Poplar box <i>Eucalyptus populnea</i> woodland with bullock <i>Allocasuarina luehmannii</i> low tree layer on Cainozoic sand plains and remnant surfaces
11.5.4		LC	NC		Narrow-leaved red ironbark <i>Eucalyptus crebra</i> , white cypress pine <i>Callitris glaucophylla</i> , black cypress pine <i>C. endlicheri</i> , Baradine red gum <i>E. chloroclada</i> , smooth-barked apple <i>Angophora leiocarpa</i> on Cainozoic sand plains and remnant surfaces on deep sands
11.5.4a		LC	NC		White cypress pine <i>Callitris glaucophylla</i> ± <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains and remnant surfaces

RE	Management status ¹			EPBC Act description	Short RE description (REDD ²)
	EPBC Act	VM Act	EP Act		
11.5.5		LC ⁴	NC		Silver-leaved ironbark <i>Eucalyptus melanophloia</i> , white cypress pine <i>Callitris glaucophylla</i> woodland on Cainozoic sand plains and remnant surfaces with deep sands
11.5.20		LC	NC		Gum-topped box <i>Eucalyptus moluccana</i> and/or inland grey box <i>E. microcarpa</i> /narrow-leaved box <i>E. pilligaensis</i> ± narrow-leaved red ironbark <i>Eucalyptus crebra</i> woodland on Cainozoic sand plains
11.5.21		LC	NC		Bloxsome's yellow bloodwood <i>Corymbia bloxsomei</i> ± white cypress pine <i>Callitris glaucophylla</i> ± narrow-leaved red ironbark <i>Eucalyptus crebra</i> ± smooth-barked apple <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and remnant surfaces
11.7.1		LC	OC		Brigalow <i>Acacia harpophylla</i> and/or belah <i>Casuarina cristata</i> and mountain yapunyah <i>Eucalyptus thozetiana</i> or inland grey box <i>E. microcarpa</i> woodland on lower scarp slopes on lateritic duricrust
11.7.2		LC	NC		<i>Acacia</i> spp. woodland on lateritic duricrust in scarp retreat zone
11.7.4		LC	NC		Gum-topped ironbark <i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., budgeroo <i>Lysicarpus angustifolius</i> on lateritic duricrust
11.7.4c		LC	NC		Gum-topped ironbark <i>Eucalyptus decorticans</i> ± <i>Eucalyptus</i> spp. ± <i>Acacia</i> spp. on low hills and ranges with shallow soils
11.7.5		LC	NC		Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks
11.7.6		LC	NC		Spotted gum <i>Corymbia citriodora</i> subsp. <i>variegata</i> or narrow-leaved red ironbark <i>Eucalyptus crebra</i> woodland on lateritic duricrust
11.7.7		LC	NC		Tall dusky-leaved ironbark <i>E. fibrosa</i> ssp. <i>nubila</i> ± <i>Corymbia</i> spp. ± <i>Eucalyptus</i> spp. on lateritic duricrust
11.8.3	E	OC	OC	SEVT of the Brigalow Belt (North and South) and Nandewar bioregions	SEVT on Cainozoic igneous rocks on steep hillsides

RE	Management status ¹			EPBC Act description	Short RE description (REDD ²)
	EPBC Act	VM Act	EP Act		
11.9.1	E	E	E	Brigalow (<i>A. harpophylla</i> dominant and co-dominant)	Brigalow <i>Acacia harpophylla</i> - Dawson gum <i>E. cambageana</i> open forest to woodland on fine-grained sedimentary rocks
11.9.4a	E	OC	E	SEVT of the Brigalow Belt (North and South) and Nandewar bioregions	SEVT on steep upper and middle slopes where heavy clay soils form
11.9.4b	E	OC	E	SEVT of the Brigalow Belt (North and South) and Nandewar bioregions	Brigalow <i>Acacia harpophylla</i> ± SEVT occurring on undulating plains and rises
11.9.5	E	E	E	Brigalow (<i>A. harpophylla</i> dominant and co-dominant)	Brigalow <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks
11.9.6	E	E	E	Brigalow (<i>A. harpophylla</i> dominant and co-dominant)	Yarran <i>Acacia melvillei</i> ± brigalow <i>Acacia harpophylla</i> open forest on fine-grained sedimentary rocks
11.9.7		OC	OC		Poplar box <i>Eucalyptus populnea</i> , false sandalwood <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks
11.9.9		LC	NC		Narrow-leaved red ironbark <i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks
11.9.10		OC	E		Brigalow <i>Acacia harpophylla</i> and poplar box <i>Eucalyptus populnea</i> open forest on fine-grained sedimentary rocks
11.10.1		LC	NC		Spotted gum <i>Corymbia citriodora subsp. variegata</i> open forest on coarse-grained sedimentary rocks
11.10.1d		LC	NC		Narrow-leaved red ironbark <i>Eucalyptus crebra</i> woodland on coarse-grained sedimentary rocks
11.10.3		LC	NC		Bendee <i>Acacia catenulata</i> or Lancewood <i>A. shirleyi</i> open forest on coarse-grained sedimentary rocks, crests and scarps

RE	Management status ¹			EPBC Act description	Short RE description (REDD ²)
	EPBC Act	VM Act	EP Act		
11.10.7		LC	NC		Narrow-leaved red ironbark <i>Eucalyptus crebra</i> woodland on coarse-grained sedimentary rocks
11.10.9		LC	NC		White cypress pine <i>Callitris glaucophylla</i> woodland on coarse-grained sedimentary rocks
11.10.11		LC	NC		Poplar box <i>Eucalyptus populnea</i> , silver-leaved ironbark <i>E. melanophloia</i> ± white cypress pine <i>Callitris glaucophylla</i> woodland on coarse-grained sedimentary rocks
11.10.13		LC	NC		<i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. open forest on scarps and sandstone tablelands

¹ Where: **E** = endangered, **OC** = of concern, **LC** = least concern, **NC** = no concern at present, * = Threshold (at risk of becoming **OC**). EP Act status is based on the 'biodiversity status' prescribed on DERM's Regional Ecosystem description database v6.

² REDD = DERM's Regional Ecosystem description database v6.

³ Only where weeping myall *Acacia pendula* occurs.

⁴ 'Threshold' REs at risk of the remnant extent falling below 30% of its pre-clearing extent, or having a remnant extent of less than 10,000ha (DERM 2009b).

Table 8.2 Extent of regional ecosystems within the relevant provinces and study area identified on 1:100,000 RE mapping (DERM 2009a)

RE	Management status ¹			Total current extent in relevant provinces ^{2,3}		Extent protected under the NC Act in relevant provinces ^{2,3,4}	Extent in study area ⁵	Extent in tenements ⁵
	EPBC Act	VMA	EP Act	Ha (% of pre-clearing extent)	Ha (% of total current extent)	Status within the relevant provinces context ⁶	Ha (% of total current extent)	Ha (% of total current extent)
11.3.1	E	E	E	3111 (2.30)	1 (0.03)	E	564 (18.12)	187 (6.01)
11.3.2	E ⁷	OC	OC	167893 (20.03)	1207 (0.72)	OC	12458 (7.42)	4498 (2.68)
11.3.3		OC	OC	11335 (12.30)	0 (0.00)	OC	761 (6.72)	292 (2.58)
11.3.4		OC	OC	14666 (14.96)	43 (0.29)	OC	2424 (16.53)	755 (5.15)
11.3.14		LC	NC	60647 (82.29)	0 (0.00)	LC	10703 (17.65)	8315 (13.71)
11.3.17		OC	E	4347 (6.01)	0 (0.00)	E	81 (1.87)	37 (0.85)
11.3.18		LC	NC	30093 (42.08)	2102 (6.99)	LC	3080 (10.23)	1112 (3.7)
11.3.19		LC	NC	29242 (50.59)	0 (0.00)	LC	1771 (6.06)	10 (0.03)
11.3.25		LC	OC	111637 (56.94)	221 (0.20)	LC	21203 (18.99)	8655 (7.75)
11.3.26		LC	NC	13261 (43.36)	0 (0.00)	LC	83 (0.62)	2 (0.01)
11.3.27b		LC	OC	3153 (55.16)	442 (14.02)	LC	45 (1.42)	n/a ⁹
11.3.39		LC	NC	11121 (50.05)	422 (3.79)	LC	889 (7.99)	n/a ⁹
11.4.3/11.4.3a	E	E	E	32277 (4.78)	768 (2.38)	E	3733 (11.57)	1371 (4.25)
11.4.7	E	E	E	3063 (16.22)	130 (4.24)	OC	256 (8.37)	41 (1.33)
11.4.10	E	E	E	1589 (6.52)	0 (0.00)	E	59 (3.70)	36 (2.29)

RE	Management status ¹			Total current extent in relevant provinces ^{2,3}		Extent protected under the NC Act in relevant provinces ^{2,3,4}	Extent in study area ⁵	Extent in tenements ⁵
	EPBC Act	VMA	EP Act	Ha (% of pre-clearing extent)	Ha (% of total current extent)	Status within the relevant provinces context ⁶	Ha (% of total current extent)	Ha (% of total current extent)
11.4.12		E	E	4337 (8.65)	0 (0.00)	E	1099 (25.33)	606 (13.98)
11.5.1/11.5.1a		LC	NC	440592 (63.19)	46 (0.01)	LC	165792 (37.63)	81587 (18.52)
11.5.4/11.5.4a		LC	NC	85052 (83.24)	1677 (1.97)	LC	29230 (34.37)	16590 (19.51)
11.5.5		LC ⁸	NC	83461 (39.16)	77 (0.09)	LC	17912 (21.46)	5530 (6.63)
11.5.20		LC	NC	82777 (65.10)	240 (0.29)	LC	15377 (18.58)	4346 (5.25)
11.5.21		LC	NC	72026 (94.21)	0 (0.00)	LC	4014 (5.57)	2 (<0.01)
11.7.1		LC	OC	39923 (32.90)	1740 (4.36)	LC	2281 (5.71)	930 (2.33)
11.7.2		LC	NC	34901 (46.82)	0 (0.00)	LC	9899 (28.36)	6134 (17.58)
11.7.4/11.7.4c		LC	NC	174688 (69.32)	1197 (0.69)	LC	70810 (40.53)	24492 (14.02)
11.7.5		LC	NC	52009 (86.83)	920 (1.77)	LC	14820 (28.49)	3465 (6.66)
11.7.6		LC	NC	178711 (86.13)	554 (0.31)	LC	23492 (13.15)	3507 (1.96)
11.7.7		LC	NC	164202 (86.28)	133 (0.08)	LC	50551 (30.79)	24918 (15.17)
11.8.3	E	OC	OC	11033 (26.16)	1956 (17.73)	OC	8 (0.07)	n/a ⁹
11.9.1	E	E	E	3893 (4.66)	0 (0.00)	E	7 (0.18)	n/a ⁹
11.9.4a/11.9.4b	E	OC	E	11043 (16.84)	32 (0.29)	OC	1433 (12.97)	177 (1.61)
11.9.5	E	E	E	76647 (5.27)	1091 (1.42)	E	9738 (12.70)	3898 (5.09)
11.9.6	E	E	E	371 (2.42)	0 (0.00)	E	117 (31.66)	n/a ⁹

RE	Management status ¹			Total current extent in relevant provinces ^{2,3}		Extent protected under the NC Act in relevant provinces ^{2,3,4}	Extent in study area ⁵	Extent in tenements ⁵
	EPBC Act	VMA	EP Act	Ha (% of pre-clearing extent)	Ha (% of total current extent)	Status within the relevant provinces context ⁶	Ha (% of total current extent)	Ha (% of total current extent)
11.9.7		OC	OC	53614(14.63)	0 (0.00)	OC	1819 (3.39)	82 (0.15)
11.9.9		LC	NC	31101 (37.41)	107 (0.34)	LC	758 (2.44)	n/a ⁹
11.9.10		OC	E	50454 (12.96)	2470 (4.90)	OC	2600 (5.15)	1025 (2.03)
11.10.1/11.10.1d		LC	NC	134467 (74.90)	233 (0.17)	LC	30447 (22.64)	3200 (2.38)
11.10.3		LC	NC	72013 (97.58)	15559 (21.61)	LC	149 (0.21)	n/a ⁹
11.10.7		LC	NC	123880 (84.23)	3127 (2.52)	LC	2752 (2.22)	n/a ⁹
11.10.9		LC	NC	86194 (54.43)	840 (0.97)	LC	14934 (17.33)	6988 (8.11)
11.10.11		LC	NC	123513 (45.86)	8081 (6.54)	LC	6788 (5.5)	2472 (2.00)
11.10.13		LC	NC	186936 (98.48)	53392 (28.56)	LC	208 (0.11)	n/a ⁹

¹ Where: **E** = endangered, **OC** = of concern, **LC** = least concern, **NC** = no concern at present. 'EP Act' status is based on the 'biodiversity status' prescribed on DERM's Regional Ecosystem description database v6.

² 'Relevant Provinces' includes provinces 25, 26, 27, 28, 30, 31 and 32 of the BBS bioregion, except REs 11.10.3, 11.10.7, and 11.10.13 (for which the Relevant Province is province 24).

³ Based on data from EPA (2008d). Data is only available for each RE as a whole, not for individual subsets (for example, for 11.4.3, not for 11.4.3a).

⁴ Areas protected under the NC Act include National Parks, Conservation Parks, Forest Reserves, Resource Reserves, and Nature Refuges, based on data from EPA (2008d).

⁵ Based on GIS analysis of certified 1:100,000 RE mapping (DERM 2009a).

⁶ Based on the VMA status criteria, where: **E** = <10% of pre-clearing extent remains, **OC** = 10-30% of pre-clearing extent remains, and **LC** = >30% of pre-clearing extent remains.

⁷ Only where weeping myall *Acacia pendula* occurs.

⁸ 'Threshold' REs at risk of the remnant extent falling below 30% of its pre-clearing extent, or having a remnant extent of less than 10,000ha (DERM 2009b).

⁹ REs not mapped within the gas field tenements.

Existing vegetation communities overview

The certified mapping suggests by far the most widespread remnant vegetation communities within the study area are open forest and woodland communities occurring on poor sandy soils (land zones 10 and 5) and characterised by the dominance of narrow-leaved red ironbark *Eucalyptus crebra*, spotted gum *Corymbia citriodora* subsp. *variegata*, poplar box *E. populnea*, silver-leaved ironbark *E. melanophloia*, inland grey box *E. microcarpa* or narrow-leaved box *E. pilligaensis*, bulloak *Allocasuarina luehmannii* or white cypress pine *Callitris glaucophylla*. Soil types within the study area are described in Volume 2 Chapter 5.

Interspersed between these sandy soils are low hills and ranges with shallow sandy soils (land zone 7) upon which eucalypt woodlands and open forests are dominated by narrow-leaved red ironbark, gum-topped ironbark *Eucalyptus decorticans*, brown bloodwood *Corymbia trachyphloia*, and white cypress pine, or dusky-leaved ironbark *Eucalyptus fibrosa* subsp. *nubila* and lemon-scented spotted gum/narrow-leaved red ironbark. Most of these large tracts of woodland and open forest are located in state forests where they are retained for white cypress pine, lemon-scented spotted gum, and ironbark timbers.

The entire study area is dissected by creek systems with associated alluvial soils (land zone 3) that support open forests of Queensland blue gum *Eucalyptus tereticornis*, river red gum *E. camaldulensis*, rough-barked apple *Angophora floribunda* and smooth-barked apple *A. leiocarpa*, while associated plains dominated by poplar box and silver-leaved ironbark occur in less frequently inundated and often fringing areas. These communities have often been retained as a vegetated riparian corridor through cleared agricultural land.

Much of the remaining land is characterised by largely level to gently undulating plains created by weathering of fine-grained sedimentary rocks (land zone 9), clay deposits (land zone 4) or igneous rocks (land zone 8). These give rise to fertile soils that dominate much of the flatter, low-lying landscape and are predominantly cleared for agriculture. Where uncleared, these soils support the remaining patches of threatened communities such as brigalow *Acacia harpophylla* – belah *Casuarina cristata* open forest, poplar box open forest and, rarely, semi-evergreen vine thicket (SEVT).

The rarest communities within the study area include open-forest to woodland of Dawson gum *Eucalyptus cambageana* or mountain yapunyah *E. thozetiana* and brigalow (RE 11.9.1), and SEVT on igneous rocks (RE 11.8.3), which cover only 7ha and 8ha, respectively.

Only 6% of the pre-clearing extent of poplar box woodland with brigalow and/or belah on alluvial plains (RE 11.3.17) remains within the relevant provinces, which equates to an endangered status at this scale and which is exacerbated by a lack of representation of this community within areas protected under the NC Act (such as national parks). Stands of gum-topped box *Eucalyptus moluccana* or inland grey box woodland to open forest on margins of alluvial plains (RE 11.3.26) are also underrepresented (83ha) and unprotected under the NC Act within the relevant provinces.

The mapping also reflects the dry character of the local landscape, with only 45ha of freshwater wetland communities (RE 11.3.27) recognised within the study area.

Vegetation community status

Nine of the REs mapped within the study area have an of concern management status and nine have an endangered management status under the provisions of the VMA, based on an assessment of the remaining extent of each RE compared to its pre-clearing extent.

The biodiversity status of an RE is based on an assessment of the condition of remnant vegetation in addition to its pre-clearing and remnant extent, and takes into account threatening processes other

than clearing. According to the Regional Ecosystem Description Database, three of the REs in Table 8.1 with a least concern management status under the VMA have an 'of concern' biodiversity status, while four of the REs with an of concern management status under the VMA have an endangered biodiversity status. Table 8.2 indicates all of the remnant vegetation communities within the study area are poorly conserved within areas protected under the NC Act.

Certified mapping of high-value regrowth vegetation

On 7 October 2009, the Queensland Government's moratorium on clearing high-value regrowth vegetation was replaced by new regulations protecting vital regrowth and its high biodiversity values. According to the new laws, high-value regrowth vegetation is mature native vegetation that hasn't been cleared since 31 December 1989, but which is not currently recognised as remnant vegetation.

High-value regrowth vegetation currently mapped for the study area is included on the certified RE mapping in Volume 5 Attachment 14. A refined assessment of regrowth vegetation has been undertaken for this Project based on the results of the 2009 ground surveys and the subsequent mapping exercise.

Existing significant species data

A search of database records (DERM 2009c,d) and a review of unpublished data (Craig Eddie pers. comm.) indicates that at least 49 terrestrial flora species of special conservation significance have been previously recorded within the study area, including 20 species listed as threatened under the EPBC Act, 38 listed as EVR or near threatened species under the NC Act and eight listed as non-EVR priority species for the BBS bioregion (EPA 2008b).

The results of the desktop assessment are presented in Volume 5 Attachment 14 Appendix H.

Field assessment results - flora

Vegetation communities

This section describes terrestrial flora communities and species recorded during the 2009 ground surveys (Section 8.2.1), or considered likely to occur based on the findings of the surveys (refer to Figure 8.3 to Figure 8.5).

Major differences between the refined vegetation mapping layer and the certified 1:100,000 RE mapping (Version 6) are as follows:

- Approximately 36,000 additional hectares of remnant vegetation were mapped, representing an increase of 7%
- Riparian areas mapped as REs 11.3.2, 11.3.14, and 11.3.25 have increased by 18%, 18% and 17%, respectively. These increases are a direct result of increased mapping scale leading to the mapping of vegetation communities previously too narrow to be mapped under 1:100,000 mapping rules (Neldner et al. 2005)
- Increase in REs 11.3.1, 11.4.3, 11.9.7, and 11.9.10 by 20-40% is the result of mapping stands and shade lines of brigalow and poplar box previously too small to be mapped under 1:100,000 mapping rules (Neldner et al. 2005)
- Increase in RE 11.7.2 by 75% is the result of mapping stands and shade lines of lancewood *Acacia shirleyi* previously too small to be mapped under 1:100,000 mapping rules, as well as the ability to detect photo pattern associated with this community under larger scale recent aerial photography taken for this study (Neldner et al. 2005)

- Rock pavements (RE 11.7.5) were often previously mapped as non-remnant, disturbed areas. Relation of photo-pattern to on-ground assessments allowed more accurate interpretation of larger scale recent aerial photographs and the subsequent identification of 33% more area of this RE
- SEVT (11.9.4a) not previously mapped was delineated by relation of photo-pattern to on-ground assessments allowing more accurate-interpretation of larger scale recent aerial photographs and the subsequent identification of approximately 150% more of this nationally endangered community.

Terrestrial vegetation communities of special conservation significance

The refined vegetation mapping exercise indicates 21 terrestrial vegetation communities of special conservation significance occur within the study area. Twelve are treated as (or, in the case of RE 11.3.2, potentially treated as) endangered ecological communities under the EPBC Act. Thirteen and nine are listed as endangered according to biodiversity status and VMA status, respectively, and eight and nine are listed as of concern according to biodiversity status and VMA status, respectively. As noted in Table 8.1, one additional RE (11.5.5) listed as least concern under the VMA is considered to be at risk of becoming of concern, while RE 11.3.17 can be considered locally endangered based on its remaining extent within the relevant provinces.

Detailed profiles for communities of special conservation significance are provided on the DEWHA website for threatened ecological communities listed under the EPBC Act and on the DERM website for REs.

The distribution of more noteworthy significant communities within the study area is described below.

Brigalow (REs 11.3.1, 11.4.3, 11.4.7, 11.4.10, 11.9.1, 11.9.5, 11.9.6)

Status: endangered (EPBC Act, biodiversity status and VMA).

Brigalow communities occur across the majority of the study area, although past clearing has resulted in much of these being confined to narrow shade lines and small shade stands less than 1ha in size or associated with riparian communities on minor creeks.

Areas where these stands are more common include areas north of the Condamine River, Wieambilla Creek, and north of Condamine within the Talinga tenement, north of Moraby Creek, along Drillham Creek, and north of Ulimora within the Carinya tenement and Weir River within the Gilbert Gully tenement. One notably large patch of brigalow occurs within the heart of Combabula State Forest, while some sizeable patches also occur around and within Woodduck State Forest.

Semi-evergreen vine thicket (REs 11.8.3 and 11.9.4)

Status: RE 11.8.3 endangered (EPBC Act) and of concern (biodiversity status and VMA); RE 11.9.4 endangered (EPBC Act and biodiversity status) and of concern (VMA).

The larger patches of SEVT known to occur within the study area are located within the southern section of the Woleebee tenement, along north facing slopes of the Gurulmundi plateau and at Fairview in the extreme northwest of the study area. Other areas include shade lines within the north-eastern section of the Combabula tenement, three patches within the eastern part of the Talinga tenement, and some patches within the eastern portion of the Kainama tenement. Many of the patches within the Woleebee tenement are in good condition and, while much of those within the Combabula tenement are affected by cattle trampling and grazing, all are relatively free from weeds.

Weeping myall (included within RE 11.3.2)

Status: RE 11.3.2 endangered where weeping myall occurs (EPBC Act) and of concern (biodiversity status and VMA).

Weeping myall *Acacia pendula* is not listed as a rare, near threatened or threatened species under State or Commonwealth legislation. However, certain woodland communities of the Darling Riverine Plains and BBS bioregions in which it occurs as the dominant canopy species (including RE 11.3.2) are considered endangered ecological communities under the EPBC Act. Only two small areas of weeping myall were located during the 2009 ground surveys – one within the south-western corner of the Carinya tenement and the other toward the centre of the Combabula tenement. In both cases, the community is located within road reserves. Weeping myall commonly occurs within other communities on alluvial soils and may occur in densities consistent with the nationally endangered community in other places within the study area (that is, within RE 11.3.2).

Rock pavements (RE 11.7.5)

Status: no concern at present (biodiversity status) and least concern (VMA).

As noted in Table 8.1, RE 11.7.5 represents vegetation communities occurring on natural scalds. These communities are dominated by low microphyll shrubs (heath) contained within large expanses of open forest (land zone 7) and woodland distributed across the greater Gurulmundi area, including the wildflower areas of Gurulmundi State Forest. Other, smaller patches occur within Condamine State Forest and other expanses of open forest (land zone 7) and woodland across the study area. These scalds are habitat for locally endemic species such as *Calytrix gurulmundensis*, *Micromyrtus carinata*, *Acacia curranii* and possibly *Philothea sporadica* (which may also occur in other habitats at times).

Black box (11.3.16)

Status: no concern at present (biodiversity status) and least concern (VMA).

A community of black box *Eucalyptus largiflorens* woodland exists along the floodplain of Sandy Creek at Talinga, which represents the northernmost known population of this community in Australia (confirmed by the Queensland Herbarium). Although there are reasonably extensive stands of this species along the Moonie, Culgoa, and Paroo Rivers, it is certainly a range restricted species in Queensland and the Talinga population is of regional, if not State, significance.

Terrestrial flora species of special conservation significance

Based on the results of the subsequent literature review, expert opinion and recent ground surveys, 36 flora species of special conservation significance are known or considered possible occurrences within the study area, as detailed in Volume 5 Attachment 14 Appendix J. This includes 16 species listed as threatened under the EPBC Act, 26 listed as EVR or near threatened species under the NC Act, and seven listed as non-EVR priority species for the BBS bioregion under the Biodiversity Assessment and Mapping Methodology (EPA 2008b).

Two species are of special note due to their highly restricted distribution: *Calytrix gurulmundensis* and *Micromyrtus carinata* are generally restricted to the rock pavements (scalds) of the Gurulmundi Plateau. Populations of *Calytrix gurulmundensis* also occur at Barakula State Forest and *Micromyrtus carinata* is present within the Dalwogan tenement (DERM 2009e).

The highly restricted distribution and high habitat specificity of these species means their long-term viability is highly susceptible to disturbance. A significant proportion of the known range of *Philothea sporadica* (i.e. primarily in Gilbert Gully) is located within the study area, while the majority of the known distribution of *Acacia curranii* within Queensland is located within the study area.

Table 8.3 lists those species identified during the initial desktop assessment and their likelihood of occurrence based on RE/habitat preference.

Table 8.3 Summary of the likelihood of occurrence of terrestrial flora species of special conservation significance within the study area¹

Family	Species name	Common name	Management status ²		
			EPBC Act	NC Act	BAMM
Species known to occur within the study area					
(species in bold were detected during the 2009 ground surveys)					
Asteraceae	<i>Rutidosia lanata</i>	Red-soil woolly wrinklewort		E	
Caesalpiniaceae	<i>Senna acclinis</i>	Rainforest cassia		R	
Cyperaceae	<i>Cyperus clarus</i>	Bright flat-sedge		V	
Cyperaceae	<i>Eleocharis blakeana</i>	Blake's spikerush		R	
Haloragaceae	<i>Gonocarpus urceolatus</i>	Gonocarpus		V	
Mimosaceae	<i>Acacia chinchillensis</i>	Chinchilla wattle	V	NT	
Mimosaceae	<i>Acacia lauta</i>	Tara wattle	V	V	
Mimosaceae	<i>Acacia melvillei</i>	Yarran		C	X
Mimosaceae	<i>Acacia microsperma</i>	Bowyakka		C	X
Mimosaceae	<i>Acacia omalophylla</i>	Yarran wattle		C	X
Mimosaceae	<i>Acacia spania</i>	Western rosewood		R	
Mimosaceae	<i>Acacia tenuinervis</i>	Scrub wattle		R	
Mimosaceae	<i>Acacia wardellii</i>	Thomby Range wattle	V	V	
Myrtaceae	<i>Calytrix gurlmundensis</i>	Gurulmundi fringe myrtle	V	V	
Myrtaceae	<i>Melaleuca irbyana</i>	Swamp tea-tree		R	
Myrtaceae	<i>Micromyrtus carinata</i>	Gurulmundi heath-myrtle		E	
Orchidaceae	<i>Diuris tricolor</i>	Pink donkey-orchid	V	C	
Orchidaceae	<i>Pterostylis cobarensis</i>	Cobar greenhood orchid	V	C	
Poaceae	<i>Homopholis belsonii</i>	Belson's panic grass	V	E	
Rutaceae	<i>Philotheca sporadica</i>	A waxflower	V	V	
Solanaceae	<i>Solanum stenopterum</i>	Winged nightshade		V	
Surianaceae	<i>Cadellia pentastylis</i>	Ooline	V	V	
Species that possibly occur within the study area					
Acanthaceae	<i>Xerothamnella herbacea</i>	Herbaceous xerothamnella	E	E	
Apocynaceae	<i>Tylophora linearis</i>	Slender tylophora	E	E	

Family	Species name	Common name	Management status ²		
			EPBC Act	NC Act	BAMM
Asteraceae	<i>Picris barbarorum</i>	Plains picris		C	X
Cyperaceae	<i>Fimbristylis vagans</i>	Wandering fringe-rush		R	
Lamiaceae	<i>Prostanthera sp. Dunmore</i>	Dunmore mint-bush	V	V	
Mimosaceae	<i>Acacia curranii</i>	Curly-barked wattle	V	V	
Myrtaceae	<i>Eucalyptus curtisii</i>	Plunkett mallee		R	
Myrtaceae	<i>Eucalyptus rhombica</i>	Diamond-fruited ironbark		C	X
Myrtaceae	<i>Eucalyptus suffulgens</i>	Shiny-leaved grey ironbark		C	X
Myrtaceae	<i>Eucalyptus virens</i>	Shiny-leaved ironbark	V	V	
Myrtaceae	<i>Eucalyptus viridis</i>	Green mallee		C	X
Rhamnaceae	<i>Cryptandra ciliata</i>	Silky cryptandra		R	
Scrophulariaceae	<i>Microcarpaea agonis</i>	Microcarpaea	E	E	
Zamiaceae	<i>Macrozamia fearnsidei</i>	Central Queensland zamia palm	V	C	

¹ A detailed account of potential occurrence is provided in Table J.1 in Volume 5 Attachment 14 Appendix J.

² Status abbreviations are as follows: **E** = endangered, **V** = vulnerable, **R** = rare, **NT** = near threatened, **C** = least concern wildlife, **X** = non-EVR priority species for the BBS bioregion.

Important habitat for significant flora species

Expert panel advice combined with research into the habitat requirements for significant flora species has revealed certain REs provide potential habitat for large numbers of significant flora species, including REs 11.7.4 (which provides potential habitat for 17 species), 11.4.3 (nine species), 11.4.7, 11.7.6, 11.7.7, 11.9.5 (all eight species), 11.9.4a (seven species) and 11.7.5 (six species). The particular habitat values of these REs have been identified as part of the relative value/sensitivity assessment and levels of protection afforded them within the sensitivity model (Volume 5 Attachment 14 Appendix A).

The value of regrowth to significant flora species

The term regrowth applies to native vegetation at many stages of community development, ranging from very sparse low shrubs to nearly remnant tall open forest with structural complexity, leaf litter, and woody debris and many niches for threatened flora and fauna species. In general, most regrowth lacks the structure and physical conditions of remnant vegetation and therefore infrequently provides adequate habitat features required to support significant flora species.

Nonetheless, non-remnant or disturbed vegetation areas can provide effective habitat for flora and fauna and there are substantial areas of it within the BBS bioregion, including approximately 37,675ha within the study area alone as shown on the refined vegetation mapping in Volume 5 Attachment 14 Appendix I. The value of regrowth to fauna species is further discussed in Section 8.5.2.

Wetlands and riparian corridors

Wetlands and riparian corridors are inherently higher in biodiversity than the surrounding landscape and provide water for many flora and fauna species inhabiting specialist habitats characterised by permanent/semi-permanent surface water. The distribution of wetlands and waterbodies are shown on the revised vegetation mapping in Volume 5 Attachment 14 Appendix I.

Wetland areas include 'flooded paddocks' (predominantly restricted to the flood plain for the Condamine River), natural in-stream waterbodies (the majority of which occur within the bed and banks of the Condamine and Balonne Rivers and Wilkie Creek) and a number of man-made waterbodies across the landscape.

Descriptions of vegetated riparian corridors are summarised for each tenement in Table 8.4 Further discussion on fauna movement corridors across the study area are provided in Section 8.3.4.

Table 8.4 Summary of vegetated riparian corridors within each tenement

Tenement	Vegetated riparian corridors
Gilbert Gully	Several small creek lines, namely Scrubby, Western, Bulli, and Waggaba Creeks, flow west across the tenement into Weir River. These creeks are well vegetated with wide riparian corridors and buffering vegetation. Riparian vegetation communities include REs 11.3.14, 11.3.18, 11.3.25 and 11.3.2.
Kainama	Kogan Creek flows north-south, bisecting the tenement. The riparian areas of this creek are well vegetated and well buffered by surrounding remnant vegetation. Characteristic riparian vegetation communities are REs 11.3.2 and 11.3.18.
Talinga/Orana	<p>The Condamine – Balonne flows east-west through the middle of this tenement and is the largest river system within the study area. Many of its floodplains have been cleared for agriculture, although the remaining narrow riparian area is continuous and well vegetated. The dominant riparian vegetation communities include REs 11.3.25, 11.3.4 11.3.3 and 11.3.1.</p> <p>Wieambilla Creek is another of the major creeks running through the tenement, flowing in a north-westerly direction. Its riparian areas are less well vegetated and not well buffered by native vegetation communities. The major riparian vegetation communities in order of dominance are REs 11.3.4, 11.3.2, 11.3.14 and 11.3.3.</p> <p>Sandy Creek crosses the far north-western corner of the tenement. A portion of this creek is vegetated by the riparian community RE 11.3.16 (<i>Eucalyptus largiflorens</i> woodland), a community discussed previously as being the most northerly example of this vegetation community in Queensland.</p>
Condabri	<p>Dogwood Creek passes in an east-west direction across the top of this tenement. Some of its riparian areas are well vegetated, whilst other areas are regrowing. Dominant vegetation includes REs 11.3.25 and 11.3.2.</p> <p>The Condamine – Balonne flows east-west through the southern part of the tenement. Its riparian areas are dominated by REs 11.3.25 and 11.3.3. The narrow riparian areas are well vegetated although not well buffered by remnant vegetation.</p>
Dalwogan	Wallan Creek runs in a north-south direction through this tenement. Its riparian areas are buffered to some degree by the vegetation of Gurulmundi State Forest along its western banks. Much of the flat alluvial areas have been cleared, including some riparian vegetation, making the riparian corridor narrow and disjunct. Remaining riparian areas are dominated by REs 11.3.25 and 11.3.2.

Tenement	Vegetated riparian corridors
Woleebee	Wandoan Creek runs south-north through the central-western portion of this tenement. This major creek has a narrow riparian strip not buffered by other terrestrial vegetation. Parts of this riparian corridor are highly disturbed and patchy. The riparian vegetation is dominated by REs 11.3.25, 11.3.19 and 11.3.2.
Carinya	<p>Tchanning Creek runs north-south through this tenement. This major creek is well vegetated and buffered by vegetation in the upper reaches. The middle and lower reaches are poorly vegetated within the riparian areas, with thin and patchy regrowth. Riparian vegetation is dominated by REs 11.3.25, 11.3.2 and 11.3.18.</p> <p>Dulacca and Drillham Creeks in the south of the tenement are poorly buffered by remnant vegetation, while remaining riparian vegetation is thin, degraded, and disjunct. Where present, riparian vegetation is dominated by REs 11.3.25, 11.3.18 and patches of 11.9.5 (brigalow open forest).</p>
Combabula/ Ramyard	<p>Three minor creeks lines flow south-north through the top of this tenement, but are not buffered by any surrounding remnant vegetation. The very narrow riparian areas are sparse and disjunct, including REs 11.3.25, 11.3.2 and patches of 11.9.5.</p> <p>Yuleba Creek flows in a north-south direction through the southern section of the tenement. In general, this creek is well buffered by surrounding remnant vegetation and riparian communities are substantially complete. The latter are dominated by REs 11.3.25, 11.3.2 and patches of 11.9.5.</p>

Weeds

The ground surveys (2009) identified the presence of 19 exotic plant species within the study area. No weed of national significance was recorded, although seven of the 19 exotic species are declared under the Queensland *Land Protection (Land and Stock Route Management) Act 2002*, and 15 are recognised environmental weeds.

Database searches and non-public data identified a further 181 non-native species as being present within the study area, of which nine species are listed under the Act (Volume 5 Attachment 17, Table 2.9). Of these, lantana *Lantana camara*, parkinsonia *Parkinsonia aculeata*, and parthenium *Parthenium hysterophorus* are also recognised weeds of national significance. Parthenium is subject to current control within an isolated area of the Talinga tenement (Craig Eddie pers. comm.).

Although no weeds have been observed to be preventing regeneration on a large scale at present, some species are potentially problematic given the nature of the proposed activities (particularly clearing and introduction/spread during construction). Those species of particular note are:

- Mother of millions *Bryophyllum delagoense* (and hybrids)
- Prickly pear species (*Opuntia stricta* and *O. tomentosa*)
- Parthenium *Parthenium hysterophorus*
- African boxthorn *Lycium ferocissimum*
- Exotic pasture grasses (specifically green panic *Megathyrsus maximus*, buffel grass *Pennisetum ciliare* and African lovegrass *Eragrostis curvula*)
- Spiny burrgrass *Cenchrus incertus*
- Crownbeard *Verbesina encelioides*

- Snake cotton *Froelichia floridana*
- Lippia *Phyla canescens*
- Tiger pear *Opuntia aurantiaca*
- Harissia cactus *Harrisia martini*

Weeds identified within the study area are listed in Volume 5 Attachment 14, Table 2.9, along with an indication of potential RE preference within the study area based on field observations.

8.3.4 Terrestrial fauna results

Desktop assessment

A predictive database search indicated that 20 terrestrial fauna species listed as threatened and 17 species listed as Migratory under the EPBC Act may occur within the study area. State and private databases identify 108 fauna species of special conservation significance previously recorded within the study area or its surrounds, including 46 species listed as threatened and/or Migratory under the EPBC Act, 37 listed as EVR or near threatened species under the NC Act, 42 listed as non-EVR priority species for the BBS bioregion and one species listed as extinct (DERM 2009c,d; Queensland Museum 2009; Birds Australia 2009; EPA 2008a).

Details of the literature review and database searches can be found in Volume 5 Attachment 14.

Field assessment results – fauna

Following field survey and expert review, 99 species of special conservation significance are known or considered possible occurrences within the study area, including 15 species listed (or pending listing) as threatened and 28 species listed as Migratory under the EPBC Act, 32 listed as EVR or near threatened species under the NC Act and 38 listed as non-EVR priority species for the BBS bioregion.

Significant species records obtained during the recent ground surveys are indicated in bold in Table 8.5. This table also lists those species identified from the desktop assessment (including some from outside the study area) that are not expected to occur, based on RE/habitat preference or a lack of actual records.

Detailed profiles for the remaining terrestrial fauna species of special conservation significance known or considered possible occurrences within the study area are provided in the references listed in Volume 5 Attachment 14 Appendix J.

Table 8.5 Summary of likelihood of occurrence of terrestrial fauna species of special conservation significance within the study area¹

Class	Species name	Common name	Management status ²		
			EPBC Act	NC Act	BAMM
Species known to occur within the study area					
(species in bold were detected during the 2009 ground surveys)					
Gastropoda	In preparation ³	Dulacca woodland snail	E ⁵		
		Camaenidae BL 12 ⁴			
Gastropoda	In preparation ³	Brigalow woodland snail	CE ⁶		
		Camaenidae BL 13 ⁴			
Insecta	<i>Jalmenus eubulus</i>	Pale imperial hairstreak		V	
Amphibia	<i>Limnodynastes salmini</i>	Salmon-striped frog		C	x
Amphibia	<i>Cyclorana verrucosa</i>	Rough frog		R	
Reptilia	<i>Emydura macquarii</i>	Macquarie turtle		C	x
Reptilia	<i>Macrochelodina expansa</i>	Broad-shelled turtle		C	x
Reptilia	<i>Strophurus taenicauda</i>	Golden-tailed gecko		NT	
Reptilia	<i>Delma plebeia</i>	Leaden delma		C	x
Reptilia	<i>Delma torquata</i>	Adorned (collared) delma ⁷	V	V	
Reptilia	<i>Paradelma orientalis</i>	Brigalow scaly-foot	V	V	
Reptilia	<i>Ctenotus ingrami</i>	Unspotted yellow-sided ctenotus		C	x
Reptilia	<i>Cyclodomorphus gerrardii</i>	Pink-tongued skink		C	x
Reptilia	<i>Egernia rugosa</i>	Yakka skink	V	V	
Reptilia	<i>Tiliqua rugosa</i>	Shingle-back		C	x
Reptilia	<i>Chlamydosaurus kingii</i>	Frilled lizard		C	x
Reptilia	<i>Physignathus lesueurii</i>	Eastern water dragon		C	x
Reptilia	<i>Varanus panoptes</i>	Yellow-spotted monitor		C	x
Reptilia	<i>Aspidites ramsayi</i>	Woma ⁷		R	
Reptilia	<i>Acanthophis antarcticus</i>	Common death adder		R	
Reptilia	<i>Cryptophis boschmai</i>	Carpentaria snake		C	x
Reptilia	<i>Furina dunmalli</i>	Dunmall's snake	V	V	

Class	Species name	Common name	Management status ²		
			EPBC Act	NC Act	BAMM
Reptilia	<i>Hemiaspis damelii</i>	Grey snake		E	
Reptilia	<i>Hoplocephalus bitorquatus</i>	Pale-headed snake		C	x
Reptilia	<i>Pseudechis guttatus</i>	Spotted black snake		C	x
Aves	<i>Stictonetta naevosa</i>	Freckled duck		R	
Aves	<i>Nettapus coromandelianus</i>	Cotton pygmy-goose	M	R	
Aves	<i>Geophaps scripta scripta</i>	Squatter pigeon (southern subspecies)	V	V	
Aves	<i>Hirundapus caudacutus</i>	White-throated needletail	M	S	
Aves	<i>Apus pacificus</i>	Fork-tailed swift	M	S	
Aves	<i>Ephippiorhynchus asiaticus</i>	Black-necked stork		R	
Aves	<i>Ardea modesta</i>	Eastern great egret	M	S	
Aves	<i>Ardea ibis</i>	Cattle egret	M	S	
Aves	<i>Plegadis falcinellus</i>	Glossy ibis	M	S	
Aves	<i>Lophoictinia isura</i>	Square-tailed kite		R	
Aves	<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	M	S	
Aves	<i>Accipiter novaehollandiae</i>	Grey goshawk		R	
Aves	<i>Burhinus grallarius</i>	Bush stone-curlew		C	x
Aves	<i>Rostratula australis</i>	Australian painted snipe ⁸	V, M	V	
Aves	<i>Gallinago hardwickii</i>	Latham's snipe	M	S	
Aves	<i>Tringa nebularia</i>	Common greenshank	M	S	
Aves	<i>Tringa stagnatilis</i>	Marsh sandpiper	M	S	
Aves	<i>Calidris acuminata</i>	Sharp-tailed sandpiper	M	S	
Aves	<i>Calyptorhynchus lathamii</i>	Glossy black-cockatoo⁷		V	
Aves	<i>Neophema pulchella</i>	Turquoise parrot		R	
Aves	<i>Ninox connivens</i>	Barking owl		C	x
Aves	<i>Tyto novaehollandiae</i>	Masked owl		C	x
Aves	<i>Merops ornatus</i>	Rainbow bee-eater	M	S	
Aves	<i>Climacteris picumnus</i>	Brown treecreeper		C	x

Class	Species name	Common name	Management status ²		
			EPBC Act	NC Act	BAMM
Aves	<i>Chthonicola sagittata</i>	Speckled warbler		C	x
Aves	<i>Melithreptus gularis</i>	Black-chinned honeyeater		R	
Aves	<i>Grantiella picta</i>	Painted honeyeater ⁷		R	
Aves	<i>Pomatostomus temporalis</i>	Grey-crowned babbler		C	x
Aves	<i>Pomatostomus superciliosus</i>	White-browed babbler		C	x
Aves	<i>Rhipidura rufifrons</i>	Rufous fantail	M	S	
Aves	<i>Melanodryas cucullata</i>	Hooded robin⁷		C	x
Aves	<i>Acrocephalus australis</i>	Australian reed-warbler	M	S	
Aves	<i>Stagonopleura guttata</i>	Diamond firetail ⁷		C	x
Mammalia	<i>Phascogale tapoatafa</i>	Brush-tailed phascogale		C	x
Mammalia	<i>Planigale tenuirostris</i>	Narrow-nosed planigale		C	x
Mammalia	<i>Phascolarctos cinereus</i>	Koala		C	x
Mammalia	<i>Petaurus australis</i>	Yellow-bellied glider ⁷		C	x
Mammalia	<i>Petaurus norfolcensis</i>	Squirrel glider		C	x
Mammalia	<i>Petauroides volans</i>	Greater glider		C	x
Mammalia	<i>Trichosurus vulpecula</i>	Common brushtail possum		C	x
Mammalia	<i>Aepyprymnus rufescens</i>	Rufous bettong		C	x
Mammalia	<i>Macropus dorsalis</i>	Black-striped wallaby		C	x
Mammalia	<i>Chalinolobus picatus</i>	Little pied bat		R	
Mammalia	<i>Nyctophilus corbeni</i> (formerly <i>timoriensis</i>) ⁹	South-eastern long-eared bat	V	V	
Species considered marginal within the study area					
Insecta	<i>Hypochrysops piceata</i>	Bulloak jewell		E	
Aves	<i>Pandion cristatus</i>	Eastern osprey	M	S	
Aves	<i>Erythrorchis radiatus</i>	Red goshawk ⁷	V	E	
Aves	<i>Falco hypoleucos</i>	Grey falcon		R	
Aves	<i>Lewinia pectoralis</i>	Lewin's rail		R	
Aves	<i>Pluvialis fulva</i>	Pacific golden plover	M	S	

Class	Species name	Common name	Management status ²		
			EPBC Act	NC Act	BAMM
Aves	<i>Limosa limosa</i>	Black-tailed godwit	M	S	
Aves	<i>Actitis hypoleucos</i>	Common sandpiper	M	S	
Aves	<i>Tringa glareola</i>	Wood sandpiper	M	S	
Aves	<i>Calidris ruficollis</i>	Red-necked stint	M	S	
Aves	<i>Calidris ferruginea</i>	Curlew sandpiper	M	S	
Aves	<i>Turnix melanogaster</i>	Black-breasted button-quail ⁷	V	V	
Aves	<i>Hydroprogne caspia</i>	Caspian tern	M	S	
Aves	<i>Lathamus discolor</i>	Swift parrot	E	E	
Aves	<i>Tyto longimembris</i>	Eastern grass owl		C	x
Aves	<i>Myiagra cyanoleuca</i>	Satin flycatcher	M	S	
Mammalia	<i>Ornithorhynchus anatinus</i>	Platypus		C	x
Mammalia	<i>Isodon macrourus</i>	Northern brown bandicoot		C	x
Mammalia	<i>Perameles nasuta</i>	Long-nosed bandicoot		C	x
Mammalia	<i>Pseudocheirus peregrinus</i>	Common ringtail possum		C	x
Mammalia	<i>Pteropus poliocephalus</i>	Grey-headed flying-fox ⁷	V	C	
Mammalia	<i>Chalinolobus dwyeri</i>	Large-eared pied bat	V	V	
Mammalia	<i>Miniopterus orianae oceanensis</i> ¹⁰	Eastern bentwing bat		C	x
Mammalia	<i>Pseudomys patrius</i>	Eastern pebble-mound mouse		C	x

Species considered as vagrants within the study area

Aves	<i>Pedionomus torquatus</i>	Plains-wanderer	V	V	
Aves	<i>Limosa lapponica</i>	Bar-tailed godwit	M	S	
Aves	<i>Numenius phaeopus</i>	Whimbrel	M	S	
Aves	<i>Philomachus pugnax</i>	Ruff	M	S	
Aves	<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo ⁷		V	
Aves	<i>Monarcha melanopsis</i>	Black-faced monarch	M	S	

¹ A detailed account of potential occurrence and habitat preferences and associated references is provided in Table J.2 in Volume 5 Attachment 14 Appendix J.

² Status abbreviations are as follows: CE = critically endangered, E = endangered, V = vulnerable, R = rare, NT = near threatened, M = migratory, S = Special Least Concern, C = Least Concern Wildlife, X = non-EVR priority species for the BBS bioregion (EPA 2008a).

³ Undescribed species, description will be published in 2010 in Stanicic et al. (in preparation).

⁴ Undescribed species, alpha-numeric code is as cited in Queensland Museum database.

⁵ Currently under submission to DEWHA for listing under the EPBC Act as endangered.

⁶ Currently under submission to DEWHA for listing under the EPBC Act as critically endangered.

⁷ 'Back on track' species www.epa.qld.gov.au/nature_conservation/wildlife/back_on_track_species_prioritisation_framework

⁸ Listed as migratory under the EPBC Act as painted snipe *Rostratula benghalensis s. lat.*

⁹ Very recently described as *Nyctophilus corbeni* (Parnaby 2009).

¹⁰ Listed in the Australian Faunal Directory (DEWHA 2009b) as eastern bent-wing bat *Miniopterus schreibersii oceanensis*

¹¹ Listed as migratory under the EPBC Act as *Xanthomyza phrygia*.

Habitats for terrestrial fauna species of special conservation significance

Habitat type is a significant factor in determining the composition of the fauna species assemblage of a certain area. Two components of any particular habitat are especially important; physical structure and resource availability.

Structure refers to the abundance and complexity of the vegetation, debris and substrate. Habitats with abundant shrubs, thick ground cover, fallen timber, rocks and crevices, and dense sub-canopy and canopy provide more shelter opportunities for fauna. Habitats with greater complexity will generally have higher fauna species diversity.

Remnant and non-remnant areas within the study area are allocated to nine broad habitat types:

1. Woodland and open forest on alluvial soils
2. Woodland and open forest on non-alluvial soils
3. Brigalow communities
4. Semi-evergreen vine thicket
5. Shrubland
6. Grasslands, including pasture
7. Regrowth
8. Rivers and creeks, including ephemeral watercourses, lakes, and billabongs
9. Dams and other artificial waterbodies.

The REs have been allocated to broad habitat types. The resultant allocations are visually represented on Figure 8.6, based on the refined vegetation mapping shown on Figure 8.3 to Figure 8.5.

Those habitats with abundant and variable resources (for example, food, shelter and breeding) may support more species, while the presence of a preferred food item may result in the presence of a particular species. Habitat use by certain species may be seasonal or may reflect current conditions, for example recent rainfall or mass flowering events.

The suitability of habitats in the study area to many of the conservation significant fauna species is also partly dependent on other factors including disturbance levels and types, patch size, connectivity and weed infestations. These factors are very site specific and may be synergistic, though soil type is typically the driving factor. Soil type influences species richness, productivity, susceptibility of a habitat to weed invasion and may encourage or discourage grazing/browsing by livestock or feral species.

The description of the values of particular habitat types within the study area to fauna, therefore, must be considered in general terms, with ground-truthing required for accurate assessment of a particular habitat patch. Each broad habitat type is described in detail in Volume 5 Attachment 14, Section 2.4.2. Three amphibious species, Macquarie turtle *Emydura macquarii*, broad-shelled turtle *Macrochelodina*

expansa and platypus *Ornithorhynchus anatinus* breed in terrestrial habitats and are included as terrestrial species.

Habitat protection for significant species

Data provided by the EPA (2008d) has been used to indicate the areas of habitat suitable for conservation significant species¹. To determine the areas of habitat for significant species currently protected under the NC Act or Forestry Act, RE mapping has been used to provide some indication of the extent of suitable habitat within reserves, including national parks.

Areas protected under the NC Act have been separated from those protected under the Forestry Act. The latter (i.e. areas within state forests) may be subject to timber felling and to long-term grazing, which may significantly reduce the habitat quality of some areas for a range of fauna species.

The likelihood of a species occurring in an RE can be determined based on the description of the RE and the known distribution of the species in question. Information on the extent of the REs within the study area is provided in Section 8.3.3

Volume 5 Attachment 14 lists the REs found in the study area which occupies part, or all, of the relevant provinces of the BBS bioregion.

Corridors

Maintaining connectivity across a landscape through corridors or 'stepping stones' of remnant vegetation is important for the long-term conservation of biodiversity. Within the study area, major areas have been designated as terrestrial bioregional corridors of State significance under BPA mapping (refer to Figure 8.2, and to Volume 5 Attachment 14 Appendix D). Also identified are several State or regionally significant watercourses with remnant vegetation acting as riparian corridors including Juandah Creek west of the Leichhardt Highway; the Condamine River; and the Weir River.

A less well recognised landscape feature that encourages movement is the vegetation, much of it remnant, occurring in road and rail reserves and stock routes. Some within the study area, such as the Condamine–Tara Road and Kogan-Condamine Road, are mapped as being of state significance and have very high special biodiversity values (EPA 2008c).

The importance of the study area to conservation significant fauna

The 1,470,000ha study area incorporates the known or expected distributions of 99 fauna species of special conservation significance. However, the number of known records of a species within the study area does not by itself indicate the importance of the study area to that species in terms of its overall population.

Table 8.6 lists species for which the study area is considered to be of high or very high importance. This assessment is based on a combination of the species' known occurrence within the study area and the extent of distribution beyond the study area.

The study area also supports important populations of salmon-striped frog, yellow-spotted monitor, woma, pale-headed snake, square-tailed kite and little pied bat, but the study area represents a smaller percentage of their overall distribution. Despite a distribution that stretches north to Cape York, the study area is considered of high importance to yakka skink, due to its patchy occurrence within its range.

¹ The current extent of remnant habitat within the relevant landscape for terrestrial fauna species of special conservation significance considered possible occurrences within the study area was assessed, based on a summary of REs for each species and the extent of REs in the relevant provinces (Section 8.3.3). See Volume 5 Attachment 14, Table 2.14 for details.

Table 8.6 Significant fauna species for which the study area is of importance

Species name	Common name	Importance of study area
In preparation	Dulacca woodland snail Camaenidae BL 12	Very important – all known records are from the study area
In preparation	Brigalow woodland snail Camaenidae BL 13	Very important – only known from study area and its close surrounds
<i>Cyclorana verrucosa</i>	Rough frog	Important – study area occupies a substantial part of known distribution (>10%) and includes large areas of suitable habitat
<i>Strophurus taenicauda</i>	Golden-tailed gecko	Very important – endemic to BBS and study area is a large portion of known distribution (>25%)
<i>Paradelma orientalis</i>	Brigalow scaly-foot	Important – near endemic to BBS and study area is a large portion of known distribution (~25%)
<i>Egernia rugosa</i>	Yakka skink	Important – colonial species with a patchy distribution
<i>Furina dunmalli</i>	Dunmall's snake	Important – near endemic to BBS and study area is a large portion of known distribution (~25%)
<i>Hemiaspis damelii</i>	Grey snake	Important – study area is approximately 10% of known distribution and includes large areas of suitable habitat
<i>Pseudechis guttatus</i>	Spotted black snake	Important – study area is approximately 10% of known distribution and includes large areas of suitable habitat for a species that has declined to the east
<i>Calyptorhynchus lathamii</i>	Glossy black-cockatoo	Important – study area is within the core area for this species in Queensland
<i>Grantiella picta</i>	Painted honeyeater 7	Important – study area is within the core area for this species in Queensland

¹ Status abbreviations are as follows: **CE** = Critically Endangered, **E** = Endangered, **V** = Vulnerable, **R** = Rare, **NT** = Near Threatened, **M** = Migratory, **S** = Special Least Concern, **C** = Least Concern Wildlife, **X** = non-EVR priority species for the BBS bioregion (EPA 2008a).

² Based on cross referencing habitat/RE preference with refined mapping (Volume 5 Attachment 14 Appendix I) and accounting for species' known distribution within Study Area as well as consideration of detectability on the number of previous records of each species. See Volume 5 Attachment 14 Appendix J for further detail.

³ Undescribed species, description will be published in 2010 in Stanisic *et al.* (in preparation).

⁴ Undescribed species, alpha-numeric code is as cited in Queensland Museum database.

⁵ Currently under submission to DEWHA for listing under the EPBC Act as Endangered.

⁶ Currently under submission to DEWHA for listing under the EPBC Act as Critically Endangered.

⁷ 'Back on Track' species www.epa.qld.gov.au/nature_conservation/wildlife/backontrackspeciesprioritisationframework

Feral terrestrial vertebrate fauna

A total of 18 feral terrestrial vertebrate species are noted from surveys and from database searches. Six of these species are recognised as Class 2 pests under the *Land Protection (Pest and Stock Route Management) Act 2002*. None of these species is unexpected and all are commonly found in the BBS bioregion except for nutmeg mannikin *Lonchura punctulata*, which is typically coastal in occurrence, and Asian house gecko *Hemidactylus frenatus* which is known from the town of

Chinchilla (Craig Eddie pers. comm.). Local government pest management plans for the study area have been referenced and do not contain species additional to those declared under the Act.

A summary of impacts on terrestrial ecological values due to each declared pest species, including red fox *Vulpes vulpes*, dingo *Canis lupus dingo*, cat *Felis catus*, rabbit *Oryctolagus cuniculus*, feral pig *Sus scrofa*, and goat *Capra hircus* is presented in Volume 5 Attachment 14. The impacts of cane toads *Rhinella marina* are also briefly discussed, given the potential spread of this species throughout the southern and western parts of the study area.

8.3.5 Existing terrestrial ecological values and associated sensitivities to disturbance

This section provides a summary of existing terrestrial ecological values, and their sensitivities to disturbance. The most sensitive areas are those associated with remnant brigalow communities, which are scattered throughout the study area. Remnant vegetation occurring within bioregional corridors is also highly sensitive. A summary visual representation of the results of the initial, relative terrestrial ecological importance assessment for the study area (i.e. a heat map), is presented in Figure 8.7. The sensitivity categories described in Figure 8.7 informed the preparation of a revised infrastructure layout, which subsequently formed the basis of the impact assessment.

Table 8.7 Terrestrial ecology sensitivity categories for clearing and infrastructure

Category	Sensitivity
1	<p>Extremely sensitive</p> <p>Habitat patches within this category possess biodiversity characteristics that are unique and threatened at a National and a State level. These patches contain very high habitat values for threatened flora and fauna of the region and are likely to be in good condition due to minimal impacts of edge effects and located where they enhance ecological functions at a landscape level.</p>
2	<p>Highly Sensitive</p> <p>The majority of habitat patches within this category possess biodiversity characteristics that are unique and threatened at a National and a State level. These patches contain very high habitat values for threatened flora and fauna of the region.</p> <p>In comparison to those patches in Category 1, these patches have a reduced chance of being in good condition due to increased impacts of edge effects and are less likely to be located where they enhance ecological functions at a landscape level.</p> <p>Those patches that are of less importance at a National and State level or that possess lower habitat values are more likely to be in good condition and located where they enhance ecological functions at a landscape level.</p>
3	<p>Sensitive</p> <p>Biodiversity characteristics of these habitat patches are mostly unique at a sub-regional level. These patches are more likely to be in good condition due to their size and located where they enhance ecological functions at a landscape level.</p>
4	<p>Neutral</p> <p>Habitat patches within this category have a low chance of possessing biodiversity characteristics unique and threatened at a National or State level. These patches contribute little to ecological functions at a landscape scale and are likely to be in poor condition due to edge effects.</p>

Category	Sensitivity
	Also includes patches that are either large in size or within recognised corridors and possess biodiversity values that are common within the bioregion.
5	<p>Robust</p> <p>Biodiversity values within this category are generally common within the bioregion, patches are isolated from other remnant vegetation or likely to be in poor condition due to edge effects.</p> <p>Most species within these patches are either increaser species that proliferate in agro-ecosystems or unable to persist in the long-term as resources in the patch degrade.</p>
6 and 7	<p>Cleared</p> <p>These areas are currently devoid of vegetation or other habitat features and do not provide important habitat for many native species.</p> <p>Where such areas occur within a recognised corridor, they are afforded a higher category (6) due to the opportunity for enhancing landscape connectivity through rehabilitation of the pre-clearing vegetation community.</p>

In addition to the categories described above, areas known or considered likely to support particular threatened species with very limited distributions, important habitat features and waterbodies were mapped as being sensitive to project impacts. These include:

- Areas known, or having high potential, to support any of two flora species, *Micromyrtus carinata* and *Calytrix gurlmundensis*, and two undescribed snail species, brigalow woodland snail and Dulacca woodland snail. These species are of conservation significance, with very restricted distributions
- Areas within Talinga tenement known to support populations of yakka skink or pine donkey orchid *Diuris tricolor* (both vulnerable under the EPBC Act), or which contain habitat features such as caves and overhangs that are important to a number of conservation significant species
- Waterbodies, due to their very high resource value, and certain areas of cleared land within floodplains subject to inundation during or following rainfall events and may provide valuable resources for conservation significant fauna species such as rough frog and grey snake when flooded
- The area of RE 11.3.16, confirmed by the Queensland Herbarium as the northernmost known population of this community in Australia.

8.4 Potential impacts

8.4.1 Impact mechanisms

Impact mechanisms resulting from the Project, including the clearing, construction, operation, and decommissioning phases of the gas fields, have been applied to the significant/sensitive aspects of the terrestrial flora and terrestrial fauna, from which necessary mitigation actions have then been identified.

In general, impacts on ecological values can be considered in terms of direct and indirect effects, both short-term and long-term. Direct impacts refer to the loss of vegetation and habitat, usually through

land clearing, while indirect impacts are secondary effects such as weed invasion and increased sedimentation. The areas that are proposed to be cleared for the construction of gas processing facilities and associated infrastructure, such as pipelines and water treatment facilities, are shown in Volume 5 Attachment 14.

A gas well layout has not been provided in mapped format as the locations cannot be accurately plotted on the ground until detailed site assessments have been undertaken. However, the indicative layout of gas wells has been informed by terrestrial ecological sensitivity mapping and other project development constraints, forming the basis of the impact assessment process. Telecommunications towers have been addressed separately.

Project staging

Volume 2 Chapter 3 indicates the proposed staging schedule for development of the gas fields and associated infrastructure. Staging of the development will allow offsets to be established and rehabilitation works to be carried out ahead of some development components, potentially reducing the effects of lag times in the establishment of environmental offsets.

Clearing

Clearing will be required to prepare sites for constructing a range of infrastructure within the study area. Clearing will also occur progressively during the life of the Project, as the gas fields are developed and infrastructure is installed to service them. Overall, it is understood a total area of up to approximately 6,000ha of remnant vegetation as defined under the VMA (and is mapped as part of surveys conducted for this report) is proposed to be disturbed over the life of the Project.

Approximately one third of this area will be rehabilitated immediately following construction of the individual infrastructure components, and ongoing gas fields' development over the life of the Project will allow for the rehabilitation of some extraction sites and associated infrastructure prior to the disturbance of new development areas.

Clearing figures have been derived by overlaying the proposed project footprint with updated RE mapping for the study area. Table 8.8 outlines the approximate areas of each RE to be cleared, together with their description under DERM's Regional Ecosystem Description Database, and their bioregional extent area contained in the study area. This table shows that the 'least concern' RE 11.5.1 stands out as the single RE that would be subject to the most clearing as a result of the Project (approximately 2,345ha). It also indicates that the Project will result in clearing of no more than 0.53% of the provincial extent of any RE that occurs within the study area. As such, issues of habitat fragmentation and isolation are considered to represent more important impacts than those related to loss of specific ecosystem types from the study area.

Removal of vegetation results in direct loss of plant species, and can result in the mortality of fauna present at the time of clearing. Secondary impacts are associated with:

- Soil disturbance/exposure and altered water flow patterns, and subsequent erosion and sedimentation, which may expose tree roots, smother vegetation, and alter the physical form, chemical processes and ecological health of downstream aquatic habitats
- Salinisation of areas downslope, depending on the clearing extent and nature of the associated landform and geology/soils
- Increases in desiccation, light penetration, wind-throw, grazing pressure, weed invasion, nest predation, and parasitism for adjacent flora and fauna (Murcia 1995). In particular, introduced weeds can change vegetation community composition and in some cases increase the intensity of fire, leading to further community degradation.

Table 8.8 Approximate current extent of REs within the relevant provinces and study area and extent to be disturbed by the Project

RE	Management status ¹			Total current extent (ha)		Extent to be disturbed			
	EPBC Act	VMA	EP Act	Relevant provinces ^{2,3}	Study area ⁴	Total area (ha)	% of relevant provinces extent	% of study area extent	% of tenements extent ⁵
11.3.1	E	E	E	3111	792	4.51	0.15	0.57	1.68
11.3.2	E ⁶	OC	OC	167893	14729	129.13	0.08	0.88	2.12
11.3.3		OC	OC	11335	656	7.81	0.07	1.07	3.50
11.3.4		OC	OC	14666	2596	10.21	0.07	0.39	1.40
11.3.14		LC	NC	60647	12590	195.67	0.32	1.55	1.95
11.3.16		LC	NC	0 ⁸	73	2.96	n/a ⁷	4.05	4.55
11.3.17		OC	E	4347	86	0.98	0.02	1.14	2.39
11.3.18		LC	NC	30093	3521	33.18	0.11	0.94	2.85
11.3.19		LC	NC	29242	1782	6.62	0.02	0.37	30.60
11.3.25		LC	OC	111637	24796	249.06	0.22	1.00	2.13
11.3.26		LC	NC	13261	83	0.00	0.00	0.00	0.00
11.3.27		LC	OC	3153	48	0.40	0.01	0.83	0.35
11.3.39		LC	NC	11121	920	3.10	0.03	0.34	n/a ⁹
11.4.3	E	E	E	32277	4759	18.86	0.06	0.40	1.08
11.4.7	E	E	E	3063	292	0.43	0.01	0.15	0.65
11.4.10	E	E	E	1589	64	0.90	0.06	1.40	2.15

RE	Management status ¹			Total current extent (ha)		Extent to be disturbed			
	EPBC Act	VMA	EP Act	Relevant provinces ^{2,3}	Study area ⁴	Total area (ha)	% of relevant provinces extent	% of study area extent	% of tenements extent ⁵
11.4.12		E	E	4337	1183	12.72	0.29	1.08	1.95
11.5.1		LC	NC	440592	165109	2344.70	0.53	1.42	2.83
11.5.4		LC	NC	85052	29540	398.35	0.47	1.35	2.43
11.5.5		LC ⁷	NC	83461	18235	213.17	0.26	1.17	3.62
11.5.20		LC	NC	82777	16064	170.75	0.21	1.06	3.75
11.5.21		LC	NC	72026	4049	0.01	0.00	0.00	0.76
11.7.1		LC	OC	39923	1951	13.83	0.03	0.71	1.99
11.7.2		LC	NC	34901	17402	176.06	0.50	1.01	2.04
11.7.4		LC	NC	174688	79344	641.41	0.37	0.81	2.18
11.7.5		LC	NC	52009	19765	125.89	0.24	0.64	1.90
11.7.6		LC	NC	178711	24070	83.42	0.05	0.35	2.21
11.7.7		LC	NC	164202	49179	513.04	0.31	1.04	2.13
11.8.3	E	OC	OC	11033	8	0.00	0.00	0.00	n/a ⁹
11.9.1	E	E	E	3893	7	0.00	0.00	0.00	n/a ⁹
11.9.4	E	OC	E	11043	3605	13.27	0.12	0.37	1.09
11.9.5	E	E	E	76647	10897	45.21	0.06	0.41	0.97
11.9.6	E	E	E	371	118	0.00	0	0	n/a ⁹

RE	Management status ¹			Total current extent (ha)		Extent to be disturbed			
	EPBC Act	VMA	EP Act	Relevant provinces ^{2,3}	Study area ⁴	Total area (ha)	% of relevant provinces extent	% of study area extent	% of tenements extent ⁵
11.9.7		OC	OC	53614	2375	2.85	0.01	0.12	2.96
11.9.9		LC	NC	31101	758	0.00	0.00	0.00	n/a ⁹
11.9.10		OC	E	50454	3140	19.80	0.04	0.63	1.58
11.10.1		LC	NC	134467	30743	140.78	0.10	0.46	4.15
11.10.3		LC	NC	72013	149	0.00	0.00	0.00	n/a ⁹
11.10.7		LC	NC	123880	2752	0.00	0.00	0.00	n/a ⁹
11.10.9		LC	NC	86194	14955	306.82	0.36	2.05	4.48
11.10.11		LC	NC	123513	7526	125.95	0.10	1.67	4.26
11.10.13		LC	NC	186936	208	0.00	0.00	0.00	n/a ⁹

¹ Where: **E** = endangered, **OC** = of concern, **LC** = least concern, **NC** = no concern at present. 'EP Act' status is based on the 'biodiversity status' prescribed on DERM's Regional Ecosystem description database v6.

² 'Relevant Provinces' includes provinces 25, 26, 27, 28, 30, 31, and 32 of the BBS bioregion, except for REs 11.10.3, 11.10.7, and 11.10.13 (for which the Relevant Province is province 24).

³ Based on data from EPA (2008d). Data is only available for each RE as a whole, not for individual subsets (for example, for 11.10.13, not for 11.10.13a).

⁴ Based on GIS analysis of refined vegetation mapping (Volume 5 Attachment 14 Appendix I).

⁵ Note: certain REs may be underrepresented within the tenements, thereby resulting in a large percentage based on overall study area disturbance.

⁶ Only where weeping myall *Acacia pendula* occurs.

⁷ 'Threshold' REs at risk of the remnant extent falling below 30% of its pre-clearing extent, or having a remnant extent of less than 10,000ha (DERM 2009b).

⁸ Not currently mapped by the Queensland Herbarium as occurring within the Relevant Provinces.

⁹ REs that do not occur within the gas field tenements.

While the majority of the study area (63%) consists of pasture (60%) and regrowth vegetation (3%) with limited values for significant flora and fauna species, the results of the proposed clearing have the potential to affect local and regional fauna movement and flora and fauna dispersal opportunities. Clearing is proposed to occur progressively and in a known sequence, allowing offsetting for habitat loss to occur 12 to 18 months in advance of clearing. The impacts of habitat loss will be greatest during the operational phase of the Project, when all gas fields are fully developed and before offsets have established to maturity.

Assessment of the cumulative impacts associated with clearing on vegetation communities and significant species are, in part, taken into account in the assessment of REs and EVR or near threatened species under Commonwealth, State, and local government legislation. While the total amount of clearing by all proponents for gas fields' development is relatively small compared with the overall tenement sizes, the need to establish gas wells in a grid format, connected by access tracks and pipelines, has a significant capacity to fragment remnant vegetation. Regardless of the conservation status of that vegetation, the activities must be carefully managed to avoid impacting on landscape linkages for flora and fauna.

At the landscape level, the cumulative impacts of habitat loss and disturbance as a result of the Australia Pacific LNG Project and other relevant projects are addressed in Volume 2 Chapter 25.

Construction activities

In addition to clearing and the associated secondary (or indirect) impacts, the construction phase has the potential to result in ongoing habitat disturbance.

Noise and dust affect habitat adjacent to operational areas due to ground disturbance, the operation and movement of machinery and construction traffic.

Working beyond daylight hours will require night lighting, which may affect behaviour of both nocturnal and diurnal fauna, both vertebrate and invertebrate. This includes interfering with birds that migrate at night, altering reproductive behaviour of frogs, disrupting communication between individual mammals and birds, focusing the foraging activities of insectivores, and increasing the likelihood of predation for some species (Longcore and Rich 2004).

Another potential impact, particularly for reptiles and small mammals, is becoming trapped in trenches or other excavations that remain open for any period of time. This may lead to mortality either by exposure, starvation, thirst or predation by other species. Open pipes may also attract fauna, particularly micro-bats and reptiles, which may then be injured or killed when the pipes are transported and utilised.

An increase in traffic, both heavy vehicles and construction workers in light vehicles, during the construction phase could contribute to increased animal/vehicle collisions on local roads. Species particularly susceptible to traffic collisions include larger and slow-moving snakes (e.g. woma, spotted black snake, carpet python), monitors and other large lizards, macropods and frogs (during wet periods).

Construction vehicles have the potential to introduce and/or spread weed species and plant pathogens in disturbed soil, while general waste and land disturbance has the potential to attract highly competitive and/or predatory exotic fauna species.

Fuels and chemical spills from storage areas and oils from heavy machinery can enter the environment, affecting habitats where the spill occurs, and potentially causing more widespread impact if contaminants reach waterways.

Increased human presence has the potential to increase the frequency of accidental fires within vegetated areas, adversely affecting habitat structure and therefore habitat value for a range of significant species.

Operational phase

The operation of the proposed development has the potential to disrupt natural ecological processes within the local area beyond initial clearing, in terms of both the spatial and temporal scale of impact. This includes:

- Limiting the natural movement and dispersal of ground-dwelling and non-volant (flightless) arboreal fauna (i.e. for breeding and foraging purposes), which are unable to traverse the developed landscape, and/or have difficulty traversing other barriers such as roads, potentially limiting the natural spread and regeneration of native flora that rely on such fauna for seed dispersal
- Altering the local surface and groundwater environment due to landform modification, and subsequent impacts on downstream ecosystems, particularly aquatic habitats, wetlands, riparian vegetation, and other sensitive vegetation communities and dependent fauna
- Traffic during the operational phase contributing to increased animal/vehicle collisions on local roads and on project roads and tracks
- Creating long-term edge effects along the borders of active areas and adjacent habitat, as well as isolated habitat patches between disturbed areas
- Altering behaviour and movement of fauna through light pollution at night
- An increased need for controlled burning of vegetated areas which has the potential to adversely affect habitat structure and therefore habitat value for a range of significant species
- Potentially increasing the frequency of accidental fire due to increased human presence.

Decommissioning phase

Decommissioning activities have the potential to result in similar impacts to those identified for the construction phase. As with construction, noise and dust, open trenches, increased traffic movements and human presence have the potential to affect habitat areas.

8.4.2 Impact assessment results

Discussion of potential impacts in this section focuses on those ecological elements for which moderate, significant or major impacts have been predicted and for which the application of mitigation measures will be necessary.

Overall, a total of approximately 6,000ha of remnant vegetation would potentially be cleared. While no RE would lose more than 0.53% of its extent within the relevant provinces (Volume 5 Attachment 14 Appendix N Tables N.1 to N.8), the potential for clearing to further fragment habitats within the study area has significance for a number of flora and fauna species which are highly geographically restricted or occur sparsely throughout their distribution.

The mitigation measures are designed to ensure impacts are reduced to negligible or at most minor levels via the application of habitat management guidelines (Section 8.5.2), and where this cannot be achieved, through offsets (Section 8.5.3).

Full details on impact assessment matrices for flora and fauna within the study area are provided in Volume 5 Attachment 14 Appendix N.

Conservation Significant – Vegetation communities and flora

The most intensive and long term impacts on conservation significant vegetation communities and flora species will result from the clearing of 6,000ha of remnant vegetation and the ongoing degradation of habitats through edge effects and fragmentation.

The results of the impact assessment (Volume 5 Attachment 14 Appendix N, Tables N.1 to N.4), indicate that, without mitigation, there is potential for moderate to significant impacts on the following vegetation communities, primarily related to their conservation status under Commonwealth and State legislation:

- Endangered ecological communities (EPBC Act and NC Act): REs 11.3.1, 11.4.3, 11.4.7, 11.4.10, 11.9.4, 11.9.5, and weeping myall within 11.3.2
- Endangered RE (NC Act): 11.4.12.

Disturbance of these communities will be avoided where they occur within sensitivity category 1 and a buffer area will be established in accordance with the approved habitat management guidelines. Where they occur within sensitivity categories 2 and 3, unless otherwise approved, all activity on undisturbed land will follow the approved habitat management guidelines, with infrastructure to be positioned along existing disturbed areas, and active rehabilitation implemented.

A 200m management buffer will be established around all occurrences of these communities throughout the study area. In avoiding these communities where practicable, and implementing management guidelines to control potential off-site effects of the Project, the predicted residual impact assessment for the above vegetation communities is reduced to minor or negligible. Regardless of the scale of mitigated impacts, any clearing of these and of concern vegetation communities will require offsetting.

Thirty-six flora species of special conservation significance are known or considered to possibly occur within the study area. This includes species listed as endangered or vulnerable under the EPBC Act, listed as endangered, vulnerable, rare or near threatened under the NC Act, and listed as non-EVR priority species for the BBS bioregion under the Biodiversity Assessment and Mapping Methodology (EPA 2008a, b).

Two species are of special note due to their highly restricted distribution. *Calytrix gurulmundensis* and *Micromyrtus carinata* are generally restricted to the rock pavements (scalds) of the Gurulmundi Plateau. Some other occurrences of these species are noted within Barakula State Forest and the Dalwogan tenement respectively (DERM 2009e). The highly restricted distribution and high habitat specificity of these species means their long-term viability is highly susceptible to disturbance.

A significant proportion of the known range of *Philotheca sporadica* (i.e. primarily in Gilbert Gully) is located within the study area, whilst the majority of the known distribution of *Acacia curranii* within Queensland is located within the study area.

The results of the impact assessment (Volume 5 Attachment 14 Appendix N Tables N.1 to N.4) indicate that, without mitigation, there is potential for moderate to significant impacts on the following conservation significant flora species:

- EPBC Act endangered: microcarpaea *Microcarpaea agonis*, slender tylophora *Tylophora linearis*.
- EPBC Act vulnerable: Chinchilla wattle *Acacia chinchillensis*, curly-barked wattle *A. curranii*, Tara wattle *A. lauta*, Thomby Range wattle *A. wardellii*, ooline *Cadellia pentastylis*, Gurulmundi fringe myrtle *Calytrix gurulmundensis*, Belson's panic grass *Homopholis belsonii*, *Philotheca sporadica*, Dunmore mint-bush *Prostanthera sp Dunmore*, Cobar greenhood orchid *Pterostylis cobarensis*.
- NC Act endangered: Gurulmundi heath-myrtle *Micromyrtus carinata* and red-soil woolly wrinklewort *Rutidosia lanata*
- NC Act vulnerable *Gonocarpus urceolatus*
- NC Act rare scrub wattle *Acacia tenuinervis*, Silky Cryptandra *Cryptandra ciliata*.

The nature of these species is that they are highly restricted in distribution and/or occur very sparsely throughout their distribution. Mitigation measures include pre-development surveys to determine whether the species occur within 200m of any proposed disturbance. If any of these species are located within this distance, they will be avoided in the first instance, and if avoidance of direct or indirect impacts is not possible, application for their removal will be made to DEWHA and/or DERM, potentially resulting in translocation.

Where they occur within 200m of any element of the development, specific threatened species management guidelines are to be prepared and implemented to mitigate the potential for offsite impacts on the species (Section 8.5).

Where direct or indirect impacts to the species can be avoided, the residual impact is reduced to negligible. Where individuals must be disturbed through translocation, impacts may still be moderate, depending on the number of individuals involved.

During construction, operations, and decommissioning, the major threats to conservation significant communities are associated with the potential for increase in accidental fire and decreased habitat quality through edge effects.

The preparation and strict implementation of clearing management and habitat management guidelines, incorporating weed and ecological fire management components (Section 8.5) throughout and beyond the life of the Project, as well as the application of individual threatened species management guidelines for known occurrences of conservation significant species, reduce these potential impacts to minor or negligible.

For all conservation significant REs subject to clearing, offsets are proposed. Offsets are also stipulated for conservation significant flora species, although with the application of appropriate mitigation measures able to reduce impacts to minor or negligible, offsets are not considered to be necessary for these species. The proposal for offsets for the Project is discussed in detail in Section 8.5.3.

Conservation Significant Fauna

The most intensive and long term impacts on conservation significant fauna species will result from the clearing of 6,000ha of remnant habitat and the ongoing degradation of habitats through edge effects and fragmentation. This impact assessment indicates that, without mitigation, there is potential for major impacts on the following conservation significant fauna species:

- EPBC critically endangered – listing pending: brigalow woodland snail (Camaenidae BL 13).

This is the only species within the study area for which major impacts are predicted in the absence of mitigation measures as the species is restricted, almost entirely, to suitable habitats within the study area. It should be noted that the recommended mitigation measures, avoidance and protection of this habitat would reduce potential impacts to a negligible level.

Impact assessment results (Volume 5 Attachment 14 Appendix N Tables N.5 to N.8), indicate that, without mitigation, there is potential for moderate to significant impacts on the following conservation significant fauna species:

- EPBC endangered – listing pending: Dulacca woodland snail (Camaenidae BL 12)
- EPBC Act and NC Act vulnerable: Australian painted snipe *Rostratula australis*, brigalow scaly-foot *Paradelma orientalis*, Dunmall's snake *Furina dunmalli*, south-eastern long-eared Bat *Nyctophilus corbeni*, yakka skink *Egernia rugosa*
- NC Act endangered: grey snake *Hemiaspis damelii*
- NC Act vulnerable: glossy black-cockatoo *Calyptorhynchus lathami*, pale imperial hairstreak *Jalmenus eubulus*
- NC Act rare or near threatened: common death adder *Acanthophis antarcticus*, golden-tailed gecko *Strophurus taenicauda*, little pied bat *Chalinolobus picatus*, painted honeyeater *Grantiella picta*, rough frog *Cyclorana verrucosa*, square-tailed kite *Lophoictinia isura*, woma *Aspidites ramsayi*

The nature of these species is that they are highly restricted in distribution, occur very sparsely throughout their distribution and/or are difficult to detect without targeted surveys.

Ninety-nine fauna species of special conservation significance are known or considered possible occurrences within the study area. This includes species listed as endangered, vulnerable or migratory under the EPBC Act, listed as endangered, vulnerable, rare or near threatened under the NC Act, and listed as non-EVR priority species for the BBS bioregion under the Biodiversity Assessment and Mapping Methodology (EPA 2008a, b).

The golden-tailed gecko is endemic to the bioregion and is common and widespread in a variety of REs in the study area. The study area therefore supports a significant proportion of the species' overall population.

Other species for which the study area is especially important are rough frog, yakka skink, brigalow scaly-foot, grey snake, and glossy black-cockatoo. It is also likely to be important for the little known

Dunmall's snake. Habitat management will be essential to prevent significant impacts to the viability of these species within the region.

During construction, operations, and decommissioning, the major threats to conservation significant fauna species are associated with:

- The potential for increase in accidental fire which causes direct mortality, alters the structure and therefore the suitability of habitats for fauna species, and facilitates weed invasion which may increase fire intensity
- Ongoing edge effects, for example, through increased solar radiation, increase wind effects, desiccation, and vegetation dieback
- The construction of access tracks through remnant vegetation causing increased access for feral predators such as foxes, cats, and cane toads
- The construction of access tracks causing increased access for competitors such as cane toads and common myna and aggressive native species (increased species such as noisy miner and rainbow lorikeet *Trichoglossus haematodus*) which may exclude other native species
- Increased access for native predators such as laughing kookaburra and pied butcherbird which may increase predation on native species, particularly small reptiles
- Construction of access tracks and artificial waterbodies leading to an increase of, or colonisation by, cane toads and subsequent increased potential mortality due to attempted predation of cane toads by native frog-eating species, particularly reptiles
- Increased weed invasion - particularly exotic grasses which outcompete native species and increase fire frequency and intensity
- Changes to hydrological conditions that may affect habitat for frogs
- The creation of artificial waterbodies which may provide suitable resources for a variety of native fauna
- The more local effects of increased noise and night time lighting.

The preparation and strict implementation of feral species management and habitat management guidelines incorporating weed and ecological fire management components throughout the life of the Project, as well as the application of threatened species management guidelines for known occurrences of conservation significant species, reduces potential impacts for many species to minor or negligible (refer to Volume 5 Attachment 14 Appendix N).

The exceptions are for the following species, which are still predicted to be subject to moderate or significant impacts as a result of habitat clearing despite the implementation of recommended mitigation measures:

- EPBC Act and NC Act vulnerable: brigalow scaly-foot *Paradelma orientalis*, Dunmall's snake *Furina dunmalli*, yakka skink *Egernia rugosa*
- NC Act endangered: grey snake *Hemiaspis damelii*
- NC Act vulnerable: glossy black-cockatoo *Calyptorhynchus lathami*
- NC Act rare or near threatened: golden-tailed gecko *Strophurus taenicauda*, little pied bat *Chalinolobus picatus*, rough frog *Cyclorana verrucosa*, square-tailed kite *Lophoictinia isura*, woma *Aspidites ramsayi*.

For conservation significant fauna species habitat subject to clearing, offsets are proposed. Where the application of the described mitigation measures is able to reduce impacts to minor or negligible, offsets are not considered to be necessary for those species. Where impacts are still predicted to be moderate or greater, offsets are proposed to ensure that there is no net loss of biodiversity.

The proposal for offsets for the Project is discussed in detail in Section 8.5.3. Where direct offsets are not appropriate or unable to mitigate potential impacts, such as the potential impacts of cane toads on reptiles of conservation significance, indirect offsets have been suggested. This may include research to determine the most effective design of the artificial waterbodies necessary for the Project, to discourage toad breeding.

Impact assessments for two turtle species and platypus are based on the information currently available, on the expectation of no impacts on permanent watercourses as a result of the Project and the implementation of relevant components of the habitat management guidelines (Section 8.5.2), in particular feral animal management guidelines, through the environmental management plan for the Project.

Potential impacts on the watercourses which could deleteriously affect these and other amphibious species include the release of water which, depending on quantities and duration, could underscore banks and destroy nesting areas, remove riparian vegetation necessary for stream health and scour watercourse substrate destroying micro-habitats and flushing food resources downstream.

The temperature, pH and salinity of water released into waterbodies may also negatively affect turtles and platypus. Conversely, environmentally sound practices governing controlled release of water could enhance waterbodies, increasing habitat and resources for amphibious species.

Table 8.9 Conservation significant fauna species for which residual impacts remain moderate or significant as a result of clearing

Species	Significance of study area	Impact type	Mitigation and compensatory measures ¹	Mitigated impact			Prediction reliability index
				Likelihood of impact occurring	Residual impact duration	Residual impact	
Nationally significant fauna - EPBC Act vulnerable							
Brigalow scaly-foot <i>Paradelma orientalis</i> (also listed as vulnerable under the NC Act)	Nineteen database and survey records. Study area is of high importance to the species.	Direct impacts: <ul style="list-style-type: none">Potential loss of approximately 674ha potential habitat (0.13% of subregional extent)Mortality during clearing activitiesBarriers to movement created Indirect impacts: <ul style="list-style-type: none">Increased access to habitat by feral predatorsDecreased prey abundance due to possible increased predation by feral species and loss of habitat	Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Certain	Long term	Moderate (offset required))	High
Dunmall's snake <i>Furina dunmalli</i> (also listed as vulnerable under the NC Act)	Six database records. Study area is of high importance to the species.	Direct impacts: <ul style="list-style-type: none">Potential loss of approximately 3,614ha potential habitat (0.35% of subregional extent)Mortality during clearing	Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management	Probable	Long term	Moderate (offset required)	Low

Species	Significance of study area	Impact type	Mitigation and compensatory measures ¹	Mitigated impact			Prediction reliability index
				Likelihood of impact occurring	Residual impact duration	Residual impact	
		activities	guidelines.				
		<ul style="list-style-type: none"> Barriers to movement created 	Implement feral animal management guidelines.				
		Indirect impacts:					
		<ul style="list-style-type: none"> Increased access to habitat by feral predators 					
		<ul style="list-style-type: none"> Decreased prey abundance due to possible increased predation by feral species and loss of habitat 					
Yakka skink <i>Egernia rugosa</i> (also listed as vulnerable under the NC Act)	Four database records. Study area of moderate importance to the species.	Direct impacts: <ul style="list-style-type: none"> Potential loss of approximately 5,272ha potential habitat (0.24% of subregional extent) Mortality during clearing activities Indirect impacts: <ul style="list-style-type: none"> Increased access to habitat by feral predators 	Ground-truth for colonies and individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Probable	Long term	Moderate (offset required)	Medium

Species	Significance of study area	Impact type	Mitigation and compensatory measures ¹	Mitigated impact			Prediction reliability index
				Likelihood of impact occurring	Residual impact duration	Residual impact	
State significant fauna - NC Act endangered							
Grey snake Hemiaspis damelii	Fourteen database records. Study area of high importance to the species.	Direct impacts: <ul style="list-style-type: none">Potential loss of approximately 674ha potential habitat (0.13% of subregional extent)Mortality during clearing activitiesBarriers to movement created Indirect impacts: <ul style="list-style-type: none">Increased access to habitat by feral predatorsDecreased prey abundance due to possible increased predation by feral species and loss of habitat	Avoid, where practicable, disturbance to soil structure of low-lying areas of cracking clays. Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Probable	Long term	Moderate (offset required)	Medium
State significant fauna - NC Act vulnerable							
Glossy black-cockatoo Calyptorhynchus lathami	Uncommon. Study area is of moderate importance to the species.	Direct impacts: <ul style="list-style-type: none">Potential loss of approximately 2,728ha potential habitat (0.34% of subregional extent)	Ground-truth for feed trees within proposed disturbance areas, including isolated trees and within non-remnant vegetation. Minimise loss of any identified food tree and of any large hollow-bearing trees in remnant or non-remnant vegetation.	Probable	Long term	Moderate (offset required)	High

Species	Significance of study area	Impact type	Mitigation and compensatory measures ¹	Mitigated impact			Prediction reliability index
				Likelihood of impact occurring	Residual impact duration	Residual impact	
		Indirect impacts: <ul style="list-style-type: none"> Increased competition for tree hollows used for nesting with other species displaced by clearing 	Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.				
State significant fauna - NC Act rare or near threatened							
Golden-tailed gecko <i>Strophurus taenicauda</i>	Common and widespread in the study area. Endemic to bioregion. Study area is very important to the species.	Direct impacts: <ul style="list-style-type: none"> Potential loss of approximately 5,432ha potential habitat (0.26% of subregional extent) Mortality during clearing activities Barriers to movement created Indirect impacts: <ul style="list-style-type: none"> Increased access to habitat by feral predators 	Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Certain	Long term	Significant (offset required)	High
Little pied bat <i>Chalinolobus picatus</i>	Twenty-three database and survey records.	Direct impacts: <ul style="list-style-type: none"> Potential loss of approximately 5,828ha potential habitat 	Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat.	Certain	Long term	Moderate (offset required)	Medium

Species	Significance of study area	Impact type	Mitigation and compensatory measures ¹	Mitigated impact			Prediction reliability index
				Likelihood of impact occurring	Residual impact duration	Residual impact	
	Study area is of moderate importance to the species.	(0.24% of subregional extent) • Mortality during clearing activities Indirect impacts: • Increased competition for roosting sites	Implement clearing management guidelines.				
Rough frog <i>Cyclorana verrucosa</i>	Generally sparse, may be common in suitable habitat. Study area is of high importance to the species.	Direct impacts: • Potential loss of approximately 458ha potential habitat (0.11% of subregional extent) • Mortality during clearing activities Indirect impacts: • Increased access to habitat by feral predators • Any possible increase in feral Pigs will increase physical disturbance of wetlands • Any possible increase in Cane Toads may increase competition	Minimise, where practicable, disturbance to soil structure of low-lying areas of cracking clays. Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat. Implement feral animal management guidelines.	Certain	Long term	Moderate (offset required)	High

Species	Significance of study area	Impact type	Mitigation and compensatory measures ¹	Mitigated impact			Prediction reliability index
				Likelihood of impact occurring	Residual impact duration	Residual impact	
Square-tailed kite <i>Lophoictinia isura</i>	Uncommon breeding resident. Study area is of moderate importance to the species.	Direct impacts: <ul style="list-style-type: none"> Potential loss of approximately 5,244ha potential habitat (0.24% of subregional extent) Indirect impacts: <ul style="list-style-type: none"> nil 	Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat.	Certain	Long term	Moderate (offset required)	High
Woma <i>Aspidites ramsayi</i>	Uncommon. Study area of moderate importance to the species.	Direct impacts: <ul style="list-style-type: none"> Potential loss of approximately 5,409ha potential habitat (0.27% of subregional extent) Mortality during clearing activities Indirect impacts: <ul style="list-style-type: none"> Increased access to habitat by feral predators Decreased prey abundance due to possible increased predation by feral species and loss of habitat 	Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Certain	Long term	Moderate (offset required)	High

¹ Further detail on specific management guidelines is provided in Volume 5 Attachment 14 Section 3.5.

Bioregional corridors

State and regional bioregional corridors (EPA 2008a,b,c) traverse the study area and a number of the individual gas fields tenements (Volume 5 Attachment 14 Appendix D). The significance of these corridors for flora and fauna is afforded particular significance within the region due to extreme fragmentation and continued disturbance of remnant vegetation, primarily as a result of grazing practices.

Many of the corridors are themselves highly fragmented and habitat patches act as 'stepping stones' in some locations, where only those species able to negotiate cleared areas can forage and disperse more widely.

The creation of further barriers to fauna movement within the corridors, such as roads, pipelines, and clearing for other Project infrastructure, would have a potentially significant and long term adverse impact on regional biodiversity without mitigation measures.

With mitigation measures, which include minimising clearing and concentrating rehabilitation and restoration of remnant vegetation for offsets within the bioregional corridors, the potential impacts are predicted to be minor in the short term and will result in a long term regional ecological benefit through the improvement of habitat connectivity.

Communications towers

A number of the communications tower sites are outside the gas fields' study area and have not yet been ground-truthed.

Based on desktop information, approximately 0.5ha will need to be permanently cleared of all existing vegetation and associated habitat for the placement and operation of each telecommunications tower, while access tracks may also need to be established for the transportation of construction materials and machinery and to allow ongoing maintenance.

Volume 5 Attachment 14, Table 3.5 provides an indicative assessment of potential impacts on currently recognised values as a result of this disturbance, along with recommended measures of avoidance, mitigation or offsetting.

In general, all proposed locations should be ground-truthed to confirm whether potential or currently recognised values are present, such that appropriate management measures are adopted. In particular, it is recommended that national parks and any confirmed occurrences of threatened ecological communities under the EPBC Act and endangered REs are protected from all disturbances.

Matters of national environmental significance

Under the EPBC Act an action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance.

Matters of national environmental significance have been addressed throughout this report as part of the impact assessment process. The recommended self-assessment process of addressing significant impact criteria as identified by DEWHA is presented in Volume 2 Chapter 23.

The findings of these assessments indicate that, provided the recommended mitigation and offset measures recommended in this report are successfully implemented, there are no predicted significant impacts on any species or community listed under the EPBC Act.

8.5 Mitigation and management

The proposed mitigation measures are designed to ensure impacts are reduced to negligible or at most minor levels via the application of habitat management guidelines (Figure 8.8), and where this cannot be achieved, through offsets described in Section 8.5.3. The successful mitigation of potential impacts will rely on the quality and implementation of the habitat management guidelines. It is proposed that the guidelines be prepared and referred/addressed in environmental management plans to be developed for the Project, including the preparation of individual threatened species management guidelines that can be applied to works that may affect specific species of significance likely to be encountered during the life of the gas fields.

8.5.1 Landscape scale

The sensitivity mapping described in Section 8.2.2 categorises the significance and sensitivity of ecosystems (using RE mapping as a base unit). Management measures to mitigate landscape-scale ecological impacts for each of the ecological sensitivity categories are as follows:

- Category 1: Extremely sensitive. Siting infrastructure within these areas will be avoided
- Category 2: Highly Sensitive. Infrastructure will only be located within or in proximity to existing cleared and disturbed areas to reduce fragmentation. Limited clearing for construction (if necessary for incremental expansion of existing disturbance) to be rehabilitated prior to operation
- Category 3: Sensitive. Clearing only for linear infrastructure and well leases. Non-linear infrastructure to be located within or in proximity to existing cleared and disturbed areas. Disturbed areas not required for ongoing operation to be rehabilitated prior to operation
- Category 4: Neutral. Clearing for linear and non-linear infrastructure is to minimise edge effects where possible
- Category 5: Robust. Clearing for infrastructure, although hollow-bearing trees and habitat connectivity, particularly along watercourses, to be retained
- Category 6 and 7: Cleared. Siting of infrastructure >100m from edges of categories 2 to 5 and >200m from category 1.

Figure 8.9 presents the results of proposed actions from the impact assessment process, indicating the locations of REs (and their analogous communities of national conservation significance) recommended to be maintained, areas where further field investigations are required to accurately locate specific, highly restricted habitats and species, and areas where offset actions will be most beneficial.

8.5.2 Habitat management guidelines

To address potential impacts on terrestrial fauna and flora, habitat management guidelines will be developed as the overarching terrestrial ecology management document, setting out the relationship of the individual ecological management guidelines to the overall goal of minimising, mitigating, and offsetting ecological impacts arising from the construction, operation, and decommissioning of the Project. The following individual management guidelines, described in detail in Section 3.5 of Volume 5 Attachment 14, will be prepared and incorporated in the environmental management plan for the Project:

- Threatened species management guidelines, plus individual guidelines for specific species where required
- Clearing management guidelines
- Weed management guidelines
- Feral animal management guidelines
- Rehabilitation and revegetation management guidelines
- Ecological fire management guidelines.

While landscape scale measures will be in place to minimise habitat disturbance and fragmentation, the threatened species management guidelines will set out the process for detecting, defining and protecting the habitats of significant species within a 200m radius of all infrastructure for endangered and vulnerable species and endangered regional ecosystems, and within a 100m radius for rare species and of concern regional ecosystems.

Management of erosion and sedimentation, soil and water contamination, and noise, dust and vibration, are standard components of the Project's EM Plan (Volume 2, Chapter 24). Suppression of dust for habitat quality reasons will be expressly dealt with in the habitat management guidelines, especially over the term of operational practices.

Habitat loss and fragmentation has the potential to impact on overall biodiversity through loss per se and through interference with processes and ecological functioning. Strategies to minimise, mitigate and offset these impacts will be outlined in the rehabilitation and revegetation management guidelines and the threatened species management guidelines.

The introduction and/or spread of weeds have the potential to degrade habitat over time. The management of extant weed populations, the minimisation of the spread of weeds throughout the study area and the eradication and control of new infestations will be detailed within the weed management guidelines.

Siting of stockpile areas, temporary accommodation facilities, offices, spoil dumps, refuse areas, vehicle parking areas and so on must, where possible, be within areas already cleared or proposed to be cleared. Management of these areas for weed and feral animals will be achieved through the weed and feral animal management guidelines.

Native vegetation, agricultural lands, and rehabilitation areas within the study area will require ongoing management of grazing activities, fire, and pest species. Livestock, particularly cattle, and feral fauna, cause damage to vegetation and substrate over large areas, compete with native herbivores and trample some native fauna species. Other feral species such as foxes and cats kill native fauna and compete with native carnivores. Weeds, especially exotic grasses and mother of millions, degrade habitat condition, as does inappropriate fire regimes. Management will be required in operational and access areas and in areas undergoing current or future rehabilitation or acting as buffers.

Vehicular strike causes death of many native fauna species crossing between habitat patches and gaps in native habitat may require devices to facilitate fauna movement and these would need to be constructed, maintained, and monitored. Speed limits will apply to construction and access roads, signage alerting drivers to the potential presence of fauna on roads will be erected in areas where the roads intersect vegetation significant patches, and driver education programmes will be implemented.

Preparing and implementing habitat management guidelines will include monitoring of associated management guidelines (weed management, feral animal, rehabilitation, and revegetation, and

ecological fire) that will allow assessment of the accuracy of predicted impacts, the effectiveness of mitigation measures and adaptive control and mitigation measures.

8.5.3 Environmental offsets

Offset policies

The Queensland Government Environmental Offsets Policy (EPA 2008f) outlines the needs and guidelines for offsets in Queensland under circumstances where clearing of remnant vegetation is unavoidable. The policy provides a broad outline of offset requirements for remnant vegetation, marine fish habitat and Koala habitat, although it does not specifically prescribe offset ratios and does not deal specifically with the offset of significant fauna habitat other than for Koalas in the south east Queensland bioregion.

A draft Queensland Government Policy for Biodiversity Offsets (EPA 2008e) is currently in the consultation stage. In the draft policy document, biodiversity offsets are described as actions to be undertaken to counterbalance an impact that causes a loss of biodiversity values. The draft Policy defines biodiversity as 'the natural diversity of native wildlife, together with the environmental conditions necessary for their survival'.

Environmental offsets for the Project

For the purposes of this assessment, the environmental metric used to measure offsets meets the required equivalent or better environmental outcome is hectare units of habitat for affected species. This has been applied to those species listed both under State and Commonwealth legislation, with requirements for offsets determined on the basis of potential impacts on each biodiversity element as assessed and the predicted success of mitigation measures (Volume 5 Attachment 14 Appendix N).

Clearing within EPBC endangered ecological communities, and endangered and of concern REs (biodiversity status) will be offset. In addition, those species for which recommended mitigation measures cannot adequately ameliorate potential impacts (i.e. reduce potential impacts to negligible or minor at most) have been identified for offsetting.

The final offset package is to be negotiated between the proponent and the relevant authorities.

While construction of each component of the proposed infrastructure would allow for varying levels of rehabilitation prior to the operational phase, overall, approximately one-third of the cleared vegetation is to be rehabilitated to pre-clearing vegetation type as part of ongoing rehabilitation during the life of the Project. The duration of the Project may also allow for the rehabilitation of some of the areas cleared for infrastructure early in the life of the Project, to be included in the offset areas as the resource is depleted and wells are closed.

The optimal approach will be to offset as much as possible within regrowth inside bioregional corridors, with the next highest priority being rehabilitation of cleared land inside bioregional corridors, and lastly to offset outside of biodiversity corridors using only regrowth vegetation. It should be noted that offsets will be recalculated once clearing areas and locations are known, and staged as the development proceeds over the 30 year development timeframe.

Figure 8.10 shows the spatial distribution of regrowth and cleared areas as they currently occur within the bioregional corridors inside the tenement boundaries.

8.6 Conclusions

8.6.1 Assessment outcomes

The terrestrial ecological assessment has been informed by a comprehensive review of available literature, high resolution aerial photography flown specifically for the Project, a field program designed to refine regional ecosystem mapping and habitat suitability and condition for the range of significant species present, and input to habitat definition for these species by a panel of ecologists with specific experience in the region.

The most intensive and long-term impacts on conservation significant vegetation communities and flora species will come from the proposed clearing of approximately 6,000ha of remnant vegetation within the 570,000 hectare gas fields' area. While no regional ecosystem will lose more than 0.53% of its area, clearing may fragment habitats of species that only occur sparsely throughout the area.

Other potential impacts identified for the Project include:

- Erosion and sedimentation
- Increased frequency of accidental fire
- Soil and water contamination from oil, fuel or chemicals
- Dust
- Traffic related impacts (vehicle strike).

Australia Pacific LNG will use the sensitivity mapping and habitat management guidelines to plan the location of infrastructure, taking into account the landscape biodiversity values with the aim of minimising habitat fragmentation.

Australia Pacific LNG will also limit clearing in areas of high biodiversity value, particularly for category 1, 2 and 3 areas as outlined in Section 8.6.2. These areas support significant regional ecosystems and/or species, located within large tracts of vegetation and/or within bioregional corridors.

For the remaining category areas within the Project development footprint, Australia Pacific LNG will undertake the following:

- Category 4: Neutral. Clearing for linear and non-linear infrastructure is to minimise edge effects where possible
- Category 5: Robust. Clearing for infrastructure, although hollow-bearing trees and habitat connectivity, particularly along watercourses, to be retained
- Category 6 and 7: Cleared. Siting of infrastructure >100m from edges of categories 2 to 5 and >200m from category 1.

Outside of the project footprint, remnant vegetation will be protected through the implementation of habitat management guidelines for all phases of the Project.

Thirty-six flora and ninety-nine fauna species of special conservation significance are known or considered possible occurrences within the study area. Many aspects of the construction and operation process will affect terrestrial flora and fauna.

To minimise the potential impacts of the Project on these species and their habitats, habitat management guidelines will be developed for incorporation into the environmental management plan, setting out the relationship of the individual ecological management guidelines with the overall goal of

minimising, mitigating and offsetting ecological impacts arising from the construction, operation and decommissioning of the Project.

The following individual management guidelines will be prepared for the Project:

- Threatened species management guidelines within 200m of endangered and vulnerable species habitat and within 100m of rare species habitat (plus individual guidelines for specific species or groups of species where required)
- Clearing management guidelines
- Weed management guidelines
- Feral animal management guidelines
- Rehabilitation and revegetation management guidelines
- Ecological fire management guidelines.

Australia Pacific LNG will undertake pre-clearing surveys prior to all clearing activities to identify the presence of significant regional ecosystems, communities or species and implement avoidance or management measures where necessary.

Management of erosion and sedimentation, soil and water contamination, and noise, dust and vibration are standard components of the Project's EM plan (Volume 2 Chapter 24). Suppression of dust for habitat quality reasons will be expressly dealt with in the habitat management guidelines, especially over the term of operational practices.

Habitat loss and fragmentation has the potential to impact on overall biodiversity through reduced habitat availability and accessibility and through interference with processes and ecological functioning. Strategies to minimise, mitigate and offset these impacts will be outlined in the rehabilitation and revegetation management guidelines and the threatened species management guidelines.

The introduction and/or spread of weeds have the potential to degrade habitat over time. The management of weed populations, the minimisation of the spread of weeds throughout the study area and the eradication and control of new infestations will be detailed within the weed management guidelines. Australia Pacific LNG has committed to work with regional councils in weed control and will construct weed wash down facilities near Miles to support gas field construction and operations.

Construction and operational traffic may come into contact with native fauna, particularly during dawn, dusk and night time hours. Impacts of this type will be dealt with in the habitat and threatened species management guidelines.

Management of weeds and feral animals will be achieved through the weed and feral animal management guidelines. These guidelines may need to be integrated into the overall biosecurity management plan to be prepared for the Project.

Native vegetation, agricultural lands and rehabilitation areas within the study area require ongoing management of grazing activities, fire and pest species. Livestock, particularly cattle, and feral fauna species, especially pigs, horses and goats, cause damage to flora and fauna habitat. Other feral species such as foxes and cats kill native fauna and compete with native carnivores. Weeds, especially exotic grasses, degrade habitat condition, as does inappropriate fire regimes. Management will be carried out in operational and access areas and in areas subject to current or future rehabilitation or acting as buffers.

The preparation and implementation of habitat management guidelines will guide rehabilitation works, identify any need for remedial measures and will include a component to conduct regular pest management programs. The operational phase of the habitat management guidelines will include monitoring components of associated management guidelines (weed management, feral animal, rehabilitation and revegetation, and ecological fire) that will allow assessment of the accuracy of predicted impacts, the success of mitigation measures and for implementation of adaptive control and mitigation measures.

Where the proposed mitigation measures are unable to reduce the potential impacts on significant ecological elements to negligible or minor at most, the establishment of habitat offsets has been recommended to achieve no net loss of biodiversity as a result of the Project. The establishment of offsets will be targeted within bioregional corridors to ensure long-term, regional habitat connectivity is protected and improved over the life of the Project. The final vegetation offsets program will be developed in consultation with the relevant authorities.

8.6.2 Commitments

Australia Pacific LNG commits to utilising sensitivity mapping and habitat management guidelines to plan the location of infrastructure, taking into account the landscape biodiversity values with the aim of minimising habitat fragmentation.

Australia Pacific LNG will limit clearing in areas of high biodiversity value, particularly for:

- Category 1 areas – these areas will be avoided and protected with 'no go' zones and a buffer area established in accordance with the approved habitat management guidelines
- Categories 2 and 3 – in these areas, unless otherwise approved, all activity on undisturbed land will follow the approved habitat management guidelines, infrastructure will be positioned along existing disturbed areas, and active rehabilitation will be implemented.

Australia Pacific LNG will also establish a vegetation offsets program that includes:

- Developing offsets for each hectare of conservation significant vegetation removed for the Project
- Considering ecological values at a regional scale when identifying locations for compensatory offset
- Targeting offsets to enhance biodiversity corridors where practical
- Using a third party provider to manage delivery of the regional program, supplemented with contributions to an administered fund
- Developing and providing offsets to respond to a disturbance inventory.

Australia Pacific LNG will engage with the Government and the community to develop sustainable regional land use strategies that combine the interests of gas production, agriculture and biodiversity values.

Weed prevention

The introduction and/or spread of weeds have the potential to degrade habitat over time. The management of weed populations, the minimisation of the spread of weeds throughout the study area and the eradication and control of new infestations will be detailed within the weed management guidelines.

Australia Pacific LNG will:

- Develop weed management guidelines to minimise the spread of weeds throughout the study area and eradicate and control new weed infestations
- Work with regional councils in weed control
- Construct weed wash down facilities near Miles to support gas field construction and operations.

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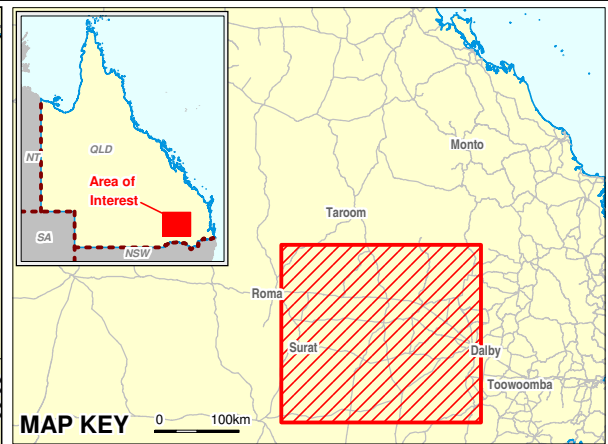
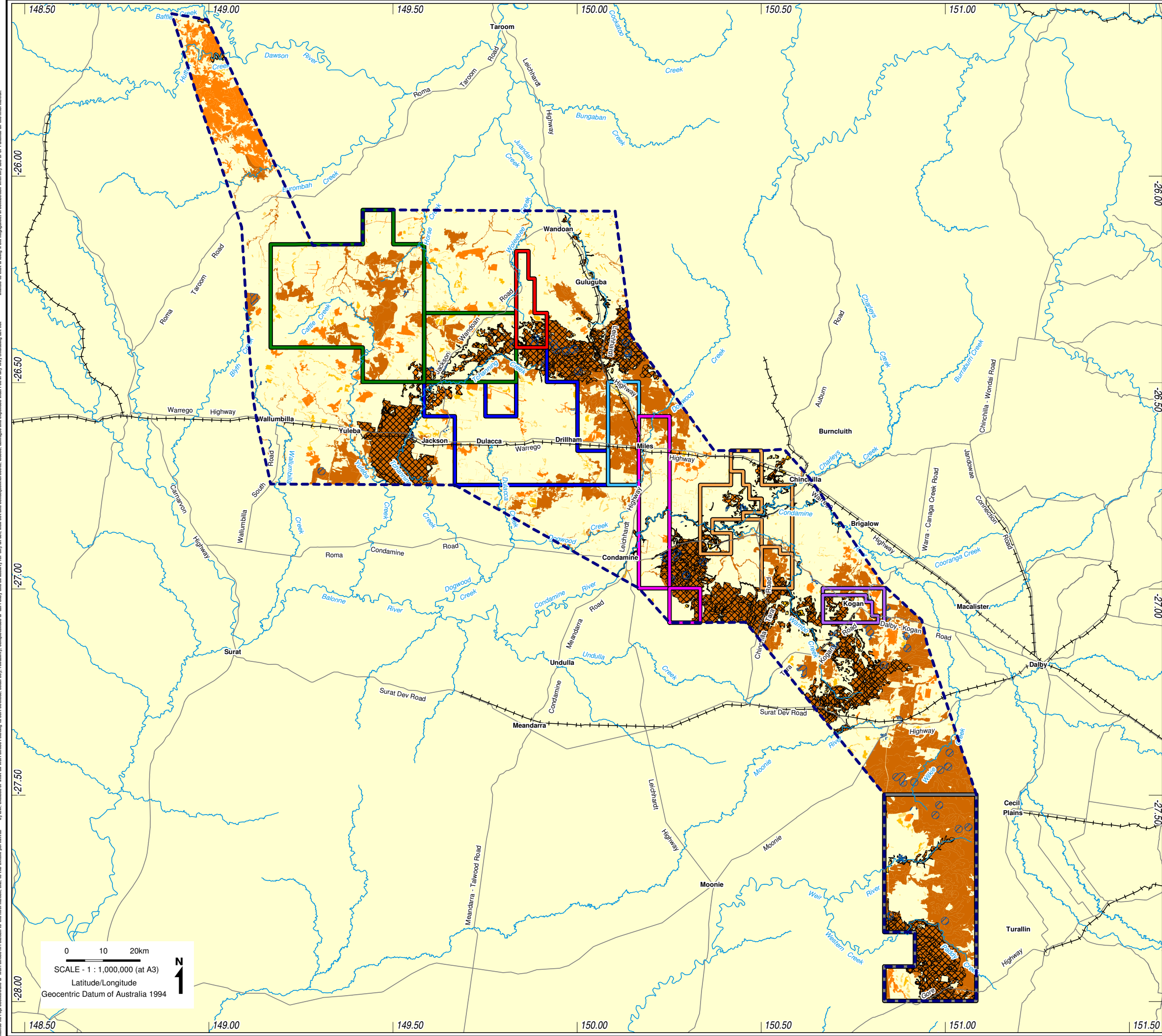
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Figures



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LEGEND

Major drainage
Study area
Road
Railway

Walloons Gas Fields Development Areas

Talinga / Orana
Dalwogan
Kainama
Gilbert Gully
Combabula / Ramyard
Woleebee
Carinya
Condabri

Tract Size

Low
Medium
High
Very high

Corridors

Regional
State

Essential Habitat

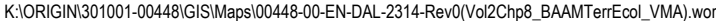
Essential habitat for EVR taxa

Source Information

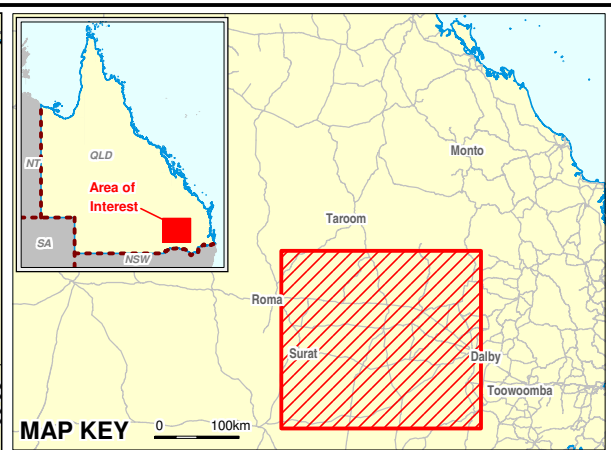
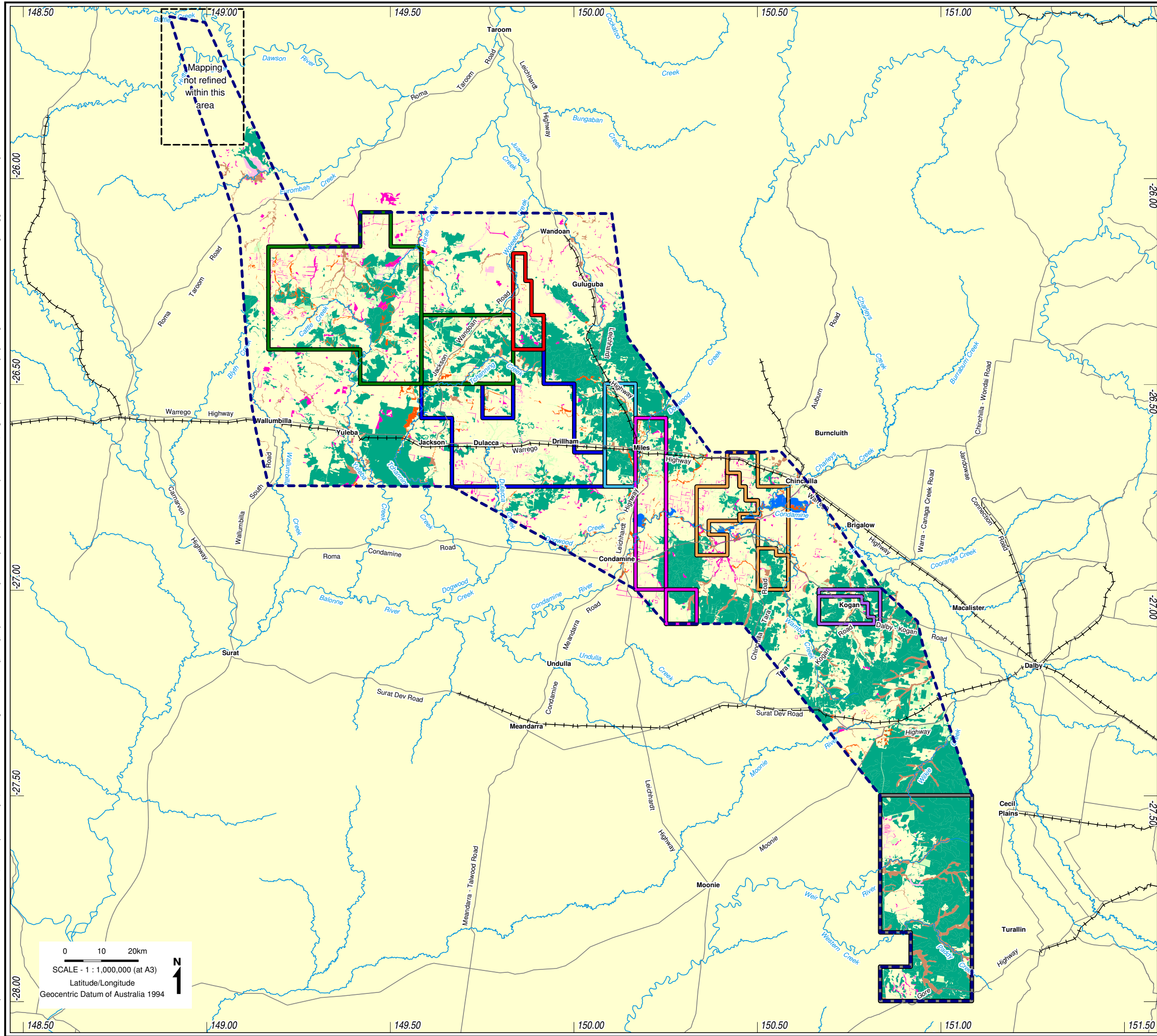
Biodiversity Planning Assessment (BPA)
Biodiversity Assessment and Management Pty Ltd 12 August 2009



Volume 2 Chapter 8
Figure 8.2 - Study area
Biodiversity Planning Assessment (BPA)
mapping: tract size and corridors



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MAP KEY

0 100km

LEGEND

Major drainage
Study area
Road
Railway

Walloons Gas Fields Development Areas

Talinga / Orana
Dalwogan
Kainama
Gilbert Gully
Combabula / Ramyard
Woleebee
Carinya
Condabri

Biodiversity Status

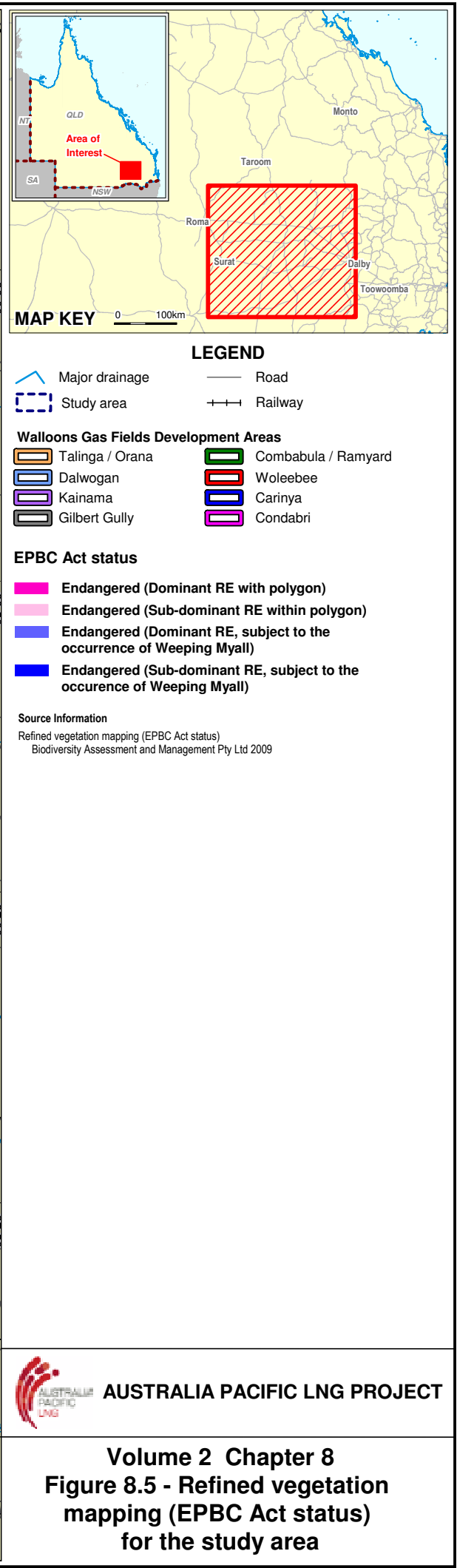
Dominant endangered RE
Sub-dominant endangered RE
Dominant of concern RE
Sub-dominant of concern RE
Not of concern RE
Wetland/waterbody
Regrowth

Source Information

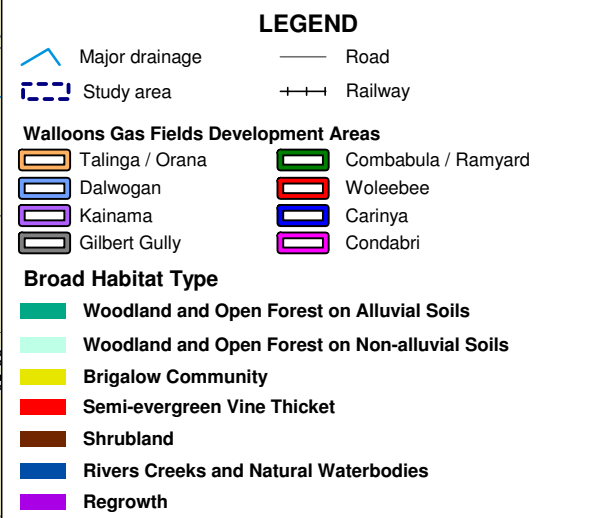
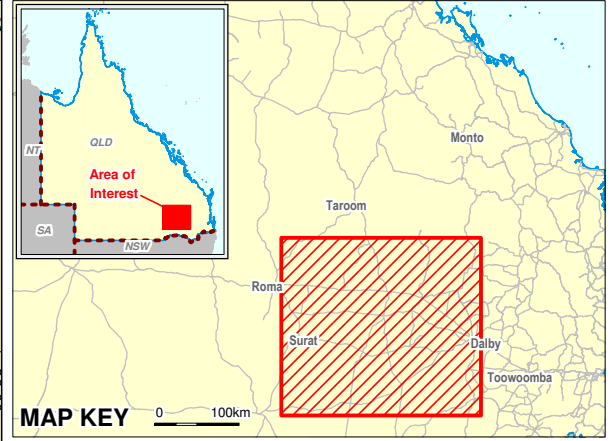
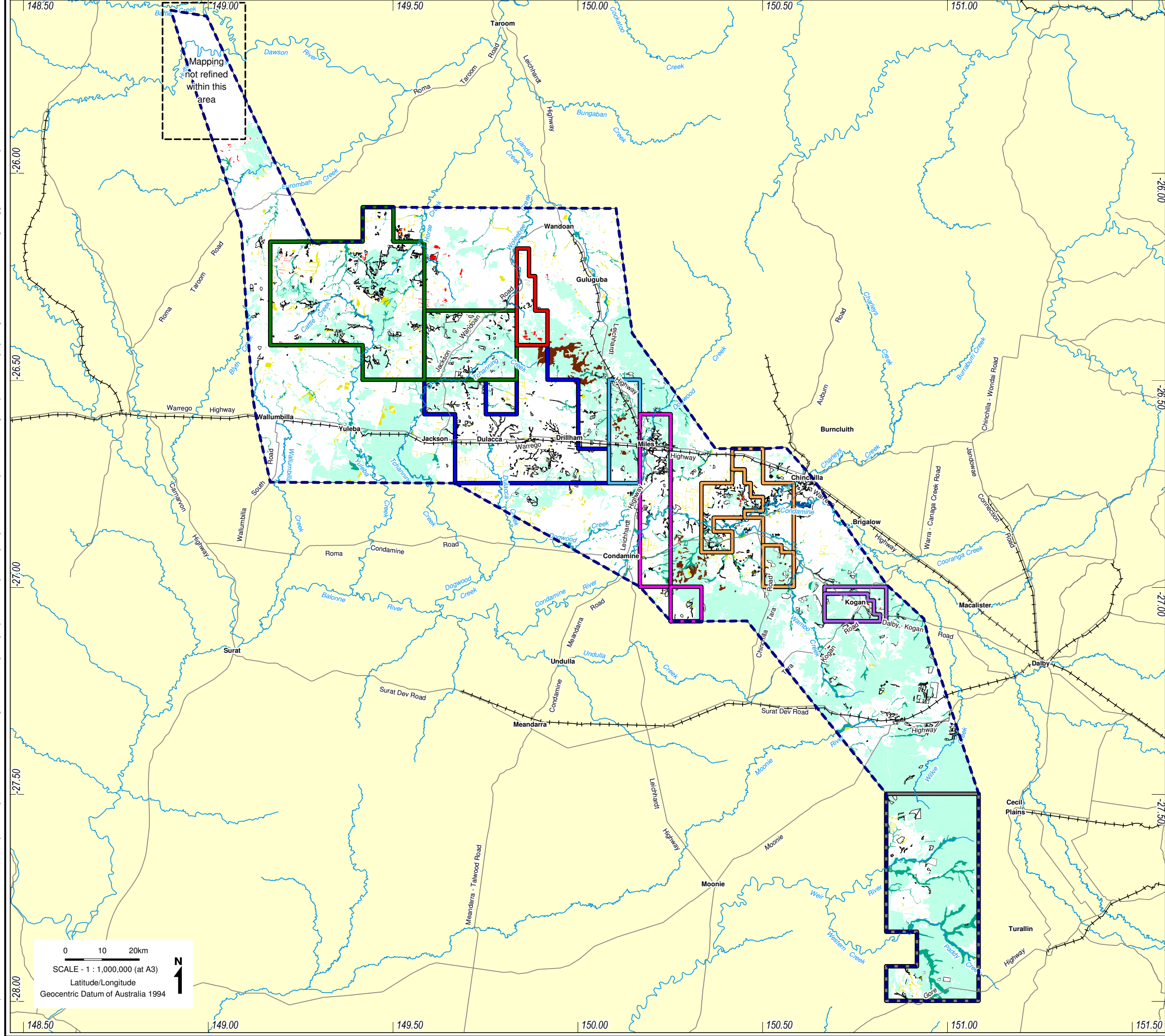
Biodiversity Status
Biodiversity Assessment and Management Pty Ltd 12 August 2009

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Figure 8.4 - Refined vegetation mapping (Biodiversity status) for the study area

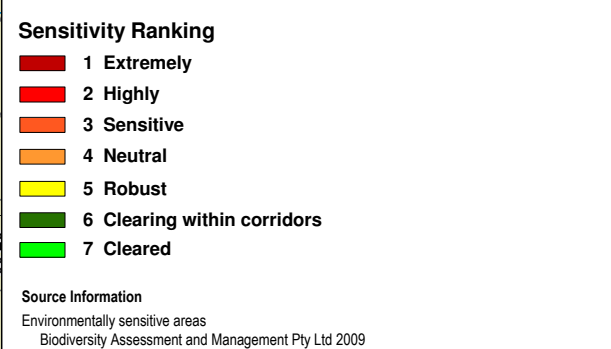
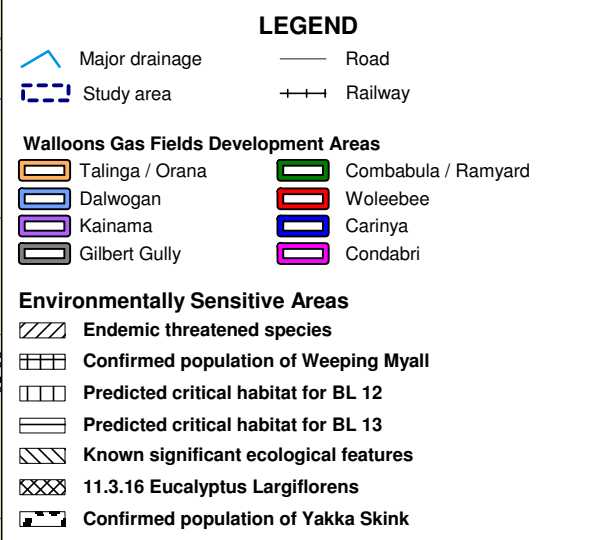
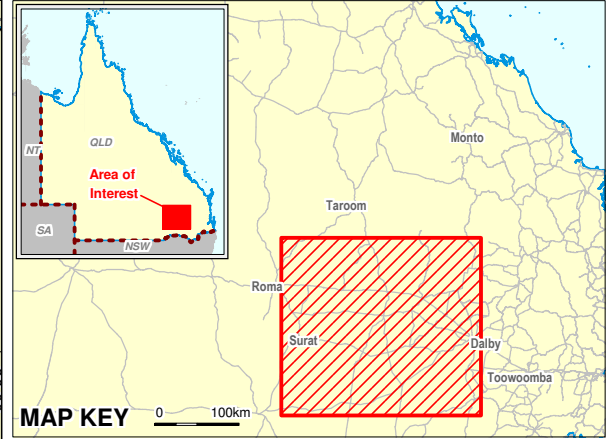
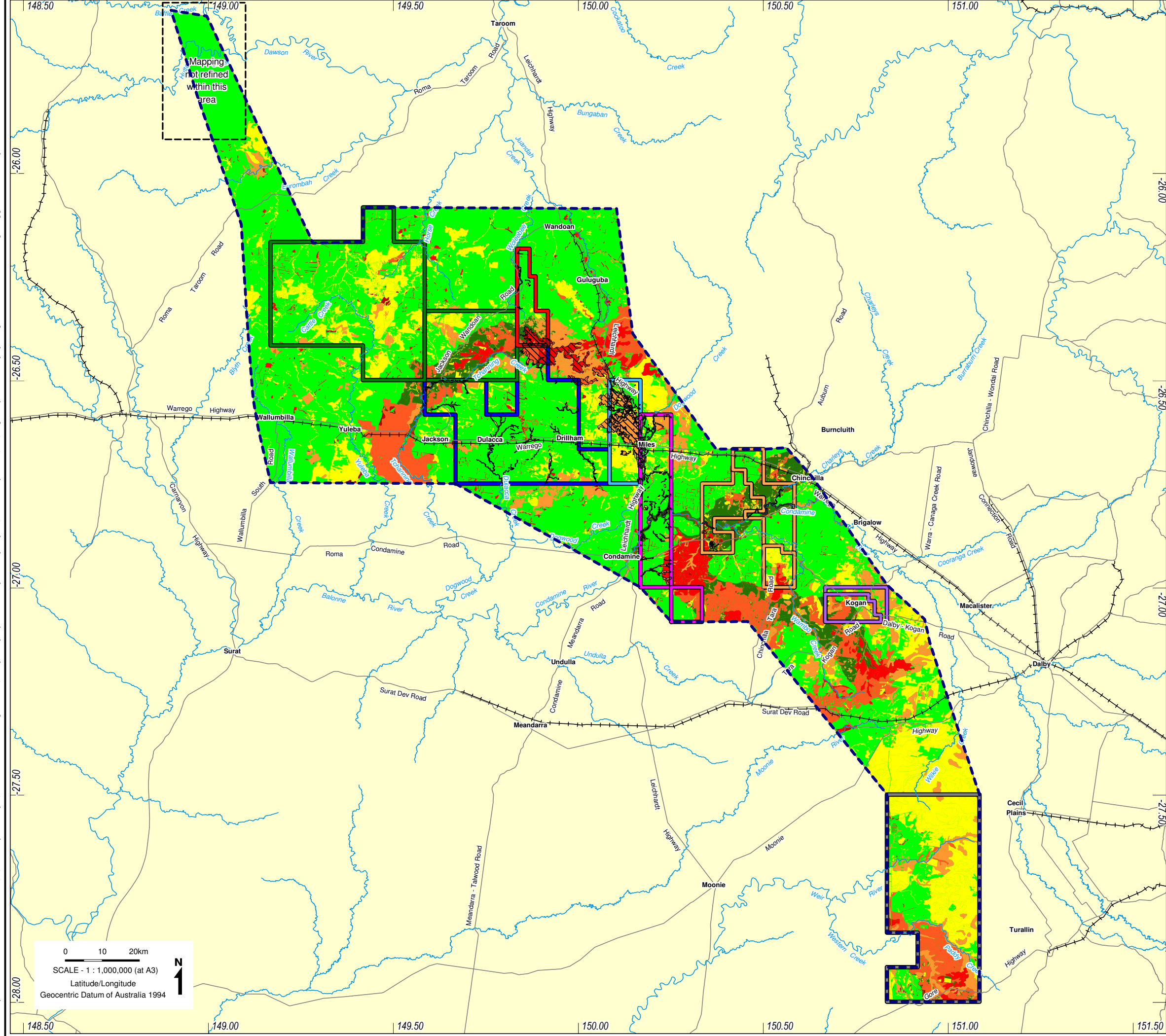


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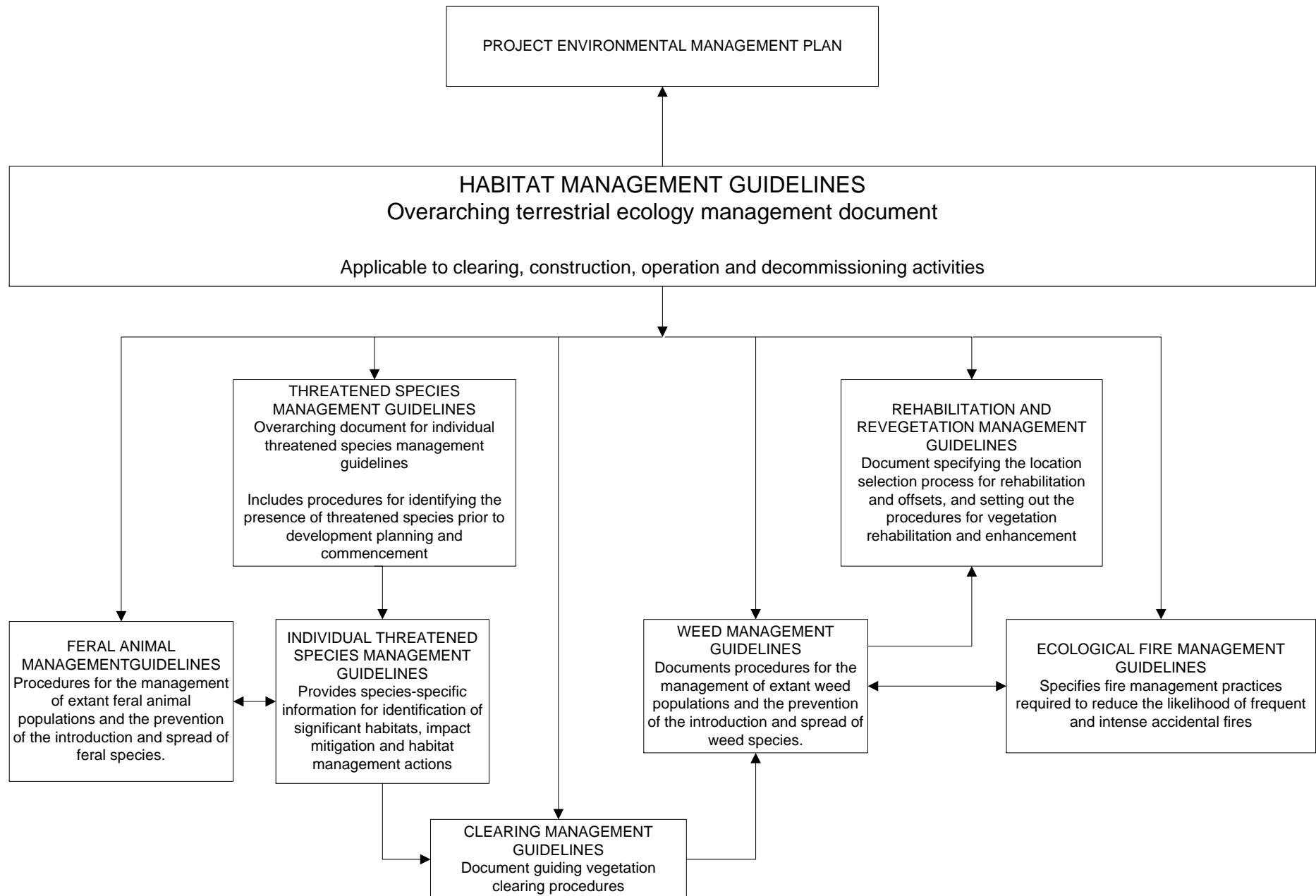
Source Information
Broad habitat type
Biodiversity Assessment and Management Pty Ltd 2009

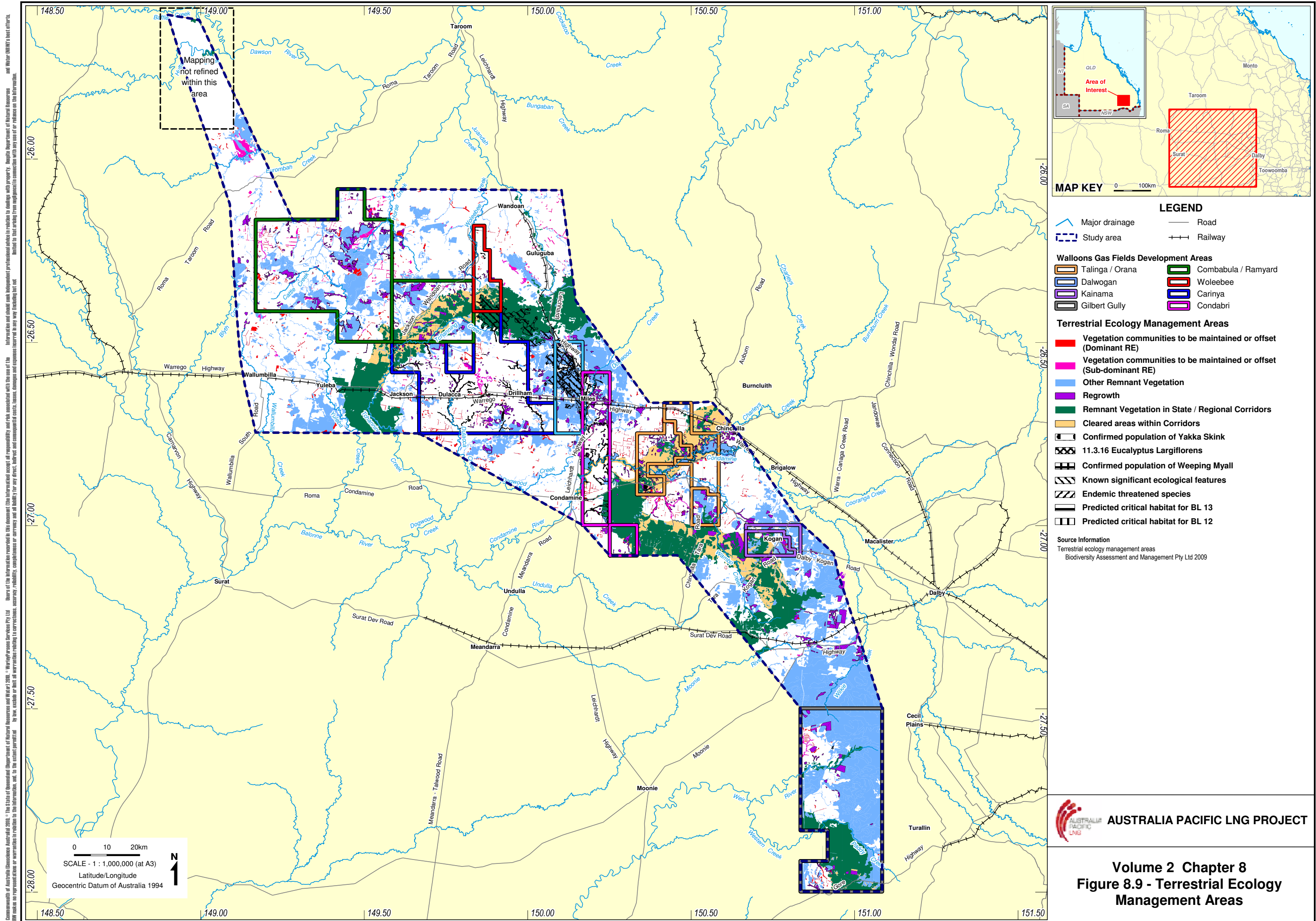
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Figure 8.7 - Study area terrestrial ecology sensitivity map

Figure 8.8 Terrestrial Ecology Management Guideline Relationship Diagram





Commonwealth of Australia (Geoscience Australia) 2010. The State of Queensland (Department of Natural Resources and Water) 2010. Motor Vehicle's best efforts.

