17A TERRESTRIAL ECOLOGY

17A.1 INTRODUCTION

This chapter details the existing terrestrial biological environment in relation to the MLA areas and surrounds. A particular focus of the work is the likely potential impacts of the Project on rare and threatened species and communities listed under the *Nature Conservation Act 1992* (NC Act), *Vegetation Management Act 1999* (VM Act) and *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

Full details of the biodiversity of the study area are provided in the Technical Report TR 17A-1-V1.5, including a Summary of Matters of National Environmental Significance (MNES) provided in Attachment J. Note that figures/documents with numbering ending in V1.5, for example, refer to figures/documents contained in Volume 1, Book 5 of the EIS.

The specific objectives of the terrestrial ecological assessments were to:

- identify and map areas that are environmentally sensitive proximate to the study area including:
  - MNES listed under the EPBC Act
  - important communities, habitats of species listed under the NC Act and/or the EPBC Act as Presumed Extinct, Critically Endangered, Endangered, Vulnerable or Rare
  - regional ecosystems (REs) recognised by the Environmental Protection Agency (EPA) as 'Endangered' or 'Of concern' or 'Not of concern' but where permits are no longer granted due to being at threshold levels, and/or ecosystems listed as 'Presumed extinct', 'Critically Endangered', 'Endangered' or 'Vulnerable' under the EPBC Act
  - ecosystems that provide important ecological functions, such as riparian vegetation, important buffers to protected areas, drought or fire refugia, or important corridors linking areas of habitat
  - protected areas proclaimed or under consideration for proclamation under the NC Act.
- describe and map terrestrial flora in the study area including:
  - location and extent of vegetation types including recognised RE type descriptions and any areas of national, state or regional significance
  - location of vegetation types of conservation significance
  - vegetation map unit descriptions, including a list of species present
  - description of REs, their value as habitat for fauna and for conservation of specific rare floral and faunal assemblages or community types
  - the current extent (bioregional and catchment) of protected vegetation types of conservation significance within the protected areas (e.g. national parks, conservation parks, resource reserves, nature refuges etc)
  - any plant communities of cultural, commercial or recreational significance
  - the distribution and abundance of significant exotic and weed species.

- describe and map terrestrial fauna present or likely to be present in the study area including:
  - species diversity (i.e. a species list) and indicative abundance of animals, including amphibians, birds, reptiles, mammals
  - any species that are poorly known but suspected of being rare or potentially threatened
  - habitat requirements and sensitivity to change, including movement corridors and barriers to movement
  - the existence of feral or exotic animals, including maps of major pest infestations
  - existence of any rare, threatened or otherwise noteworthy species/communities in the study area, including discussion of range, habitat, breeding, recruitment, feeding and movement requirements, and current level of protection (e.g. any requirements of protected area management plans)
  - use of the area by migratory and nomadic birds, in particular areas for breeding or significant congregations.
- provide an assessment of the potential impact on terrestrial flora, fauna and environmentally sensitive areas. This assessment outlines:
  - the significance of impacts at a local, catchment, bioregional, State or national level
  - direct (or short term) and indirect (or long-term) impacts due to loss of range/habitat, food supply, nest sites, breeding/recruiting potential or movement corridors
  - cumulative effects of direct and indirect impacts
  - impacts on rare and threatened or otherwise noteworthy species
  - threatening processes leading to progressive loss
  - identification of the conservation importance of identified populations at the regional, State and national levels.
- outline measures to mitigate the impacts of the Project on terrestrial flora, fauna and environmentally sensitive areas including:
  - methods to ensure rapid rehabilitation of disturbed areas following construction, including the selection of species for revegetation consistent with the surrounding associations. Details of post construction monitoring programs and the benchmarks to be used for review of monitoring
  - methods of minimising the potential for the introduction and/or spread of weeds or plant disease
  - measures to minimise wildlife capture and mortality during construction and operation
  - methodologies to avoid injuries to native fauna as a result of the Project's construction and operational works
  - methods for minimising the introduction of feral animals and other exotic fauna.

The mine component of the Project was declared to be a 'controlled action' under the EPBC Act on the basis that the Project may have a significant impact on listed threatened species and ecological communities (sections 18 and 18A). The biodiversity assessment considers impacts on the relevant MNES listed under the EPBC Act.

17A.2 METHODOLOGY

Technical studies have been undertaken of terrestrial ecology to address the requirements of the Terms of Reference and other relevant International, Commonwealth and state requirements and policies relating to biodiversity.

The approach to the terrestrial ecological impact assessment involved a desktop assessment of literature and relevant databases followed by comprehensive field surveys. The literature and database review was used to identify ecologically sensitive areas and compile a list of conservation significant species for consideration in the impact assessment based on known records or predicted habitat in the study area and surrounds.

The study area for the terrestrial ecological impact assessment included areas that could potentially be affected by the Project either directly or indirectly including:

- the three MLA areas (50229, 50230 and 50231)
- accommodation facilities proposed to house the majority of the workforce north of Wandoan (outside of the MLA areas)
- a potential new high pressure gas supply pipeline from the Peat-Scotia gas line to the mine running 26 km to the north east.

Field surveys were undertaken in the study area to verify the presence of and provide site specific descriptions of vegetation communities, species or their habitats in the study area. Two seasonal surveys of the MLA areas were conducted in October 2007 (spring survey) and March-April 2008 (autumn survey). The gas pipeline route was surveyed between 19 and 21 August 2008 (late winter) and will require further seasonal survey.

The survey of terrestrial flora involved verification of Regional Ecosystem (RE) type and remnant status as mapped by EPA (Environmental Protection Agency 2007), mapping and description of other vegetation regrowth (non-remnant vegetation) and compilation of a comprehensive list of species of plant that occur in the study area. The survey method for terrestrial flora was based on the approach outlined in the Queensland Herbarium's Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner et al. 2005). The flora survey method also used sample techniques and methods used for the Herbarium's CORVEG secondary and tertiary site data collection (Appendix 2 of Neldner *et al.* 2005). The location of flora survey effort is shown in Figure 17A-1-V1.3.

The objective of the survey of terrestrial fauna was to compile a comprehensive list of animal species and their habitats that occur in the study area. The surveys involved a range of survey methods to provide a census of terrestrial vertebrate fauna including trapping, ultrasonic bat detection, spotlighting, call broadcast and active searches for herpetofauna, birds and other incidental evidence of fauna. In addition to these census techniques, fauna habitat assessments were also conducted to provide a basis for the assessment of likelihood of rare and threatened species to occur in the study area and surrounds (Figure 17A-1-V1.3).

17A.3 EXISTING ENVIRONMENT

17A.3.1 REGIONAL CONTEXT

The study area is located within the Taroom Downs subregion of the Brigalow Belt bioregion. The Brigalow Belt bioregion covers an area of 279,496 km^2 and is one of the largest of the 80 defined bioregions (Thackway & Cresswell 1995), extending from Gladstone on the Queensland coast, south to Dubbo in New South Wales. Geologically this region consists predominantly of Jurassic and younger deposits of the Great Artesian Basin and tertiary deposits with elevated basalt flows. Vegetation types include woodlands and open forests of *Eucalyptus populnea* (Poplar Box), *Corymbia citriodora* subsp*. variegata* (Spotted Gum), ironbarks, Bloodwoods (e.g. *Corymbia trachyphloia, C. hendersonii*) and *Callitris* spp. (Cypress Pine). Woodland and forests of *Acacia harpophylla* (Brigalow)*, Casuarina cristata* (Belah) and semi-evergreen vine thickets (SEVT) are also a feature of this bioregion.

The Brigalow Belt bioregion has been largely cleared of woodlands for grazing and dryland agriculture, with the larger remaining areas of vegetation now occurring on the rockier hilly terrain, as roadside vegetation, or as relatively small isolated remnants. The study area is characteristic of areas of the bioregion that have been cleared for grazing and dryland agriculture.

A number of state forests and national parks surround the MLA areas including Precipice National Park (60 km north of the MLA areas), Isla Gorge National Park (70 km north of the MLA areas) and extensive areas of state forest to the east and south.

17A.3.2 DRAINAGE LINES

The waterways of the MLA areas are within the upper Dawson River catchment in the Taroom sub-catchment. The major creeks associated with the MLA areas include:

- Spring Creek and Mud Creek, which flow through MLA 50229
- Halfway Creek, Frank Creek, Two Mile Creek and Juandah Creek, which flow through MLA 50230
- Blackant Creek, Wandoan Creek and Woleebee Creek, which flow through MLA 50231.

These creeks flow into Juandah Creek, which then flows into the Dawson River approximately 75 km north of the MLA areas, just south of Taroom. The Dawson River eventually flows into the Fitzroy River approximately 85 km south west of Rockhampton. The Dawson River is the largest tributary of the Fitzroy River, and the Dawson Catchment covers 35% of the Fitzroy Basin (Joo et al. 2000). Detailed discussion of the aquatic ecology of the study area and region is in Chapter 17B Aquatic Ecology.

17A.3.3 REGIONAL ECOSYSTEMS

A Regional Ecosystem (RE) is a set of vegetation communities in a bioregion that is consistently associated with a particular combination of geology, landform and soil (Sattler & Williams 1999). Eight REs were identified within the study area (Table 17A-1 and Figure 17a-2-V1.3) and these are described below. Mapping of REs and non-remnant vegetation at 1:10,000 scale is provided in Attachment E of the Technical Report TR 17A-1-V1.5.

Table 17A-1: Field verified regional ecosystems within the study area

RE Code	RE description[1]	VM Act status	EPA Biodiversity status	EPBC Act status
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Not of concern	Of concern	Not listed
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of concern	Of concern	Not listed
11.9.4	Semi-evergreen vine thicket on fine grained sedimentary rocks	Endangered	Endangered	Endangered
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered	Endangered
11.9.6	*Acacia melvillei +/- Acacia harpophylla* open forest on fine-grained sedimentary rocks	Endangered	Endangered	Endangered
11.9.7	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	Of concern	Of concern	Not listed
11.9.10	*Acacia harpophylla*, *Eucalyptus populnea* open forest on fine-grained sedimentary rocks	Of concern	Endangered	Not listed
11.10.9	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	Not of concern	No concern at present	Not listed

NOTE: 1 – Environmental Protection Agency (2007)

The study area was largely cleared of remnant vegetation as a result of grazing and dryland agriculture. The remaining remnant vegetation was generally restricted to the main drainage lines traversing the study area including Spring Creek and Mud Creek, which flow through the western MLA area (MLA 50229); Wandoan Creek and Woleebee Creek which flow through the central MLA area (MLA 50231); and Halfway Creek, Frank Creek, Two Mile Creek and Juandah Creek which flow through the eastern MLA area (MLA 50230), as shown in Figure 17A-2-V1.3. Vegetation along these drainage lines was dominated by RE 11.3.25 (*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines) with RE 11.3.2 (*Eucalyptus populnea* woodland on alluvial plains) spreading across the floodplains. The remnant vegetation along these drainage lines forms continuous linear patches that form part of a wider regional corridor network. This vegetation is also recognised as having regional significance under the Biodiversity Planning Assessment for the Brigalow Belt bioregion as depicted in Figure 17A-3-V1.3.

Other remnant vegetation in the study area was highly fragmented and comprised similar REs dominated by *Acacia harpophylla* (Brigalow) and *Eucalyptus populnea* (Poplar box) (RE 11.9.5, RE 11.9.6, 11.9.7 and RE 11.9.10). In addition to the remnant vegetation mapped by the EPA, over 1,000 ha of vegetation regrowth (non-remnant vegetation) was mapped and described in this assessment. The non-remnant vegetation was dominated by

Acacia harpophylla analogous with RE 11.9.5 and small areas of highly modified semi-evergreen vine thicket (SEVT) (analogous with RE 11.9.4).

RE 11.9.4 has a conservation status of endangered under the VM Act, however this only applies to patches of remnant vegetation, of which none occurs in the study area. Vegetation analogous with RE 11.9.4 (remnant and non-remnant) is however consistent with semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions, and endangered ecological community listed under the Commonwealth EPBC Act.

REs 11.9.5 and 11.9.6 have a conservation status of endangered under the VM Act and are also consistent with the Brigalow (*Acacia harpophylla* dominant co-dominant) endangered ecological community listed under the EPBC Act.

The listing of Brigalow (*Acacia harpophylla* dominant and co-dominant) under the EPBC Act includes both remnant and non-remnant vegetation, but excludes regrowth vegetation in poor condition (i.e. regrowth lacking structure and species composition typical of remnant Brigalow). Brigalow regrowth (non-remnant vegetation) in the study area characteristic of RE 11.9.5 and RE 11.9.6 was of poor quality and generally lacked the species composition and structural elements typical of that found in remnant Brigalow in the study area. Regrowth (non-remnant vegetation) within the study area was therefore not considered part of the Brigalow ecological community that is listed under the EPBC Act (Threatened Species Scientific Committee 2001).

Remnant RE 11.9.5 and RE 11.9.6 is consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant), as listed under the EPBC Act.

17A.3.4 SPECIES OF PLANT

Searches of relevant databases identified records of 649 species of plant that were likely to be found in the study area and surrounds. The field surveys of the study area confirmed 465 species of plant, of which 388 (84%) are native. The most diverse family was the grasses (Poaceae) of which 109 species were recorded (81.6% of which are native).

Seven species recorded in the study area are 'declared plants' listed under the *Land Protection (Pest and Stock Route Management) Act 2002*, all of which are listed as Class 2 pests, as listed in Table 17A-2. Class 2 pests are species established in Queensland which have, or could have, an adverse economic, environmental or social impact. The control and management of these pest species is a coordinated effort involving State and local government, community and landowners.

Table 17A-2: Declared plants recorded in the study area

Species	Common name	Class
Bryophyllum delagoense	*Mother of Millions*	2
Bryophyllum x *houghtonii* (syn. *Bryophyllum delagoense* x *B. daigremontianum*)	*Hybrid Mother of Millions*	2
Opuntia stricta	*Prickly Pear*	2
Opuntia tomentosa	*Velvet Tree Pear*	2
Parthenium hysterophorus	*Parthenium*	2
Sporobolus africanus	*Parramatta Grass*	2
Xanthium spinosum	*Bathurst Burr*	2

Seven threatened species of plant listed under the NC Act and four under the EPBC Act were identified as potentially occurring within the study area or surrounds from the desk-top assessment. Only one of these species, *Homopholis bensonii,* was recorded during field surveys conducted for this assessment. This species was recorded at four locations within the study area, within non-remnant vegetation analogous with RE 11.9.5 (*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks) as shown in Figure 17A-4-V1.3. The identification of this species has been confirmed by the Queensland Herbarium. *Homopholis belsonii* is also a priority taxa species of plant for the Brigalow Belt South (Environmental Protection Agency and Environmental Planning Southwest Queensland 2002). *Acacia melvillei* (Yaran) and *Swainsona swainsonioides* (Downy Swainson-pea) were the only other priority plant taxa for the Brigalow Belt South recorded in the study area.

No other threatened species listed under the NC Act, EPBC Act or priority taxa species of plant for the southern Brigalow Belt bioregion were considered likely to occur in the study area due to lack of suitable habitat.

17A.3.5 FAUNA HABITATS

Five broad fauna habitat types exist within the study area. These are eucalypt woodlands, non-eucalypt woodlands, riparian, wetlands (natural or artificial), and cleared lands. These fauna habitats are broad groupings of the vegetation types/REs present within the study area shown in Table 17A-3.

Table 17A-3: Fauna habitats and corresponding RE code

Habitat type	Corresponding RE code
Eucalypt woodland	RE 11.3.2, RE 11.9.7, RE 11.9.10
Non-Eucalypt woodland	RE 11.9.4, RE 11.9.5, RE 11.9.6, RE 11.10.9
Riparian	RE 11.3.25
Wetland (including natural and artificial baterbodies)	—
Cleared lands	—

Woodland and riparian habitats within the study area and surrounds were highly fragmented with much of the surrounding landscape cleared. Within the study area there is only limited connectivity among habitat patches given the extent of clearing and the distance separating larger areas of core habitat. Under these circumstances, even small patches may provide important stepping stones for animals traversing a fragmented landscape (Bennett 1993).

Much of the remaining vegetation within the study area comprises linear strips adjacent to creeks, as shown in Figure 17A-2-V1.3. Most of this vegetation comprises REs 11.3.25 and 11.3.2. These continuous linear patches of woodland form part of a wider regional corridor network that is likely to play an important role in the movement of wildlife throughout the landscape, particularly for species such as the Koala (*Phascolarctos cinereus*) and Greater Glider (*Petaurus australis*), which were both observed in these habitats. These linear patches are recognised by State Wildlife Corridor mapping (Environmental Protection Agency 2004) and are of regional significance under the

Biodiversity Planning Assessment for the Brigalow Belt bioregion (Environmental Protection Agency 2003) as shown in Figure 17A-3-V1.3.

17A.3.6 SPECIES OF ANIMAL

Database searches returned records of 288 terrestrial vertebrate species within the study area and surrounds, comprising 181 species of bird, 22 species of frog, 26 species of mammal and 59 species of reptile.

Field surveys of the study area recorded 232 species of vertebrate fauna including 220 native species and 12 introduced species. Birds were the most diverse groups of terrestrial vertebrate fauna recorded in the study area followed by reptiles, mammals and frogs as listed in Table 17A-4.

Table 17A-4: Summary of species of terrestrial fauna identified in the study area

Taxa	MLA areas (spring surveys)	MLA areas (autumn surveys)	Gas pipeline	Native species	Introduced species	Total
Mammals	31	26	19	27	7	34
Birds	107	103	75	132	3	135
Frogs	16	13	4	15	1	16
Reptiles	36	26	10	46	1	47
Total	**190**	**168**	**108**	**217**	**12**	**232**

Fauna species detection within the MLA areas was highest in spring, with 190 species recorded during surveys. In autumn, 168 species were recorded on MLA areas including 39 species not recorded on summer surveys. Only two additional species were recorded within the study area during survey of the gas supply pipeline route.

Species diversity was broadly comparable across fauna habitat types with the exception of wetland habitat, where only 85 species (mainly wetland birds and frogs) were recorded, as summarised in Table 17A-5. In other habitat types, the number of species recorded during surveys ranged from 147 (non-eucalypt woodland) to 115 species (eucalypt woodland habitats).

Table 17A-5: Summary of terrestrial fauna diversity associated with broad habitat types

Group	Non-Eucalypt woodland (Brigalow / SEVT)	Eucalypt woodland (Ironbark dominated)	Eucalypt woodland (Poplar Box dominated)	Riparian	Cleared	Wetland / dam
Frogs	10	8	10	15	13	16
Reptiles	30	15	22	18	17	4
Mammals	28	25	25	27	16	14
Birds	79	67	79	86	71	51
Total	**147**	**115**	**136**	**146**	**117**	**85**

Nineteen Rare or Threatened species of animal listed under the NC Act and six threatened species under the EPBC Act were considered likely to occur within the study area and surrounds based on likelihood-of-occurrence assessment as listed in Table 17A-6. During field surveys, four of these species were recorded (Figure 17A-4-V1.3):

- Glossy Black-cockatoo (*Calyptorhynchus lathami*)
- Little-pied Bat (*Chalinolobus picatus*)
- Brigalow Scaly-foot (*Paradelma orientalis*)
- Golden-tailed Gecko (*Strophurus taenicauda*).

In addition, twelve regionally significant species and two migratory species were recorded in the study area.

Table 17A-6: Threatened species of animal predicted to occur within the study area

Name	Conservation status[1]			Likelihood of occurrence
	NC Act	EPBC Act	Priority Taxa	
Rough Frog (*Cyclorana verrucosa*)	R		Yes	Moderate
Dunmall's Snake (*Furina dunmalli*)	V	V	Yes	Moderate
Brigalow Scaly-foot (*Paradelma orientalis)*	V	V	Yes	High (recorded)
Golden-tailed Gecko (*Strophurus taenicauda*)	R		Yes	High (recorded)
Common Death Adder (*Acanthopis antarcticus*)	R		Yes	Moderate
Yakka Skink (*Egernia rugosa*)	V	V	Yes	Moderate
Cotton Pygmy Goose (*Nettapus coromandelianus*)	R		Yes	Moderate
Grey Goshawk (*Accipiter novaehollandiae)*	R		Yes	Moderate
Grey Falcon (*Falco hypoleucos)*	R		Yes	Moderate
Square-tailed Kite (*Lophoictinia isura*)	R		Yes	Moderate
Black-necked Stork (*Ephippiorhynchus asiaticus*)	R		Yes	High
Australian Painted Snipe (*Rostratula australis*)	V	V	Yes	Moderate
Squatter Pigeon (southern race) (*Geophaps scripta scripta*)	V	V	Yes	Moderate
Pink Cockatoo (*Cacatua leadbeateri*)	V		Yes	Moderate
Glossy Black-cockatoo (*Calyptorhynchus lathami)*	V		Yes	High (recorded)
Black-chinned Honeyeater (*Melithreptus gularis*)	R		Yes	Moderate
Painted Honeyeater (*Grantiella picta*)	R		Yes	Moderate
Little-pied Bat (*Chalinolobus picatus*)	R		Yes	High (recorded)
Greater long-eared Bat (*Nyctophilus timoriensis*)	V	V	Yes	Moderate

1. Conservation significance: NC Act and EPBC Act: E = Endangered, V = Vulnerable, R = Rare (NC Act). Priority taxa as identified by the Brigalow Belt South Flora Expert Panel (Environmental Protection Agency and Environmental Planning Southwest Queensland 2002)

Thirty-one non-threatened priority taxa species of animal for the Brigalow Belt South (Environmental Protection Agency and Environmental Planning Southwest Queensland 2002) were considered likely to occur within the study area and surrounds based on likelihood-of-occurrence assessment. Thirteen of these species were detected within the study area during the field surveys undertaken for this assessment. These field survey findings are discussed further in the Technical Report, TR 17A-1-V1.5.

No essential habitat has been mapped within the study area or surrounds (Environmental Protection Agency 2003).

17A.4 POTENTIAL IMPACTS

17A.4.1 LOSS OF VEGETATION AND HABITATS (LAND CLEARANCE)

The Project will result in the loss of vegetation and associated habitats. Clearing of native vegetation has been avoided where possible through the mine layout and gas supply pipeline route selection and design process. Within the MLA areas, 63% of remnant vegetation and 51% of regrowth (non-remnant) vegetation will be retained. Nonetheless, total avoidance of vegetation clearing will not possible and 1,175 ha (673 ha of remnant vegetation and 502 ha of regrowth (non-remnant) vegetation) will be cleared as a result of the Project as listed in Table 17A-7.

Loss of vegetation results in a range of direct and indirect impacts to vegetation communities and species of plant and animal including:

- reduction in the extent of vegetation communities and associated habitats
- loss of local populations of individual species
- fragmentation of remnants of vegetation communities or local populations of individual species
- reduction in the viability of ecological communities resulting from loss or disruption of ecological functions
- destruction of flora and fauna habitat and associated loss of biological diversity (habitat removal may include removal of hollow bearing trees, loss of leaf litter layer, and resultant changes to soil biota)
- riparian zone degradation
- increased habitat for invasive species.

The residual impact of loss and vegetation and habitats, and other potential impacts on each threatened community or species and priority animal taxa assessed as having a moderate or high likelihood of occurrence in the study area is summarised in section 17A.4.8.

Table 17A-7: REs and their extent in the study area as well as potential clearing due to proposed pits and associated infrastructure

Mine component	Remnant Status	Extent of each RE type directly affected (ha)									Total
		11.3.2	11.3.25	11.9.4	11.9.5	11.9.6	11.9.7	11.9.10	11.10.9	Other non-remnant vegetation	
Mining pits (50 m buffer)	Remnant	100.7	445.9		35.4			71.6			**653.7**
	Non-remnant	6.1	1.5	8.8	159.3		6.8	203.8		12.0	**398.3**
Coal transport	Remnant	2.1	10.1				0.1	0.1			**12.4**
	Non-remnant		6.3	3.9	69.1		0.1	6.0	2.9		**88.3**
Water infrastructure	Remnant	0.3	0.1								**0.4**
	Non-remnant		0.6	4.0	2.0				4.7		**11.2**
Gas pipeline	Remnant		1.1								**1.1**
	Non-remnant		0.2								**0.2**
Accommodation facility	Remnant										**0.0**
	Non-remnant							3.7			**3.7**
Total proposed clearing	**Remnant**	**103.1**	**457.2**	**0.00**	**35.4**	**0.0**	**0.1**	**71.7**	**0.0**	**0.0**	**667.7**
	Non-remnant	6.1	8.6	16.7	230.4	0.0	6.9	213.5	7.6	12.0	501.7
Total extent within MLA	Remnant	258.7	1254.7	0.00	92.7	0.0	4.4	182.7	0.0	0.0	1,793.1
	Non-remnant	50.1	17.2	23.2	386.1	0.6	59.1	374.6	15.2	83.3	1,009.5
Extent remaining in MLA following clearing[1]	Remnant	155.6	797.5	0.0	57.3	0.0	4.3	111.0	0.0	0.0	1125.4
	as percent	60%	63%		62%		98%	61%			63%
	Non-remnant	44.0	8.6	6.5	155.7	0.6	52.2	161.1	7.6	71.3	507.8
	as percent	88%	51%	28%	40%	100%	88%	44%	51%	86%	51%

1. The extent remaining in MLA is based on the Total extent within MLA minus vegetation clearing associated with the mining pits, coal transport, water infrastructure, airstrip and MIA. The gas pipeline and accommodation are located outside of the MLA.

17A.4.2 CREEK DIVERSIONS

The Project includes the diversion of the following waterways within the study area:

- Spring Creek
- Mount Organ Creek
- Mud Creek
- an unnamed tributary of Juandah Creek
- Woleebee Creek
- Frank Creek.

Mount Organ Creek, Mud Creek, Woleebee Creek and Frank Creek are recognised as being of regional significance under the Biodiversity Planning Assessment (Environmental Protection Agency 2003). In addition, Woleebee Creek is recognised as a state significant wildlife corridor (Environmental Protection Agency 2004). Diversion of these creeks will reduce the extent of riparian habitats and contribute to habitat fragmentation, as discussed below. Impacts on the aquatic ecology are discussed in Chapter 17B.

17A.4.3 HABITAT FRAGMENTATION AND BARRIER EFFECTS

Habitat fragmentation is the division of a single area of habitat into two or more smaller areas, with the occurrence of a new habitat type in the area between the habitat fragments. The loss of vegetation and creek diversions proposed as part of the Project will result in significant local and regional scale habitat fragmentation.

Creek diversions will modify state significant wildlife corridors along Woleebee Creek, and other regional wildlife corridors along Frank Creek, Mount Organ Creek and Mud Creek. Modification of these wildlife corridors will have the greatest impact on arboreal mammals including the following priority taxa recorded or considered likely to occur in the study area: Koala, Greater Glider, Yellow-bellied Glider, Squirrel Glider, Common Ringtail Possum and Common Brushtail Possum. For these species, the riparian habitats provide landscape-scale linkage between Hinchley and Mount Organ State Forests to the south-west and Juandah Creek to the north-east. The loss of riparian habitats would also reduce landscape scale connectivity for other species.

The loss of other woodland habitats within the study area will also contribute to habitat fragmentation in the study area. Although vegetation in many patches in the study area is of insufficient size to maintain viable populations, in many cases there may be only limited connectivity among the patches, given the extent of clearing and the distance to core areas. Even small patches may, however, provide stepping stones within the wider landscapes (Bennett 1993).

The new dividing habitat type is often artificial and inhospitable to the species remaining within these fragments (Bennett 1990, 1993; Lindenmayer & Fischer 2006; MacNally 1999) or is generally used by some generalists species, those species that are often considered aggressive, (e.g. Noisy Miners, Loyn *et al.* 1983), thus further reducing population levels of the species remaining in the fragments. Revegetation and habitat restoration will assist in offsetting the fragmentation, however, it will take many years for

these new creek diversions to achieve habitat values equivalent to the existing drainage lines (e.g. development of abundant tree hollows).

In addition to the loss of total habitat area, the process of fragmentation has the potential to impact on the species within the newly created fragments in a number of ways, including barrier effects, genetic isolation and edge effects. The degree to which these potential impacts affect the flora and fauna within the newly created fragments depends on a number of variables, including distance between the fragments, local environmental conditions, the species present and mitigation measures. Some of the potential impacts are summarised below.

Barrier effects

Barrier effects occur where particular species are either unable or are unwilling to move between suitable areas of fragmented habitat. This may result in either a complete halt to movement or a reduced level of movement between fragments. Species most vulnerable to barrier effects include rare species (where even a small reduction in movements can reduce genetic continuity within a population, hence reducing the effective population size), smaller ground-dwelling species and species with low mobility. Species least vulnerable to barrier effects tend to be those that are highly mobile (e.g. birds and bats), although even these species can vary in their response to barriers.

Genetic isolation

Genetic isolation occurs where individuals from a population within one fragment are unable to interbreed with individuals from populations in adjoining fragments. Genetic isolation can lead to problems with inbreeding and genetic drift for populations isolated within a fragment.

While the Project will create a barrier to dispersal within the broader regional landscape it is unlikely that this would result in total genetic isolation. The newly separate populations would have connectivity (although reduced) through regional connections to both the east and west of the study area.

Edge effects

Edge effects are zones of changed environmental conditions (e.g. altered light levels, wind speed, temperature) occurring along the edges of habitat fragments. These new environmental conditions along the edges can promote the growth of different vegetation types (including weeds), allow invasion by pest animals specialising in edge habitats or change the behaviour of resident animals (Moenting & Morris 2006). Edge zones can be subject to higher levels of predation by introduced mammalian and native avian predators. The distance of edge effects can vary, with edge effects in roads having been recorded at distances greater than 1,000 m from the road surface (Forman et al. 2000). However, in a comparison of edge effects in a variety of different habitat types, Bali (2000; 2005) estimated that average edge effects in roads generally occur up to 50 m away from the road edge. Within the study area the vegetation/habitat is already highly fragmented and as a result will already be subject to significant edge effects such as weed invasion. It is therefore unlikely that the Project would significantly increase the overall extent of edge effects in the local area.

17A.4.4 MORTALITY

Fauna injury or death has the greatest potential to occur during the start-up phase of construction when vegetation and habitats are being cleared. While some mobile species, such as birds, may be able to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows, may find it difficult to move rapidly over relatively large distances. Threatened species that could be affected by the clearing include microbats and the Brigalow Scaly-foot.

Without the implementation of mitigation measures, entrapment of wildlife in the gas pipeline trench during construction is another potential cause of fauna injury or death. Species most likely to become trapped in the pipeline trench are ground dwelling species that are too small to climb out of the trench such as frogs, reptile and some mammals.

There is a small chance of fauna mortality during the operation of the Project through vehicle collision. Generally, rates of vehicle strike mortality are directly proportional to the distance of native vegetation/fauna habitat crossed by a Project (Forman *et al.* 2000) and the number of vehicles present. Considering the nature of the Project, this impact is likely to be very low.

Entrapment of wildlife in pits, water detention basins, trenches or other excavations is another potential cause of fauna injury or death during operation of the mine. Species most likely to become trapped in pits or other excavations during the operation of the mine are larger ground dwelling species that are capable of moving across a modified landscape in the absence of woodland habitat. Species in this category include macropods and many of the reptile species.

17A.4.5 WEEDS AND PEST SPECIES

Seventy-seven species of weed were recorded in the study area. Further details about the results of the surveys are provided in Attachment E of the Technical Report TR 17A-1-V1.5). Among these were seven declared plants as listed under the *Land Protection (Pest and Stock Route Management) Act 2002*.

Without appropriate management strategies, the construction and operation of the Project has the potential to disperse weeds into areas of remnant vegetation where weed species are currently limited. The most likely causes of weed dispersal associated with the Project include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery. This may, in turn, reduce the habitat quality of the sites for threatened species. The majority of the vegetation within the study area, however, already has weed growth. Therefore, the overall extent of habitat modification is not likely to increase significantly.

Twelve species of introduced animals were recorded in the study area. Among these were five declared pest species listed under the *Land Protection (Pest and Stock Route Management) Act 2002*: Dingo/Wild Dog (*Canis lupus dingo)*, Red Fox (*Vulpes vulpes*), Feral Cat (*Felis catus*), Rabbit (*Oryctolagus cuniculus*) and Feral Pig (*Sus scrofa*). These pest species are all listed under Class 2, which are pests that are established in Queensland and have, or could have, a substantial adverse economic, environmental or social impact. Management of these pests requires coordination and they are subject to programs led by local government, community or landowners. Under the *Land Protection*

(Pest and Stock Route Management) Act 2002 landowners must take reasonable steps to keep land free of Class 2 pests.

Without appropriate mitigation measures, the construction and operation of the Project has the potential to further disperse pest species out of the study area across the surrounding landscape as well as within areas of native habitat remaining in the study area. However, it is likely that the pest species recorded in the study area already exist in vegetation and habitats surrounding the study area and, as such, the Project is unlikely to result in the establishment of pest species into areas where they are currently absent. However, the dispersal of these species may result in an increase in predation on, or competition with native wildlife in areas into which they re-establish.

17A.4.6 NOISE AND DUST

During construction and operation of the Project, there will be increased noise and dust in the study area. This may cause disturbance for some fauna. A number of factors are thought to influence the reaction of animals to noise including the volume, the frequency and the characteristic of the noise (e.g. short and percussive versus long and constant). How fauna located in the local area will respond to the noise is not known, but given the degree of current habitat disturbance in the local area and the presence of many common and generalist species, it is not likely to be significant.

17A.4.7 CUMULATIVE IMPACTS

The potential biodiversity impacts of the Project have been considered as a consequence of the construction and operation of the Project within the existing environment. The incremental effect of multiple sources of impact (past, present and future) are referred to as 'cumulative impacts' (Contant & Wiggins 1991; Council on Environmental Quality 1978) and provide an opportunity to consider the Project within a strategic context. This is necessary so that impacts associated with the Project and other activities within the region are examined collectively.

Potential developments in the nearby area that may interact with the construction of the Project include:

- other mines that may be opened in the future in the region
- the Surat Basin Rail Project
- the proposed water supply pipelines (as discussed in Volumes 2, 3 and 4).

All such developments are likely to contribute to a greater extent of vegetation clearing in the region and a further fragmentation of habitat.

17A.4.8 SIGNIFICANCE OF IMPACTS

A number of threatened REs, communities, species of plant and species of animal have either been recorded in the study area or are considered likely to occur (moderate or high likelihood), and may be affected by the Project.

For ecological communities and species listed under the EPBC Act, impact assessments were completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of the Environment, Heritage, Water and the Arts 2006). As the VM Act and NC Act do not outline factors for consideration in assessing impacts of a project, the assessment was based on the following matters for consideration:

- the conservation value of the area affected for the species or community
- the importance of the individuals and habitats being affected to maintaining long-term viability of the population or community
- whether or not the impacts will be long-term, permanent and irreversible.

The impact assessments also consider the range of impact mitigation measures proposed to avoid, reduce and mitigate environmental impacts. Significance assessments for communities and species are included in Attachment I of Technical Report TR 17A-1-V1.5.

A summary of significance assessments undertaken for threatened biodiversity is provided in Table 17A-8. These impact assessments conclude that the Project is not likely to have a significant impact on threatened species or communities, nor will it interfere with their recovery, assuming suitable mitigation measures are put in place as outlined in Section 17A.5.

Table 17A-8: Summary of threatened biodiversity for which significance assessments were undertaken and their likelihood of being significantly affected by the Project

Name	EPBC Act Status	NC Act Status	VM Act	Likely to be significantly affected	Primary reason for the outcome
REs					
RE 11.9.5	E		E	No	Small extent of fragmented and modified remnant RE to be removed
RE 11.9.6	E		E	No	Small extent of fragmented and modified remnant RE to be removed
Ecological communities					
Brigalow (dominant co-dominant)	E			No	Small extent of fragmented and modified endangered ecological communities (EEC) to be removed, with significant proportion of community in the MLA to be retained
SEVT	E			No	Small extent (16.7 ha) of highly modified and poor condition EEC to be removed
Plants					
Homopholis belsonii	V	E	Y	No	Low density of occurrence within study area and availability of habitat in the local area
Reptiles					
Brigalow Scaly-foot (*Paradelma orientalis*)	V	V	—	No	Low density of animals recorded (2) and similar suitable habitat available in the surrounding landscape
Yakka Skink (*Egernia rugosa*)	V	V	—	No	Not recorded within study area and no important habitat present

Name	EPBC Act Status	NC Act Status	VM Act	Likely to be significantly affected	Primary reason for the outcome
Dunmall's Snake (*Furina dunmalli*)	V	V	—	No	Not recorded within study area and no important habitat present
Birds					
Australian Painted Snipe (*Rostratula australis*)	V & M	V	—	No	Not recorded within study area and no important habitat present
Squatter Pigeon (southern race) (*Geophaps scripta scripta*)	V	V	—	No	Not recorded within study area and no important habitat present
Pink Cockatoo (*Cacatua leadbeateri*)	—	V	—	No	Not recorded within study area and no important habitat present
Satin Flycatcher (*Myiagra cyanoleuca*)	M	—	—	No	Not recorded within study area and no important habitat present
Glossy Black-cockatoo (*Calyptorhynchus lathami*)	—	V	—	No	Low density of animals recorded (2), similar suitable habitat available in the surrounding landscape, and no evidence of breeding detected within study area
Mammals					
Eastern Long-eared Bat (*Nyctophilus timoriensis*)	V	V	—	No	Not recorded within study area and no important habitat present

17A.5 MITIGATION MEASURES

17A.5.1 AVOIDING ENVIRONMENTAL IMPACTS

The WJV has the objective to avoid environmental impacts where possible throughout the Project planning and preliminary design phases. There will also be ongoing opportunities to further avoid impacts at a local scale through the detailed design process.

The capacity of major components of the Project, such as the pit layout and creek diversions, to avoid adverse environmental impacts while achieving the objectives of the Project (coal extraction) is limited. However, the design and layout of much of the remaining infrastructure, such as the coal transport infrastructure, water infrastructure, gas supply pipeline and MIA have been positioned so as to avoid or limit impacts to

remnant vegetation and regrowth and the associated flora and fauna habitats. As such, 63% of the remnant vegetation within the MLA area and 51% of regrowth (non-remnant) vegetation will be retained.

17A.5.2 MANAGEMENT OF THE MITIGATION PROCESS

The impacts and mitigation associated with the Project are discussed below in general terms. As part of the detailed design, and prior to the start of construction, more detailed mitigation measures will be developed and presented in a biodiversity management plan for both the construction and operation of the Project. The plan will include, where appropriate, procedures for:

- detailed design of mitigation measures such as fauna underpasses and fencing (as required associated with access tracks)
- general impact mitigation
- staff/contractor inductions and ongoing education
- pre-clearing surveys and fauna salvage/translocation where practical
- rehabilitation and restitution of adjoining habitat where possible
- weed control
- pest management
- rehabilitation protocols
- monitoring.

The biodiversity management plan will include clear objectives and actions for the Project including, where appropriate, including:

- minimising human interferences to flora and fauna
- minimising vegetation clearing/disturbance
- minimising impact to threatened species and communities
- minimising impacts to riparian and aquatic habitats and species
- ongoing monitoring of impacts on flora and fauna.

The biodiversity management plan will include the mitigation measures outlined in Table 17A-9.

Table 17A-9: Summary of mitigation measures

Mitigation measure	Design	Construction	Operation
▪ Identify locations and design of fauna underpasses, where appropriate, in the design of access tracks.	Y		
▪ Designated areas for stockpiles and equipment lay-down will be placed in cleared areas to avoid or minimise impact to vegetation and habitat.		Y	Y
▪ Staff/contractor inductions on site will be conducted by a suitably qualified staff/contractor (i.e. a trained ecologist or other qualified environmental specialist).		Y	Y

Mitigation measure	Design	Construction	Operation
▪ Dust suppression will be implemented in order to reduce biodiversity impacts.		Y	Y
▪ Appropriate erosion and sediment control strategies will be implemented.		Y	Y
▪ Preferred seed mixes for revegetation works, ideally to be collected from the study area and surrounds, will be used.		Y	Y
▪ Procedures for specific targeted species searches for those threatened species and priority taxa considered to have potential to occur prior to any staged development will be implemented. If located, consideration will be given to translocation of individuals according to guidelines from the Australian Network for Plant Conservation (Vallee *et al.* 2004) or fauna guidelines such as those in the Nature Conservation (Koala Conservation) Plan 2006 (Environmental Protection Agency & Queensland Parks and Wildlife Service 2005).		Y	Y
▪ A weed and feral animal management plan will be developed, including vehicle wash down procedures to limit edge effects such as the establishment of aggressive weeds, and the spread of annual and perennial exotic herbs. Methods to minimise the potential for the introduction and/or spread of weeds or plant disease will include, where appropriate, the following: ‣ Determination of the potential for the introduction of or facilitation of exotic, non-indigenous and noxious plants ‣ management process to identify origin of construction materials, machinery and equipment ‣ vehicle inspection points for weed free status on entering and exiting the Project area ‣ vehicle wash down protocols, in particular a protocol that all vehicles and equipment must be cleaned on entering the Project area, and the washdown water is managed to ensure it does not enter creek, other water ways or gullies.		Y	Y
▪ Sensitive areas, such as those containing fauna habitat, will be cleared of fauna prior to construction and operational activities commencing by a trained ecologist or other qualified environmental specialist in order to: ‣ mark the limits of clearing in sensitive areas (e.g. endangered and of concern REs or areas of significant fauna habitat) to avoid unnecessary vegetation and habitat removal ‣ collect native seed for use in the revegetation of disturbed areas ‣ place transportable habitat features such as large logs and boulders in adjacent retained areas to allow their continuation as potential fauna refuge sites ‣ implement pre-clearing surveys for fauna. Pre-clearing involves removal of the understorey and smaller non-hollow bearing trees in order to disturb fauna and encourage them away from the clearing area.		Y	Y
▪ During the life of the mine, areas not required for operation of the mine will be revegetated following a revegetation/rehabilitation plan. This plan will include: ‣ planting of a range of locally occurring native shrubs, trees and groundcover plants, in keeping with the former vegetation types present. Choice of species would be in consultation with the Environmental Protection Agency (EPA) and should include Allocasuarina, Eucalyptus, Angophora and Corymbia species to compensate for any impacts to habitat of the koalas and hollow dependent species ‣ rehabilitation and planting trials to assist in development of successful long-term rehabilitation		Y	Y

Mitigation measure	Design	Construction	Operation
▸ increasing the overall vegetation cover within the Project area ▸ incorporating existing natural vegetation where possible ▸ linking vegetation remnants ▸ focusing on riparian vegetation to protect waterways ▸ excluding stock from areas rehabilitated for nature conservation objectives.			
▪ A flora and fauna monitoring program for the Project will be developed and implemented aimed at achieving a better understanding of impacts and rehabilitation actions to flora and fauna throughout the study area. Monitoring will also include exotic weeds and feral animals. The plan will be adaptive.		Y	Y

17A.5.3 FURTHER SURVEY

Surveys of the proposed gas pipeline route were undertaken in late winter, which is sub-optimal for detection of many species of plant and animal. Accordingly, additional targeted surveys for flora and fauna have been planned along this section of the study area to support the EIS. Fauna surveys will be undertaken in late spring/early summer, while flora surveys will be completed in late summer/early autumn.

Two seasonal surveys were conducted over the MLA areas. Accordingly, further detailed survey of these habitats is not considered necessary for the EIS. It is anticipated, however, that ongoing terrestrial ecology surveys will be undertaken as part of the biodiversity management plan throughout the life of the Project.

17A.6 RESIDUAL IMPACTS AND OFFSETS

Residual impacts are those that remain after implementation of the Project and all associated mitigation and other environmental management measures have been undertaken. Residual impacts for the Project include the removal of 1,175 ha of vegetation and associated habitat comprising 673 ha of remnant vegetation and 502 ha of regrowth (non-remnant) vegetation. Where there is residual loss or degradation of vegetation and habitat after mine plan and infrastructure detailed design, and determination of mitigation measures, compensation in the form of compensatory habitat, land rehabilitation and/or contribution to research can be employed (i.e. offsets).

17A.6.1 OFFSETS

A draft framework for the WJV's Biodiversity Offset Strategy is detailed in Appendix 17A-1-V1.4 and has been developed as the primary ameliorative measure to minimise the residual impact of the Project on biodiversity. Once a raw water pipeline option is selected, a detailed strategy incorporating offsets for vegetation impacts from the pipeline and related infrastructure will be developed in consultation with key stakeholders, Department of the Environment, Water, Heritage and the Arts (DEWHA) and the Environmental Protection Agency (EPA).

The draft strategy is being developed to address both Commonwealth and State Government requirements for biodiversity offsets.

The aim of the draft strategy is to provide a net improvement in ecological value as a result of the Project, including providing immediate protection for an equal or greater area of similar habitat to that lost through the Project.

Once a raw water supply option is selected, a draft strategy incorporating offsets for vegetation impacts associated with the selected water pipeline and related infrastructure (the subject of Volumes 2, 3 and 4) will also be developed.

A combination of offsets is proposed to provide immediate protection as well as additional conservation during development of the mine. Subject to further verification and consultation with key interest groups, the draft strategy proposes a target ratio of 3:1 of 'like for like' in terms of the vegetation protected by offsets compared to that disturbed by the Project's mining operations. Offset areas are proposed to be located both within and outside the mining area.

It is proposed to actively increase the habitat value of the offset areas through appropriate means which may include planting of native species. An estimate of the area within each proposed offset area suitable for active planting will be made based primarily on topography, as this heavily influences the ability to conduct planting.

As detailed in Chapter 9 Geology, Mineral Resources, Overburden and Soils, it is also proposed to rehabilitate some mining areas for nature conservation which will provide further habitat, further contributing to the long term ratio of conserved vegetation to vegetation disturbed by the project.

Detailed assessments for the characteristics and quality in terms of ecological value of the offsets compared with the area proposed to be disturbed will be undertaken. Such assessments will include reviews of foraging value, availability of habitat (e.g. roost trees), and physiological characteristics such as topography and soil type.

This draft strategy is viewed as the starting point for a Green Offsets Package for the Project to be developed in consultation with the EPA and DEWHA taking into consideration the relevant State and Commonwealth offset policies outlined below.

Queensland Government Environmental Offsets Policy

The Queensland Government Environmental Offsets Policy (EPA 2008) provides a framework for environmental offsets in Queensland including principles and guidelines for using environmental offsets and guidance on when offsets should be used. The Queensland Government Environmental Offsets Policy applies to decisions on development approvals under a range of approval processes including the *Integrated Planning Act 1997* (IP Act), the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and the *Environmental Protection Act 1994* (EP Act).

The Queensland Government Environmental Offsets Policy outlines seven policy principles that direct the way offsets must be used to contribute to environmentally sustainable development (ESD) as follows:

1. Offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy.

2. Environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact.
3. Offsets must achieve an equivalent or better environmental outcome.
4. Offsets must provide environmental values as similar as possible to those being lost.
5. Offset provision should minimise the time-lag between the impact and delivery of the offset.
6. Offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values
7. Offsets must be legally secured for the duration of the offset requirement.

The Green Offsets Package developed for the Project will follow these principles and the guidelines of the Queensland Government Environmental Offsets Policy.

State policy for vegetation management offsetting

The requirements for offsets under State legislation are contained within the subordinate legislation made under the VM Act and NC Act, specifically the:

- Regional Vegetation Management Code (Department of Natural Resources and Water 2006)
- Policy for Vegetation Management Offsets (Department of Natural Resources and Water 2007)
- Policy 2 of the Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006-2016 (The Koala Plan) (Environmental Protection Agency & Queensland Parks and Wildlife Service 2005).

The Green Offsets Package for the Project will be determined following detailed design of the Project and based on the residual impacts once all reasonable alternatives to avoid impacts have been exhausted. This is also necessary in order to determine the minimum requirements for offsetting in accordance with the 'maintain existing extent' test for REs, essential habitat and conservation status thresholds under the Regional Vegetation Management Code for the Brigalow Belt and New England Tablelands Bioregions (Department of Natural Resources and Water 2006).

Environmental offsets for impact on Matters of National Environmental Significance

Environmental offsets for impacts on MNES may be used to maintain or enhance the health, diversity and productivity of the environment as it relates to MNES. Environmental offsets are not applicable to all approvals under the EPBC Act and the requirement for offsets is assessed on a case by case basis. MNES recorded in the study area for which offsets may be required for the Project may include:

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
- *Homopholis belsonii* habitat
- Brigalow Scaly-foot (*Paradelma orientalis*) habitat.

MNES are discussed further in Attachment J of the Technical Report in TR 17A-1-V1.5.

The Australian Government has identified eight principles for the use of environmental offsets under the EPBC Act (Department of the Environment and Water Resources 2007). These principles will be used to assess any proposed environmental offsets to ensure consistency, transparency and equity under the EPBC Act. The eight principles are stated below:

1. Environmental offsets should target the matter protected by the EPBC Act that is being impacted.
2. A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents.
3. Environmental offsets should deliver a real conservation outcome.
4. Environmental offsets should be developed as a package of actions — which may include both direct and indirect offsets.
5. Environmental offsets should, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.
6. Environmental offsets should be located within the same general area as the development activity.
7. Environmental offsets should be delivered in a timely manner and be long lasting.
8. Environmental offsets should be enforceable, monitored and audited (Department of the Environment and Water Resources 2007).

The DEWHA define offsets as 'actions taken outside a development site that compensate for the impacts of that development — including direct, indirect or consequential impacts' (Department of the Environment and Water Resources 2007). Actions that constitute a suitable offset will differ between projects and there is no prescriptive formula as to what constitutes an adequate offset. Accordingly, if required the DEWHA will be negotiated with through the development of the Green Offsets Package to ensure all relevant requirements are met.

17A.7 CONCLUSIONS

The Project is located in a landscape that has been largely cleared of vegetation as a result of grazing and dryland agriculture. The remaining vegetation generally occurs in continuous linear patches along the main drainage lines traversing the study area and is dominated by RE 11.3.25 (*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines) with RE 11.3.2 (*Eucalyptus populnea* woodland on alluvial plains) spreading across the floodplains. This remnant vegetation forms part of a wider regional corridor network that is recognised by State Wildlife Corridor mapping (Environmental Protection Agency 2004) and is of regional significance under the Biodiversity Planning Assessment for the Brigalow Belt bioregion (Environmental Protection Agency 2003). Other remnant vegetation in the study area is highly fragmented and comprises two similar REs dominated by *Acacia harpophylla* (Brigalow) and *Eucalyptus populnea* (Poplar box) (RE 11.9.5, RE 11.9.6 and RE 11.9.10). In addition to the remnant vegetation mapped by the Environmental Protection Agency (2007), over 1,000 ha of vegetation regrowth (non-

remnant vegetation) has been mapped and described. The non-remnant vegetation is dominated by *Acacia harpophylla* analogous with RE 11.9.5 and small areas of highly modified Semi-evergreen vine thicket (analogous with RE 11.9.4).

465 species of plant (388 native species) and 232 species of vertebrate fauna (220 native species) were recorded in the study area. This included one threatened species of plant and four rare or threatened species animal:

- Belsons Panic (*Homopholis belsonii*)
- Brigalow Scaly-foot (*Paradelma orientalis*)
- Golden-tailed Gecko (*Strophurus taenicauda*)
- Glossy black-cockatoo (*Calyptorhynchus lathami*)
- Little-pied Bat (*Chalinolobus picatus*).

In addition to these species, a further 15 threatened species of animal were considered likely to occur in the study area and surrounds based on the presence of suitable habitat. No further threatened species of plant was considered likely to occur.

The Project will result in a range of direct and indirect impacts to biodiversity in the study area, with clearing of native vegetation and the associated loss of habitat being the most substantial direct impact to biodiversity. Clearing of native vegetation has been avoided where possible through the mine layout and pipeline route selection and design process and within the MLA areas, 63% of remnant vegetation and 51% of regrowth (non-remnant) vegetation will be retained. Nonetheless, total avoidance of vegetation clearing is not possible and 1,175 ha (673 ha of remnant vegetation and 502 ha of regrowth (non-remnant) vegetation) will be cleared as a result of the Project.

In addition to the direct loss of habitat, vegetation clearing associated with the Project will also result in fragmentation of important wildlife corridors associated with the drainage lines, which provide landscape-scale linkage between Hinchley and Mount Organ State Forests to the south-west and Juandah Creek to the north-east.

Assessment of the significance of impacts associated with the Project was carried out for:

- threatened species that were recorded in the study area or considered likely to occur (moderate or high likelihood of occurrence)
- migratory species (for which the study area is at their distributional range limit)
- endangered ecological communities
- REs (threatened and of concern).

The impact assessments concluded that the Project was unlikely to result in a significant impact to any threatened species of plant or animal, RE or ecological community. Nonetheless, the impacts of the Project will require detailed mitigation measures to ensure that where possible impacts are avoided, reduced or mitigated. Accordingly, as part of the detailed design, and prior to the start of construction, detailed mitigation measures will be developed and presented in a biodiversity management plan relating to the construction and operation of the mine.

In addition, where there is residual loss or degradation of vegetation and habitat after mine plan and infrastructure detailed design, and determination of mitigation measures, compensation in the form of compensatory habitat, land rehabilitation and/or contribution

to research will be employed (i.e. offsets). A Green Offsets Package for the Project will be developed in consultation with EPA and DEWHA giving consideration to relevant State and Commonwealth policies.

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