

17A TERRESTRIAL ECOLOGY

17A.1 INTRODUCTION

This chapter details the existing terrestrial biological environment in relation to the proposed western coal seam methane (CSM) water supply pipeline (the proposed pipeline). A particular focus of the work is the likely impacts of the proposed pipeline on Rare and Threatened species and communities listed under the *Nature Conservation Act 1992* (Qld) (NC Act), *Vegetation Management Act 1999* (Qld) (VM Act) and *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act).

Full details of the biodiversity of the study area are provided in the Terrestrial Ecology Technical Report (TR 17A-1-V3.5). Note that figures/documents with numbering ending in V3.5, for example, refer to figures/documents contained in Volume 3, Book 5 of the EIS.

The specific objectives of the terrestrial ecological assessment were to:

- identify and map areas that are environmentally sensitive in proximity to the proposed pipeline, including:
 - Matters of National Environmental Significance (MNES) listed under the EPBC Act
 - important communities, habitats of species listed under the NC Act and/or the EPBC Act as 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 their being at threshold levels
 - 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 that have been proclaimed under the NC Act or are under consideration for proclamation.
- describe and map terrestrial flora in proximity to the proposed pipeline, 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 area, including:
 - species diversity (i.e. a species list) and indicative abundance of animals, including amphibians, birds, reptiles and 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 proposed pipeline on terrestrial flora, fauna and environmentally sensitive areas. These measures include:
 - methods to ensure rapid rehabilitation of disturbed areas following construction, including the species chosen for revegetation, which should be consistent with the surrounding associations. Details of any post-construction monitoring programs and what benchmarks would be used for review of monitoring should be included
 - 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 for avoiding injuries to native fauna as a result of the proposed pipeline's construction and operational works
 - methods for minimising the introduction of feral animals and other exotic fauna.

The proposed pipeline was declared a Controlled Action under the EPBC Act on the basis that the proposed pipeline may have a significant impact on listed Threatened species and ecological communities (Sections 18 and 18A). The biodiversity assessment considers impacts on MNES as listed under the EPBC Act.

17A.2 METHODOLOGY

Technical studies of terrestrial ecology were undertaken to address the requirements of the Terms of Reference (ToR) and other relevant international, Commonwealth and state requirements and policies relating to biodiversity. The approach to the terrestrial ecological impact assessment involved a desk-based assessment of literature and relevant databases, followed by 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 proposed pipeline terrestrial ecology assessment consisted was a 100 m corridor along the proposed pipeline from Origin Energy's reverse osmosis plant at Spring Gully to the Wandoan Coal Project MLA areas.

Field surveys were undertaken in the study area to verify the presence, and provide site specific descriptions, of vegetation communities, species or their habitats in the study area in August 2008 (late winter). Flora and fauna surveys of the eastern section of the study area within the Mining Lease Application (MLA) areas were undertaken in spring 2007 and autumn 2008 for the Terrestrial Ecology Impact Assessment of the MLA and infrastructure, and are the subject of the Terrestrial Ecology Impact Assessment supporting Volume 1 of the EIS (refer TR 17A-1-V1.5). As such, the proposed pipeline corridor in the MLA areas was not surveyed in August 2008. Further seasonal survey of the proposed pipeline will be completed to verify the findings of the August survey.

The assessment of impacts on terrestrial ecology includes remnant and non-remnant vegetation and species of plant and animal identified, or considered likely to occur, within the habitats along the indicative pipeline corridor within the MLA areas.

The survey of terrestrial flora involved verification of RE type and remnant status as mapped by the EPA (Environmental Protection Agency 2007), mapping and description of other vegetation regrowth (non-remnant vegetation) and compilation of a comprehensive list of species of plants 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 (see Appendix 2 of Neldner et al. 2005). The location of flora survey effort is shown in Figure 17A-1-V3.3.

The survey of terrestrial fauna aimed 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 done to provide a basis for the assessment of likelihood of Rare and Threatened species to occur in the study area and surrounds (refer Figure 17A-1-V3.3).

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 km² and is one of the largest of the 80 defined bioregions (Thackway & Cresswell 1995), extending from the Queensland coast at Gladstone, 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 *Eucalyptus* woodlands and open forests of Ironbarks, Poplar Box, Spotted Gum (*Corymbia citriodora* subsp. *variegata*), Cypress Pine (*Callitris glaucophylla*), Bloodwoods (e.g. *Corymbia trachyphloia*, *C. hendersonii*), Brigalow-Belah forests (*Acacia harpophylla*, *Casuarina cristata*) and semi-evergreen vine thicket.

This 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 areas, as roadside vegetation or as relatively small isolated remnants. The study area is characteristic of country used for dryland agriculture and is devoid of large areas of remnant vegetation. REs and associated fauna habitats remaining in the study area are relatively homogenous as a result of the limited variation in lithology.

Significant areas of remnant vegetation surrounding the study area (at a regional scale) are located in sandstone-dominated country to the north of Spring Gully which are identified as forming part of State Wildlife Corridors (Environmental Protection Agency 2004), Bioregional Wildlife Corridors (Environmental Protection Agency 2003) and significant areas of critical habitat. These areas will not be affected by the proposed pipeline.

17A.3.2 DRAINAGE LINES

As shown in Figure 17A-2-V3.3, the proposed pipeline traverses numerous named and unnamed drainage lines, including:

- Durham Creek and/or Eurombah Creek on the Origin Energy property at the western end of the study area depending on the final alignment
- potentially, three minor unnamed drainage lines on the Origin Energy property at the western end of the study area depending of the final alignment
- Kurragong Gully and an unnamed drainage line west of the Roma Taroom Road
- Slatehill Creek at its intersection with the Roma Taroom Road
- three unnamed drainage lines along the Roma Taroom Road between Slatehill Creek and Bartons Creek
- Bartons Creek at the Roma Taroom Road east of the intersection of Wykola Wallumbilla Road
- two unnamed tributaries of Bartons Creek crossing the Roma Taroom Road east Bartons Creek
- Kangaroo Creek and two of its tributaries of this drainage line west of the intersection of Roma Taroom Road and Canal Clifford Road

- Canal Creek and one of its tributaries between Roma Taroom Road and the Golden Brimadeen Road
- two unnamed tributaries of Nine Mile Creek along the Golden Brimadeen Road
- Horse Creek and Duck Creek east of Perretts Road
- Spring Creek, Mud Creek, Log Hut Creek and other unnamed drainage lines within the MLA (depending in the final alignment).

Detailed discussion of the aquatic ecology of the study area and region is provided in Chapter 17B.

17A.3.3 REGIONAL ECOSYSTEMS

A 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). Seven REs were identified within the study area (see Table 17A-1 and Figure 17A-2-V3.3). Mapping of REs and non-remnant vegetation at 1:40,000 scale is provided in Attachment E of the Terrestrial Ecology Technical Report (TR 17A-1-V3.5).

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

RE code	RE description (1)	Old VMA status	EPA biodiversity status	EPBC Act status
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Of Concern	Of Concern	Not listed
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> 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	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks	Endangered	Endangered	Endangered
11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	Of Concern	Of Concern	Not listed
11.9.10	<i>Acacia harpophylla</i> , <i>Eucalyptus populnea</i> open forest on fine-grained sedimentary rocks	Of Concern	Endangered	Not listed
11.10.9	<i>Callitris glaucophylla</i> woodland on coarse-grained sedimentary rocks	Not of Concern	Not of Concern at Present	Not listed

Note: 1 – Environmental Protection Agency (2007)

Queensland’s REs have been assigned both a vegetation management status and biodiversity status, as explained below.

Vegetation management status: The statutory status of an RE as defined under Section 22 of the VM Act is either Endangered, Of Concern or Not of Concern. This status is based on an assessment of the pre-clearing and remnant extent of an RE, and as listed in Schedules 1-5 of the *Vegetation Management Regulation 2000*. The vegetation management status only applies to remnant vegetation.

Biodiversity status: The non-statutory status of an RE is defined by the EPA as Endangered, Of Concern or Not of Concern at Present. This status is based on assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem. Although not the statutory status of the RE, the biodiversity status should be used as a guide for decision making.

Five REs with remnant vegetation within the study area have a VM Act status of Endangered or Of Concern, as listed in Table 17A-1. Two of these REs are also listed under the EPBC Act.

Brigalow (*Acacia harpophylla* dominant and co-dominant) corresponded with remnant RE 11.9.5 in the study area. The listing of Brigalow (*Acacia harpophylla* dominant and co-dominant) under the EPBC Act does not automatically dismiss non-remnant vegetation, rather species composition and structural elements typical of that found in undisturbed areas of the listed Brigalow are determining factors. However, regrowth areas that have not regained the structure and species composition typical of remnant Brigalow (generally regrowth under 15 years) will not qualify as the listed Brigalow ecological community (Anon. 2003). Significant areas of non-remnant vegetation identified in the road corridor along the Roma Taroom Road are mature and correspond with this ecological community, as shown in Figure 17A-3-V3.3. However none of this vegetation corresponding with an endangered ecological community will be affected by the proposed pipeline.

Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions are considered likely to occur in the study area (Department of the Environment, Water, Heritage and the Arts 2008); however, no remnant vegetation consistent with the ecological community is mapped within the study area (Environmental Protection Agency 2005). Non-remnant vegetation mapped within the study area that was analogous with RE 11.9.4 is consistent with the ecological community (refer Figure 17A-3-V3.3), but these patches were small, fragmented and highly modified in structure and composition.

17A.3.4 SPECIES OF PLANT

Searches of relevant databases identified records of 249 species of plant in the study area and surrounds. Field surveys undertaken for this assessment identified 265 species of plant in the study area, of which 217 (82%) were native. The most diverse families included the grasses (*Poaceae*), daises (*Asteraceae*), saltbushes (*Chenopodiaceae*) and hibiscus (*Malvaceae*).

The low diversity of species of plant is indicative of the low diversity of land zones and associated RE types traversed by the proposed pipeline, and the high level of modification of remnant vegetation.

Two species recorded in the study area are 'declared plants' listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld): *Opuntia stricta* (Prickly Pear) and *O. tomentosa* (Velvet Tree Pear). *Opuntia tomentosa* was found to occur in most REs, but was most commonly found within vegetation representative of RE 11.9.5. Neither species was found to occur as a dominant species. Both these species are listed as class 2 pests, which are defined as species established in Queensland that have, or could have, an adverse economic, environmental or social impact. The management of these pests requires coordination and they are subject to programs led by local government,

community or land owners. Both of these species were identified throughout the study area.

Several other exotic species are known to be in the region but were not encountered. Field surveys to be performed during more optimal conditions, such as late summer/early autumn, may reveal the presence of certain herbaceous and graminoid species, particularly *Parthenium hysterophorus* (Parthenium Weed) which is also a class 2 pest.

Three Threatened species of plant listed under the NC Act and four under the EPBC Act were identified from the desk-based assessment as potentially occurring within the study area or surrounds. No Threatened species of plant was recorded in the study area during the winter survey. However, potential habitat exists for two Threatened species, as shown in Table 17A-2.

Table 17A-2: Threatened species of plant considered likely to occur in the study area based on the presence of suitable habitat

Name	Conservation status ¹	
	EPBC Act	NC Act
<i>Diuris tricolor</i> (syn. <i>Diuris sheaffiana</i>)	V	
<i>Homopholis belsonii</i>	V	V

Two Priority taxa species of plant for the Brigalow Belt South (Environmental Protection Agency and Environmental Planning Southwest Queensland 2002) were however recorded: *Acacia melvillei* (Yaran) and *Swainsona swainsonioides* (Downy Darling Pea). *Acacia melvillei* was recorded in patches of RE 11.9.5 and RE 11.9.6 (remnant and regrowth) while *Swainsona swainsonioides* was recorded infrequently in areas of non-remnant vegetation that was not analogous with an RE (cleared areas).

17A.3.5 FAUNA HABITATS

Five broad fauna habitat types exist in the study area: *Acacia harpophylla/Casuarina cristata* scrub, woodlands, riparian (Queensland Blue Gum), wetlands (natural or artificial) and cleared lands. These fauna habitats are broad groupings of the vegetation types/REs present within the study area, as shown in Table 17A-3

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

Habitat type	EPA RE code
<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> scrub	RE 11.9.5
Eucalypt woodlands	RE 11.3.2 and RE 11.9.7
Riparian	RE 11.3.25
Wetland (artificial/natural)	—
Cleared lands	—

Vegetation within the study area and surrounds is highly fragmented, with large expanses of cleared land surrounding the proposed pipeline. Although remnant vegetation in many patches is of sufficient size to maintain viable populations of some species, 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 of habitat may, however, provide stepping stones within the wider landscapes (Bennett 1993).

Remnant and non-remnant woodland vegetation in the study area is concentrated in linear patches along drainage lines (RE 11.3.25) and adjoining eucalypt woodlands (RE 11.3.2). The continuous linear patches of woodland are likely to function as a part of a local and 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 recorded along Woleebee Creek (within the MLA areas) (refer Figure 17A-2-V3.3). 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. These linear patches are recognised by State Wildlife Corridor mapping (Environmental Protection Agency 2004) and are of regional biodiversity significance under the Biodiversity Planning Assessment mapping (Environmental Protection Agency 2003), as shown in Figure 17A-4-V3.3.

In addition to riparian areas, remnant and non-remnant vegetation within the road corridor is also likely to play an important role in the connectivity of vegetation and associated fauna habitats. Vegetation in the road corridor is generally less than 75 m wide; therefore, it is too narrow to be a mappable entity of remnant vegetation (Neldner et al. 2005). At some locations, vegetation in the road corridor was found to be in good condition and to be providing known or likely habitat for significant species.

17A.3.6 SPECIES OF ANIMAL

Database searches returned records of 237 terrestrial vertebrate species within the study area and surrounds: 160 species of bird, 17 species of frog, 30 species of mammal and 30 species of reptile.

Field surveys of the study area recorded 144 species of vertebrate fauna, including 136 native species and eight introduced species. Birds were the most diverse group of terrestrial vertebrate fauna recorded in the study area, followed by mammals, reptiles and frogs respectively, as listed in Table 17A-4.

Table 17A-4: Summary of species of terrestrial fauna recorded in the study area during current field surveys

Taxa	Native	Introduced	Total
Mammals	16	7	23
Birds	99	0	99
Frogs	4	1	5
Reptiles	17	0	17
Total	136	8	144

Species diversity was highest in association with the non-eucalypt woodland (i.e. *Acacia harpophylla/ Casuarina cristata* Scrub) with 89 species recorded in this fauna habitat type. Species diversity was broadly comparable across fauna habitat types and the number of species recorded during surveys ranged from 45 (Wetland) to 78 (Riparian), as given in Table 17A-5.

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

Group	Eucalypt woodland (Ironbark-dominated)	Eucalypt woodland (Poplar Box–dominated)	Acacia harpophylla and/or Casuarina cristata Scrub	Riparian	Cleared	Wetland/dam
Mammals	6	14	16	13	12	8
Birds	35	50	58	51	39	35
Frogs	0	1	1	5	1	2
Reptiles	6	10	14	9	2	0
Total	47	75	89	78	54	45

Seventeen Rare or Threatened species of animal listed under the NC Act and five Threatened species under the EPBC Act were considered likely to occur within the study area and surrounds, based on likelihood-of-occurrence assessment, as given in Table 17A-6. During field surveys, three Rare or Threatened species were recorded in the study area; these are also listed in Table 17A-6.

Thirty-three 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. Eight of these species were detected within the study area during the field surveys of the MLAs.

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 (<i>Cyclorana verrucosa</i>)	R		Yes	Moderate
Dunmall's Snake (<i>Furina dunmali</i>)	V	V	Yes	Moderate
Brigalow Scaly-foot (<i>Paradelma orientalis</i>)	V	V	Yes	High (recorded)
Golden-tailed Gecko (<i>Strophurus taenicauda</i>)	R		Yes	High (recorded)
Australian Painted Snipe (<i>Rostratula australis</i>)		V	—	Moderate

Name	Conservation status ¹			Likelihood of occurrence
	NC Act	EPBC Act	Priority taxa	
Freckled Duck (<i>Stictonetta naevosa</i>)	R		Yes	Moderate
Cotton Pygmy-goose (<i>Nettapus coromandelianus</i>)	R		Yes	Moderate
Grey Falcon (<i>Falco hypoleucos</i>)	R		Yes	Moderate
Square-tailed kite (<i>Lophoictinia isura</i>)	R		Yes	Moderate
Black-necked stork (<i>Ephippiorhynchus asiaticus</i>)	R		Yes	High
Squatter Pigeon (southern race) (<i>Geophaps scripta scripta</i>)	V	V	Yes	Moderate
Pink Cockatoo (<i>Cacatua leadbeateri</i>)	V		Yes	Moderate
Glossy Black-cockatoo (<i>Calyptorhynchus lathamii</i>)	V		Yes	Moderate
Black-chinned Honeyeater (<i>Melithreptus gularis</i>)	R		Yes	Moderate
Painted Honeyeater (<i>Grantiella picta</i>)	R		Yes	Moderate
Little Pied Bat (<i>Chalinolobus picatus</i>)	R		Yes	High (recorded)
Eastern Long-eared bat (<i>Nyctophilus timoriensis</i>)	V	V	Yes	Moderate

1: Conservation significance: State — 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)

17A.3.7 ESSENTIAL HABITAT

Essential Habitat is mapped by the EPA under the Biodiversity Planning Assessment framework (Environmental Protection Agency 2003) and are used by Queensland Department of Natural Resources and Water (NRW) in determining applications to clear vegetation.

Essential Habitat is an area or location with essential resources for the maintenance of populations of Priority taxa (which includes Threatened and non-Threatened species of regional significance) (Environmental Protection Agency 2002). Essential Habitat may be defined from known records or considered potential according to expert knowledge of habitat relationships. Essential Habitat is considered known where the taxon is present (based on accurate records) and there are indications of reproduction, or where a significant number of individuals are present, or where important resources (such as nest sites, roost caves or major food sources) are present, or where important movement corridors for breeding and/or non-breeding (including migratory) individuals have been identified. Alternatively, Essential Habitat is considered possible where suitable habitat exists of a size capable of supporting one or more breeding units, and important resources (such as nest sites, roost caves, major food sources) are present, or the area is proximal to populations, or may act as a potentially important corridor.

The study area does not traverse areas of Essential Habitat, as can be seen in Figure 17A-4-V3.3. A large area of Essential Habitat is located to the north of Spring Gully in association with sandstone country. This Essential Habitat will not be affected by the proposed pipeline.

17A.4 POTENTIAL IMPACTS

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

The potential for clearing of native vegetation has been avoided as far as possible through the route selection and preliminary design process: much of the route follows existing road corridors. In addition, impacts to riparian vegetation will be avoided through the use of directional drilling as opposed to trenching, in order to cross drainage lines with minimal impact.

Nonetheless, it is not possible to totally avoid vegetation clearing, and 9.7 ha of woodland vegetation (2.7 ha of remnant vegetation and 7.0 ha of regrowth) and associated fauna habitat will be cleared as a result of the proposed pipeline, based on clearing of a 20-m-wide corridor for construction, as summarised in Table 17A-7. This includes 0.6 ha of semi-evergreen vine thicket as listed under the EPBC Act.

However, all patches of remnant RE 11.9.5 and non-remnant revegetation consistent with the Brigalow (*Acacia harpophylla* dominant co-dominant), an Endangered ecological community, have been avoided.

The extent may be further reduced through the detailed design phase and further examination of the RE mapping.

Table 17A-7: Extent of vegetation clearing resulting from the western CSM water supply pipeline (based on a 20 m wide corridor)

RE code	Remnant status		Total (ha)
	Remnant (ha)	Non-remnant (ha)	
11.3.2		2.7	2.7
11.3.25	1.3	<0.1	1.3
11.9.4		0.6	0.6
11.9.5		2.1	2.1
11.9.7		0.5	0.5
11.9.10	1.4	0.2	1.6
11.10.9		0.8	0.8
Total	2.8	7.00	9.8

17A.4.2 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 fragments (Andren 1994; Ford et al. 2001). This new dividing habitat type is often artificial and inhospitable to the species remaining within the fragments. Although the newly created habitat is generally used by some species, those species are usually generalists and are often considered aggressive, further decreasing population levels of the species remaining

in the fragments. In addition to the loss of total habitat area, the process of fragmentation can impact on 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 that are present, and mitigation measures. Some of the potential impacts are summarised below:

- **Barrier effects:** Barrier effects occur where particular species are either unable or unwilling to move between suitable areas of fragmented habitat. This could result in either a complete halt to movement or reduced level of movement between fragments
- **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 inbreeding and genetic drift problems for populations isolated within a fragment

Significant species that would be sensitive to further fragmentation were also recorded in the study area, such as the Brigalow scaly-foot (*Paradelma orientalis*). As such, the alignment has been modified to avoid impacts to areas of known potential habitat for this species. For these species, the effect of fragmentation is likely to be temporary during construction only. Following construction the footprint will be rehabilitated and is unlikely to form a permanent barrier to woodland-dependent species.

17A.4.3 EDGE EFFECTS

Edge effects are zones of changed environmental conditions (i.e. altered light levels, wind speed and/or temperature) occurring along the edges of habitat fragments. These new environmental conditions can promote the growth of different vegetation types (including weeds) and allow invasion by pest animals specialising in edge habitats. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. The distance of edge effects can vary, with edge effects along roads having been recorded at distances greater than 1,000 m from the road surface (Foreman 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.

Habitats within the study area are already highly fragmented as a result of past land uses practices. The small patches of remnant vegetation and regrowth in the road corridors and along the creeks are already subject to edge effects and additional clearing across these habitats will not result in the introduction of new or novel edge effects.

17A.4.4 MORTALITY

Clearing of native vegetation results in direct mortality of plants and less mobile animals in the areas being cleared, including potentially Threatened species. This would directly impact any species (including Threatened species) occurring in the cleared areas.

Fauna injury or death has the greatest potential to occur during the construction phase 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

nocturnal or restricted to tree hollows may find it difficult to move rapidly to adjoining areas of suitable habitat. Threatened species that could be affected by the clearing include microchiropteran bats and the Brigalow Scaly-foot.

There may also a chance of animals entering the pipeline trench during construction and being trapped. This would particularly be the case for ground-dwelling fauna including reptiles, amphibians and small mammals.

17A.4.5 WEEDS AND PEST SPECIES

Forty-eight species of weed were recorded in the study area, as listed in Attachment E of TR 17A-1-V3.5. Among these were two declared plants as listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld): **Opuntia stricta* (Prickly Pear) and **O. tomentosa* (Velvet Tree Pear). Several other exotic species are known from the region but were not encountered. Field surveys to be performed during more optimal conditions, such as late summer/early autumn, may reveal the presence of certain herbaceous and graminoid species, particularly **Parthenium hysterophorus* (Parthenium Weed), which is also a class 2 pest.

The construction and operation of the proposed pipeline 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 proposed pipeline would 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 within the study area. However, as the study area already has weed growth, the overall extent of habitat modification is not likely to increase significantly.

Eight species of introduced animals were recorded in the study area, as listed in Table 17A-8. Among these were five declared pest species listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld). 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 is subject to programs led by local government, community or land owners. Land owners must take reasonable steps to keep land free of class 2 pests.

Table 17A-8: Pest animals recorded in the study area

Common name	Species	Declared animal class ¹
Cane Toad	<i>Rhinella marina</i> (listed as <i>Bufo marina</i>)	Non-declared animal
Dingo/Wild Dog	<i>Canis lupus dingo</i>	Class 2
Red Fox	<i>Vulpes vulpes</i>	Class 2
Feral Cat	<i>Felis catus</i>	Class 2
Brown Hare	<i>Lepus capensis</i>	Non-declared animal
Rabbit	<i>Oryctolagus cuniculus</i>	Class 2
House Mouse	<i>Mus musculus</i>	Non-declared animal
Feral Pig	<i>Sus scrofa</i>	Class 2

1. Declared animal classes as listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld). 'Non- declared' refers to introduced species that are not listed Class 1-3

It is likely that the pest species recorded in the study area already exist in vegetation and habitats surrounding the study area, so the proposal is unlikely to result in the further establishment of pest species into areas where they are currently limited.

17A.4.6 NOISE AND DUST

During construction of the proposed pipeline, there will be increased noise in the local area for a short period of time. This may cause disturbance for fauna in the area, although given the proximity of the pipeline to existing roads, it is expected that the impact of this would be minor. Operational access for maintenance vehicles may cause intermittent disturbance; however, as the pipeline predominantly follows existing roads, the impacts associated with this are likely to be minor.

Dust also has potential to impact surrounding vegetation and fauna habitats during construction. This impact is likely to be temporary and reversible following rehabilitation of the construction footprint.

17A.4.7 CUMULATIVE IMPACTS

The potential biodiversity impacts of the proposed pipeline have been considered as a consequence of the construction and operation of the proposed pipeline 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 proposed pipeline within a strategic context. This is necessary so that impacts associated with the proposed pipeline and other activities within the region are examined collectively.

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

- the mine and associated infrastructure of the Project (refer to Volume 1 of the EIS)
- the coal transport corridor for the Project
- other proposed water sources for the Project.

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 OPERATION OF THE PIPELINE

There is a small chance of fauna mortality during the operation of the proposed pipeline through collision of fauna with maintenance vehicles. Generally, rates of vehicle strike mortality are directly proportional to the distance of native vegetation/fauna habitat crossed by a project (Foreman et al. 2003) and the number of vehicles present. Due to the nature of the proposed pipeline, this impact is likely to be very low.

17A.4.9 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 proposed pipeline.

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. 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 the technical report TR 17A-1-V3.5.

A summary of significance assessments undertaken for threatened biodiversity is provided in Table 17A-9. These impact assessments conclude that the proposed pipeline is not likely to have a significant impact on threatened species or communities, nor would it interfere with their recovery, assuming suitable mitigation measures are put in place.

Table 17A-9: Summary of threatened biodiversity for which significance assessments were undertaken and their likelihood of being significantly affected by the proposed pipeline

Name	EPBC Act ¹ status	NC Act status ²	VM Act	Likely to be significantly affected	Primary reason for the outcome
Ecological communities					
SEVT	E	—	E	No	Small extent (0.6 ha) of non-remnant, highly modified and poor condition EEC to be removed
Plants					
<i>Homopholis belsonii</i>	V	E	Y	No	Low density of occurrence within study area and availability of habitat in the local area
Reptiles					
Brigalow Scaly-foot (<i>Paradelma orientalis</i>)	V	V	—	No	Low density of animals recorded (1) and similar suitable habitat available in the surrounding landscape
Dunmall's Snake (<i>Furina dunmalli</i>)	V	V	—	No	Not recorded within study area and no important habitat present
Birds					
Squatter Pigeon (southern race) (<i>Geophaps scripta scripta</i>)	V	V	—	No	Not recorded within study area and no important habitat present
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	M	—	—	No	Not recorded within study area and no important habitat present

Name	EPBC Act ¹ status	NC Act status ²	VM Act	Likely to be significantly affected	Primary reason for the outcome
Australian Painted Snipe (<i>Rostratula australis</i>)	V and M	V	—	No	Not recorded within study area and no important habitat present
Pink Cockatoo (<i>Cacatua leadbeateri</i>)	—	V	—	No	Not recorded within study area and no important habitat present
Glossy Black-cockatoo (<i>Calyptorhynchus lathami</i>)	—	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 (<i>Nyctophilus timoriensis</i>)	V	V	—	No	Not recorded within study area and no important habitat present

Conservation status — State as listed under the NC Act: E = Endangered, V = Vulnerable, R = Rare; National as listed under the EPBC Act: E = Endangered, V = Vulnerable. VM Act – E = Endangered

17A.5 MITIGATION MEASURES

17A.5.1 AVOIDING ENVIRONMENTAL IMPACTS

Avoiding environmental impacts has been considered where possible throughout the proposed pipeline route selection, 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 winter survey of the study area identified significant areas of non-remnant vegetation that were in moderate to good condition and consistent with the Brigalow (*Acacia harpophylla* dominant co-dominant), an Endangered ecological community listed under the EPBC Act within the road corridor along the Roma Taroom Road. Brigalow regrowth in the road reserve of Goldens Bimbadeen Road reserve was also identified, although not consistent with the ecological community as listed under the EPBC Act. Brigalow Scaly Foot, a Threatened species, was also identified in the non-remnant vegetation within the Roma Taroom Road reserve.

Given the above mentioned findings, the proposed pipeline alignment sits largely to the north of the road reserves in adjoining private properties that are already cleared.

17A.5.2 MANAGEMENT OF THE MITIGATION PROCESS

The impacts and mitigation associated with the proposed pipeline 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 relating to both the construction and operation of the proposed pipeline. The Biodiversity Management 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 proposed pipeline, including where appropriate:

- 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 plan will include mitigation measures as outlined in Table 17A-10.

Table 17A-10: Summary of mitigation measures

Mitigation measure	Design	Construction	Operation
▪ Further survey is required to increase the likelihood of detecting Rare and Threatened species in the study area and surrounds.	Y		
▪ Refine alignment of pipeline in light of biological knowledge and design constraints in accordance with this report.	Y		
▪ Utilise trenchless technology to cross drainage lines. Directional drilling launch and receiving pad areas should be carefully planned to avoid removal of mature trees. If this is not possible, the number of trees to be affected should be minimised. It is envisaged, however, that any directional drilling should take place from within the cleared easement.	Y	Y	
▪ Prepare and implement a Biodiversity Management Plan.	Y		Y
▪ Provide for designated areas in cleared and degraded land for stockpiles and equipment lay-down to minimise the overall impact of construction and avoid unnecessary vegetation and habitat removal.	Y	Y	
▪ Conduct staff/contractor inductions on site by a suitably qualified staff/contractor (e.g. a trained ecologist or other qualified environmental specialist).		Y	
▪ Implement dust suppression during construction.		Y	
▪ Implement appropriate erosion and sediment control strategies.		Y	
▪ Use preferred seed mixes for revegetation works, ideally to be collected from the study area and surrounds.		Y	
▪ Procedures for specific targeted species searches for those threatened		Y	Y

Mitigation measure	Design	Construction	Operation
<p>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 <i>et al.</i> 2004) or fauna guidelines such as those in the Nature Conservation (Koala Conservation) Plan 2006 (Environmental Protection Agency & Queensland Parks and Wildlife Service 2005).</p>			
<ul style="list-style-type: none"> ▪ Prepare weed and feral animal management plans, including vehicle washdown procedures, to limit edge effects such as the establishment of aggressive weeds, and the spread of annual and perennial exotic herbs. 		Y	Y
<ul style="list-style-type: none"> ▪ Pre-clear the disturbance areas prior to construction activities commencing in coordination with a trained ecologist or other qualified environmental specialist in order to: <ul style="list-style-type: none"> ▶ mark the limits of clearing in sensitive areas (e.g. Endangered and Of Concern REs) to avoid unnecessary vegetation and habitat removal ▶ 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	
<ul style="list-style-type: none"> ▪ Except for trenching, vegetation clearing should involve only the removal of above-ground plant parts, with root systems and the soil profile left undisturbed. 		Y	
<ul style="list-style-type: none"> ▪ Areas not necessary for the operation of the pipeline should be rehabilitated in a progressive manner as construction proceeds. Revegetate areas to improve habitat value and visual amenity, including: <ul style="list-style-type: none"> ▶ planting a range of locally occurring native shrubs, trees and groundcover plants, in keeping with the vegetation types formerly present. Species would be chosen in consultation with the EPA and should include <i>Allocasuarina</i>, <i>Eucalyptus</i>, <i>Angophora</i> and <i>Corymbia</i> species to compensate for any impacts to habitat of the Koala and other hollow-dependent species ▶ increasing the overall vegetation cover within the proposed pipeline alignment area ▶ incorporating existing natural vegetation where possible ▶ linking vegetation remnants ▶ focusing on riparian vegetation to protect waterways ▶ excluding stock from rehabilitated areas. 		Y	Y
<ul style="list-style-type: none"> ▪ Soil that may contain seeds of exotic species should be stockpiled away from drainage lines, and vegetated areas and weed-free soil stockpiles. Weed-infested stockpiles would be covered to eliminate the spread of the soil and seed during rainfall and high-wind events. 		Y	
<ul style="list-style-type: none"> ▪ No materials, spoil or machinery should be stored or parked within the dripline of any trees. 		Y	
<ul style="list-style-type: none"> ▪ The amount of open trenching should be generally limited at any one time to 100 m per crew. 	Y	Y	
<ul style="list-style-type: none"> ▪ Trenches should be backfilled so as to cover as much open trench as 		Y	

Mitigation measure	Design	Construction	Operation
practicable by the end of each day's work. If this is not possible, the ends of the open trenches must be graded to allow escape for any animals that may venture into the trench.			
<ul style="list-style-type: none"> ▪ Implement a flora and fauna monitoring program (as part of the greater Wandoan Coal Project flora and fauna monitoring program) aiming to better understand and manage impacts and rehabilitation actions to flora and fauna throughout the study area. Monitoring would also include exotic weeds and feral animals. The detailed monitoring plans would be incorporated into the Biodiversity Management Plan for the Project. 		Y	Y

17A.5.3 FURTHER SURVEY

Surveys of the proposed western CSM water supply pipeline were completed in later winter 2008. Weather conditions during this survey period were generally cool and sub-optimal for detecting herpetofauna (reptiles and frogs). The cool dry weather and general season (late winter) is also a time of reduced vegetative growth and reproductive activity for many species of plant, particularly grasses and other herbaceous groundcover species. Further seasonal surveys will be undertaken in late spring/early summer 2008 and late summer/early autumn 2009 in order to better detect Threatened and Rare species and inform detailed design.

17A.6 RESIDUAL IMPACTS AND OFFSETS

Residual impacts are those that remain after the proposed pipeline has been implemented and all associated mitigation and other environmental management measures have been undertaken. Residual impacts for the proposed pipeline include the removal of 2.76 ha of remnant vegetation and 7.00 ha of regrowth (non-remnant) vegetation and associated habitat. Where there is residual loss or degradation of vegetation and habitat after 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).

A Green Offsets Package for the proposed pipeline will be developed in consultation with EPA and Department of the Environment, Water, Heritage and the Arts (DEWHA), giving consideration to relevant state and Commonwealth policies relating to offsets, as outlined below. This Green Offsets Package will address both state and Commonwealth offsetting requirements.

17A.6.1 OFFSETS

A draft framework for WJV's Biodiversity Offset Strategy is detailed in Appendix 17A-1-V1.4 of Volume 1 and has been developed as the primary ameliorative measure to minimise the residual impact of the proposed pipeline 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 stakeholders, DEWHA and EPA.

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

The draft strategy aims to provide a net improvement in ecological value as a result of the proposed pipeline, including providing protection immediately for an equal or greater area of similar habitat as that lost through the contraction of the pipeline. These offsets will complement those proposed for the Project the subject of Volume 1.

A mixture of offsets providing immediate protection and those produced to provide additional conservation during development of the mine is proposed. 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 in offsets compared with that disturbed by the proposed pipeline. 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 suitable for active planting will be made based primarily on topography, as this heavily influences the ability to conduct planting.

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 proposed pipeline that will be developed in consultation with EPA and DEWHA giving consideration to relevant State and Commonwealth policies relating to offsets, as outlined below.

Queensland Government Environmental Offsets Policy

The *Queensland Government Environmental Offsets Policy* aims to provide a supporting 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), *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 principles for 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. The Green Offsets Package developed for the proposed pipeline 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 fall under the subordinate policies of the VM Act and NC Act, specifically:

- *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* (Koala Plan) (Environmental Protection Agency & Queensland Parks and Wildlife Service 2005).

The offsets strategy will be determined following detailed design of the proposed pipeline and will be 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 following 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 Matters of National Environmental Significance (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 requirement for them is assessed on a case-by-case basis.

The Australian Government has identified eight principles for the use of environmental offsets under the EPBC Act. These eight principles will be used to assess any proposed environmental offsets to ensure consistency, transparency and equity under the EPBC Act. The Australian Government's position is that:

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 that 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 defines 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 for what constitutes an adequate offset. As such, if required the DEWHA will be negotiated with through the development of the Green Offsets Package to ensure all relevant requirements are met for offset of the proposed pipeline.

17A.7 CONCLUSIONS

The proposed pipeline to supply water to 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) and regrowth vegetation with the road corridor of the Roma Taroom Road and Goldens Bimbadeen Road.

Despite being a largely cleared landscape, the remaining remnant vegetation along the drainage lines was identified as being of regional significance under the Biodiversity Planning Assessment. In addition, much of the non-remnant vegetation in the road corridors was identified to include Brigalow (*Acacia harpophylla* dominant and co-dominant) and semi-evergreen vine thickets. These are Endangered ecological communities listed under the EPBC Act, which provide habitat for Rare and Threatened species including, recorded in the study area, Brigalow Scaly-foot (*Paradelma orientalis*), Little Pied Bat (*Chalinolobus picatus*), Eastern Long-eared bat (*Nyctophilus timoriensis*) and Golden-tailed Gecko (*Diplodactylus taenicauda*). In addition to these species, a further two Threatened species of plant and 13 Rare or Threatened species of animal were considered likely to occur in the study area and surrounds.

The impacts to remnant and non-remnant vegetation and the associated fauna habitats are largely avoided by locating the proposed pipeline route within private properties rather than within the road reserve. The route design has avoided all patches of Brigalow (*Acacia harpophylla* dominant and co-dominant) and most of semi-evergreen vine thickets Endangered ecological communities. The route will also significantly reduce the impact to Threatened species, and their habitat, recorded or considered likely to occur in the study area.

Nonetheless, 2.7 ha of remnant vegetation and 7.0 ha of non-remnant vegetation will be directly affected by the proposed pipeline. This figure does not account for impacts to vegetation that will be avoided through directional drilling to cross drainage lines, and the extent of vegetation affected may also be further reduced during the detailed design.

Assessment of the significance of impacts associated with the proposed pipeline was done 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; and endangered REs.

The impact assessments concluded that the proposed pipeline is unlikely to result in a significant impact to any Threatened species of plant or animal, RE or ecological communities. Nonetheless, the impacts of the proposed pipeline are acknowledged and will be reduced where possible during detailed design. Detailed mitigation measures will be developed and presented in a biodiversity management plan relating to the construction and operation of the pipeline. Furthermore, the residual impacts of the proposed pipeline will be accounted for in the Green Offsets Package developed for the proposed pipeline.

17A.8 REFERENCES

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